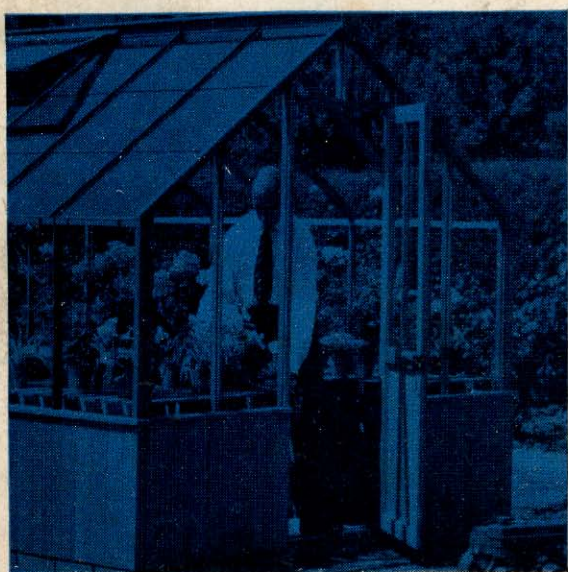
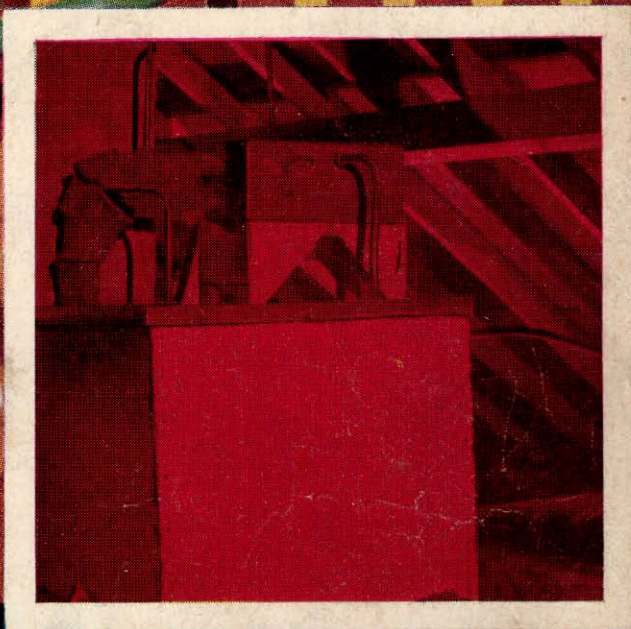


Practical Electronics

JANUARY 1967

PRICE 2/6

**REMOTE
TEMPERATURE
MEASUREMENT**



**for
Greenhouses
H.W. Tanks
Radiators**

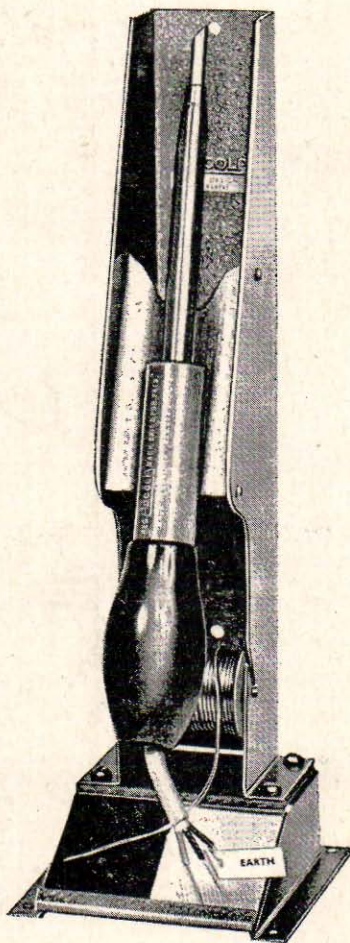
AND MANY OTHER USEFUL
APPLICATIONS

ADCOLA

PRODUCTS LIMITED
(Regd. Trade Mark)

SOLDERING EQUIPMENT

for the
**DISCRIMINATING
ENTHUSIAST**



ILLUSTRATED:
L64 3/8" BIT INSTRUMENT IN
L700 PROTECTIVE SHIELD

APPLY DIRECT TO:
SALES & SERVICE DEPT.
ADCOLA PRODUCTS LTD.
ADCOLA HOUSE
GAUDEN ROAD
LONDON, S.W.4
TELEPHONE: MACAULAY 0291/3

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 components, 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 3
WIRE STRIPPER
AND CUTTER**
Strips insulation without nicking the wire. cuts wire and splits plastic twin flex.
4/- each

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

OLRUS ELECTRONICS LTD.

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

FACTORY NEW VALVES FULLY GUARANTEED TRANSISTORS - DIODES - ZENER

DAF91 4/6	PVF80 7/-	AC107 10/-	GET113 5/-	OAZ210 6/6	OC70 4/-
DAF96 4/6	PVF86 8/6	AC126 6/6	GET114 4/-	OAZ211 6/6	OC71 4/-
DF91 3/-	PCL82 7/-	AC127 6/6	GET115 9/-	OAZ212 6/6	OC72 5/-
DF96 7/-	PCL83 8/6	AC127Z 9/6	GET116 12/6	OAZ213 6/6	OC73 7/6
DK91 5/6	PCL84 7/6	AC128 6/6		OAZ222 9/6	OC75 6/-
DK92 8/-	PCL85 8/6	AC176 7/6	NKT213 6/-	OAZ242 4/6	OC76 5/-
DK96 7/-	PCL86 8/6	AC177 8/6	NKT216 7/6	OAZ245 4/6	OC77 7/-
DL92 5/-	PL36 9/-	ACV18 8/-	NKT251 5/-	OAZ246 4/6	OC78 5/-
DL94 5/9	PL81 7/-	ACV19 6/6	NKT255 6/6	OAZ247 4/6	OC78D 5/-
DL96 7/-	PL82 6/6	ACV20 5/-	NKT304 8/-	OAZ290 9/6	OC81 5/-
DY86 6/4	PL83 6/6	ACV21 6/-	NKT403 17/6	OAZ291 9/6	OC81D 5/-
EBC41 7/6	PL84 6/6	AD140 16/-		OAZ292 9/6	OC81M 5/-
EBC81 6/3	PL500 13/6	AD149 16/-	OA5 4/-	OC16 20/-	OC81DM 5/-
EBC90 4/3	PY32 8/6	AD161 11/-	OA7 4/-	OC19 7/6	OC81Z 9/-
EBF89 6/9	PY81 6/-	AD162 11/-	OA10 3/-	OC22 10/-	OC82 8/-
ECC81 4/-	PY82 5/6	ADT140	OA47 3/-	OC23 12/6	OC82D 5/-
ECC82 5/-	PY83 6/-		OA70 2/-	OC24 17/6	OC83 5/-
ECC83 5/6	PY88 7/3	AF102 18/-	OA73 2/6	OC25 9/6	OC84 8/-
ECC85 5/-	UBC41 7/6	AF114 6/6	OA79 2/6	OC26 7/6	OC122 15/-
ECC89 7/-	UBC81 7/6	AF115 6/6	OA81 2/6	OC28 12/6	OC139 7/6
ECH35 10/9	UC85 6/6	AF116 6/6	OA85 3/-	OC29 15/-	OC140 9/6
ECH42 9/-	UCH42 8/6	AF117 5/-	OA86 4/-	OC35 12/6	OC169 5/-
ECH81 5/2	UCH81 6/3	AF118 12/6	OA90 2/6	OC36 12/6	OC170 5/-
ECH84 8/10	UCH82 7/3	AF124 8/-	OA91 2/6	OC41 6/6	OC171 6/-
ECL80 7/-	UL41 8/6	AF125 8/6	OA95 3/6	OC42 5/-	OC200 7/6
ECL82 6/3	UL84 6/3	AF126 8/-	OA200 3/3	OC43 9/-	OC201 11/6
ECL86 9/-	Y85 5/6	AF127 8/-	OA202 4/3	OC44 5/-	OC202 13/6
EF80 5/-	Y25 9/6	AF139 15/-	OA210 7/6	OC44M 5/6	OC203 10/6
EF86 6/3	Y26 8/6	AF186 19/6	OA211 9/6	OC45 4/-	OC204 15/-
EF183 6/4	Y40B 8/6	AFY19 22/6	OAZ2011 17/-	OC46 5/6	OC205 15/-
EF184 6/4	Y36GT 5/-	AFZ11 17/-	OAZ20110 17/-	OC47 7/6	OC206 22/6
EL34 9/6	5Z4GT 8/-	AFZ12 12/6	OAZ202 8/6	OC47 7/6	OC207 8/6
EL41 8/6	6P23 10/-	ASY26 8/6	OAZ203 8/6	OC57 16/-	OC208 5/-
EL84 4/9	6L6GC 7/6	ASY28 8/6	OAZ204 8/6	OC58 17/6	OC209 4/6
EM84 7/-	6SN7GTB7 7/-	ASZ20 7/6	OAZ205 8/6	OC59 18/6	OC210 20/-
EY31 7/-	4V6GT 6/6	GET20 10/-	OAZ206 8/6	OC60 17/6	OC212A 25/-
EY86 6/6	6X5GT 6/-	GET102 6/-	OAZ207 9/6	OC63 22/6	OC213 25/-
EZ40 7/6	25L6GT 6/6	GET103 4/6	OAZ208 6/6	OC66 25/-	OC213 29/-
EZ80 5/-	30C15 10/-	GET105 8/6	OAZ209 6/6		
EZ81 5/-	30FL1 10/6				
EZ90 4/-	30FL14 11/-				
GZ32 10/-	30L15 11/-				
GZ34 10/-	30P12 9/-				
PC86 11/-	30P19 13/-				
PC88 11/-	30P14 10/6				
PC97 7/8	30P13 12/-				
PC984 6/-	35L6GT 6/-				
PC989 11/-	35Z3GT 5/6				
PCC189 11/-	50L6GT 6/6				

C.W.O. ONLY

P.P. 2/- in £

I/- Minimum

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

ENORMOUS PURCHASE GUARANTEE. APPROX. HALF PRICE. WORLD FAMOUS MAKE

★ TAPE ★

We offer you fully tensilised polyester/nylon and P.V.C. tapes of identical quality hi-fi, wide range recording characteristics as top grade tapes. Quality control manufacture. They are truly worth a few more pence than acetate, sub-standard, joined or cheap imports. TRY ONE AND PROVE IT YOURSELF.

Standard Play	Long Play
3in. 150ft. 2/3	3in. 225ft. 2/9
4in. 300ft. 4/6	4in. 450ft. 5/6
5in. 600ft. 7/6	5in. 900ft. 10/6
5 1/2in. 900ft. 10/6	5 1/2in. 1,200ft. 13/-
7in. 1,200ft. 12/6	7in. 1,800ft. 18/6

Double Play	Triple Play
3in. 300ft. 4/-	4in. 900ft. 13/-
4in. 600ft. 8/-	5in. 1,800ft. 25/-
5in. 1,200ft. 15/-	5 1/2in. 2,400ft. 24/-
7in. 2,400ft. 27/-	7in. 3,600ft. 44/-

Postage 1/- net

Post Free less 5% on three reels. Quantity and Trade enquiries invited. NOTE. Large tape stocks at all branches.

Transistorised FM Tuner

CALLERS WELCOME Demonstration without obligation to all branches



HIGH QUALITY: LOW NOISE: BATTERY OR MAINS OPERATION

15 Watt TUNER AMPLIFIER KIT

14 TRANSISTOR consisting of FMT41 tuner and the excellent Sinclair Z12 (built) together with complete integrated control. Kit consisting complete vol. on/off treble and bass, component sets with complete connecting instructions and circuits, battery version

£13.19.0

or complete with AC mains power pack £13.85 STEREO VERSION with 2 Z.12 amplifiers £18.10.0 A.C. STEREO £22.10.0

This beautifully compact 6 transistor machine (size 6 x 4 x 2 in.) will give quietest, more interference free reception. Months of use from a standard 9 volt battery or its small power requirements can be drawn from any amplifier. Low noise frequency changer with smooth 2 gang tuning feeding no less than three I.F. stages coupled to a double-tuned discriminator terminating in an L.F. stage giving ample output for all quality amplifiers.

LATEST GARRARD

All Factory Fresh. All with cartridge. EV26 Ceramic Stereo cartridge fitted to any deck for 15/- extra

SRP12	£4. 7.6
SRP25	£9.19.0
AUTOSLIM	£5.10.0
Model 50	£6.19.0
Model 1,000	£8. 5.0
Model 2,000	£8.10.0
Model 3,000	£8.10.0
AT80	£9.19.0
A70	£18.10.0
LAB80	£24.19.0
401	£29.19.0

B.S.R. BARGAINS

TU14	59/-
GU7	85/-
UA14	89/-
UA18	99/-
UAB5 SUPERSLIM	£5.10.0

CARTRIDGES

G.C.2 Garrard Mono	16/-
EV26 Garrard Stereo Ceramic	24/-
EUPHONIC SUPER Ceramic	
Stereo Diamond 100mV	
Output	29/-
DECCA DERAM Stereo	50/-

TRANS/CEIVERS

The very latest Silver/Black finish. They give an excellent performance with reliability, long telescopic aerial, crystal controlled. Note a licence is required to transmit. They compare with much dearer models 2/6 p. & p. £6.19.0 These cannot be operated in U.K.

BARGAIN PARCELS

Including variable condensers, i.f. coils, loudspeaker plugs/sockets, knobs, pots, condensers, resistors, nuts, bolts, cabinet fittings, switches, transformer choke, rectifier, transistors at a small fraction of list value. Due to heavy demand we are now packing them in several sizes—TRY ONE.

3 lbs. (post 3/-)	9/-
7 lbs. (post 5/-)	17/6
14 lbs. (post 8/-)	29/-

avoid disappointment

ORDER NOW £8-10

HEAVY DUTY

14/20 WATT AMPLIFIER KITS

Famous make. Consisting integrated controls, high/low gain pre-amp stages feeding EL34 push-pull output, C core transformers complete with instructions down to the last bolt. Current model at fraction of list price. 8 1/2 Gns.

SP25 ON PLINTH

Latest Garrard quality single player on Garrard matching plinth. Factory fresh. Unusual value at 11 1/2 Gns.

NEW! STABILISED TRANSISTOR POWER PACKS

Adjustable 9V or 12V 1 amp. Ripple and voltage stabilised. 2 transistors, 2 Zener diodes. High quality, unusual value. Satisfaction guaranteed 79/-

F.M. MICS

Dynamic microphone feeding transistor F.M. transmitter, tunable approx. 90-105Mc/s. Complete in miniature case with PP3 battery. Really excellent range and reproduction quality £4.19.0

5 in. HIGH

COMPLIANCE SPEAKER UNITS

As used in expensive bookshelf units, 8 amp 8W peak. High flux. Wide full range response. Truly unusual value at 49/-

AUTO R.P. KITS

BSR UA14 Autochanger, 2 valve mains amplifier (built), high phase speaker in modern portable 2 tone cabinet. Value built 15 gns. Special limited kit price 9 1/2 Gns.

MAINS TRANSFORMERS

All with 6-3V. Windings high quality 200/250V.	
250V 60mA	12/6
350-0-350V 80mA	25/-
350-0-350V 120mA	37/6

Value in VALVES

GUARANTEED 3 MONTHS BY RETURN OF POST

Satisfaction or Money Back Guarantee on goods if returned unused within 14 days. ALL VALVES ARE NEW UNLESS OTHERWISE INFORMED. FREE TRANSIT INSURANCE. POSTAGE 1 valde 9d. 2-11 6d. per valve. Free over 12.

11A	2/3	6G6GT	9/6	20P4	17/9	6X5	9/6	6Z24	10/6	SP61	2/9
1B5	4/9	6L1	9/6	25L6GT	7/-	6F8	7/9	KT81	12/-	TDD4	7/6
1B4	4/9	6L6	9/6	25Z4G	7/-	6F82	7/9	KT63	5/9	U14/18	7/6
1B5	4/9	6L18	7/9	30F5	9/-	6CH21	10/-	KT86	19/6	U25	9/6
1T4	3/-	6LD20	9/6	30FL1	9/9	6CH35	11/-	KT88	27/6	U26	9/6
2D21	5/6	6P25	12/-	30L15	11/6	6CH42	10/6	KTW61	5/9	U35	12/6
3A5	6/-	6P28	9/6	30P4	11/6	6CH81	9/9	KTW63	5/-	U37	11/-
3Q4	5/6	6Q7G	7/-	30P12	9/-	6CH83	7/9	KTZ63	7/-	U107	12/6
504G	6/-	6Q7GT	8/9	30PL1	11/-	6CL80	5/9	MU14	7/-	U191	12/6
5X3GT	6/6	6SL7GT	9/9	38A5	9/6	6CL82	7/6	N57	9/6	U291	9/6
5Z4G	6/9	6SN7GT	6/9	35L6GT	8/6	6CL83	10/6	N78	13/-	U282	15/-
5Z4GT	9/6	6U4GT	9/6	35W4	6/6	6CL86	9/6	N108	13/-	U329	8/6
6/30L2	9/6	6V6G	4/9	35Z4GT	5/9	6F36	4/9	PC86	9/6	U801	19/-
6ASG	7/6	6V6GT	6/9	30L8GT	8/6	6F39	7/-	PC97	7/6	UABC80	8/6
6AK5	4/9	6X4	4/8	80	7/6	6F40	10/-	PC84	8/6	UAF42	7/6
6AQ5	5/-	6X50	5/-	18BTA19	6/6	6F41	9/-	PC85	7/6	U241	8/6
6AT6	5/6	6X50T	9/6	807	3/6	6F50	3/3	PC88	11/9	UBC41	8/6
6BA6	5/6	7B6	11/6	955	3/6	6F80	4/3	PC89	11/-	UBC81	9/6
6BE6	5/6	7B7	7/6	956	3/6	6F85	6/3	PC189	9/9	UBF80	7/6
6BH6	6/6	7C5	9/6	6Z31	8/6	6F86	7/6	PCF80	6/9	UBF89	7/6
6BJ6	7/-	7C6	7/6	6BL31	19/6	6F89	6/6	PCF82	6/9	UBL21	10/6
6BB7	9/6	7B7	7/6	DAP46	7/3	6F91	6/6	PCF86	8/3	UC29	6/6
6BW6	7/6	7B7	14/6	DF96	7/3	6F183	8/-	PC182	7/9	UC85	7/3
6BW7	5/-	7Y4	7/-	DK92	8/6	6F184	8/-	PC183	9/6	UCF80	8/6
6C4	3/-	10C1	11/-	DL96	7/3	6L32	5/-	PC184	9/-	UCH21	10/9
6C5	5/6	10C2	12/6	DL92	8/-	6L33	12/-	PC185	9/6	UCH42	8/6
6C8	4/-	10P1	7/6	DL94	8/6	6L34	11/6	PC186	9/6	UCH81	7/-
6C9	11/-	10L11	14/6	DL96	7/3	6L35	8/-	PC188	8/6	UC182	8/-
6CD6G	17/-	10P13	9/6	EAPC80	6/9	6L38	15/-	PC188	11/6	UC183	10/6
6D6	4/-	10P14	9/6	EAPF42	8/-	6L41	9/-	PC188	12/6	UF41	9/-
6F1	6/6	12A7	4/9	EB41	4/6	6L42	8/6	PC181	7/9	UF42	6/9
6F6G	5/-	12A7	5/6	EB92	2/9	6L44	8/6	PC182	5/9	UF85	7/6
6F13	4/6	12AX7	6/-	EB038	7/6	6M30	7/-	PC183	6/-	U21	6/9
6F14	7/6	12TGT	9/-	EB041	9/6	6M31	7/6	PC184	7/-	U141	10/-
6F15	9/6	12K7GT	5/-	EB091	6/9	6M34	7/6	PC181	7/6	U144	14/-
6F23	8/-	12K8GT	6/6	EBP80	7/9	6Y51	7/6	PC182	9/6	U146	10/6
6G6G	4/-	12Q7GT	6/6	EBP89	7/-	6Y86	7/3	PC183	7/6	U184	8/6
6G5GT	6/6	1457	14/6	EBL21	11/-	6Y88	8/6	PC189	5/9	UM80	9/6
6H6	3/3	19AQ5	5/6	EC040	9/6	6Z40	7/6	PC181	5/9	U21	8/6
6H7G	5/6	20D1	8/9	EC081	4/9	6Z41	8/6	PC182	5/6	U141	7/-
6H7GT	9/6	20P2	9/6	EC082	5/6	6Z20	5/6	PC183	5/9	U285	5/6
6K7G	2/8	20L1	16/-	EC083	6/-	6Z21	6/-	PC188	8/6	U2105	5/-
6K7GT	5/9	20P1	9/6	EC084	7/-	6C4	8/-	PC180	7/-	U2150	4/-
6K8G	5/9	20P3	9/6	EC085	5/9	6Z22	8/6	PC180	9/6	Z86	7/9

Stockist of Leak, Quad, Chapman, Goodman, Armstrong, Tripletone, Linear, Rogers, Truxon, Ferrograph, Whorfdale, etc. Post: 1 lb. 1/5, 1 1/2 lb. 2/6, 2 lb. 2/9, 4 lb. 3/3, 6 lb. 4/-, 14 lb. 5/6.

TECHNICAL TRADING

LONDON
10 Tottenham Court Road, W.1
Tel.: MUSEUM 2639

BRIGHTON
Park Crescent Place
Tel. 680722

PORTSMOUTH
350-352 Fratton Road
Tel. 22034

SOUTHAMPTON
79 East Street
Tel. 25851

WORTHING
132 Montague Street
Tel. 2585

750 mW TRANSISTOR AMP.



4 transistors including two in push-pull input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 6 mV.

PRICE 19/6

Post and ins. 2/6.

Speakers 3in. 12/6; 5in. 12/6; 6in. x 4in. 14/6.

MAINS POWER PACK

MAINS 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.

ACOS GP83 TURNOVER PICK-UP CARTRIDGE



For Stereo—L.P.—and 78 records, fitted with two Styl. Diamond for LPs, Sapphire for 78s. This is mounted and is standard replacement for most record players, using Garrard, B.S.R., etc., etc. The regular price of this cartridge is 55/- We offer these new and perfect for 15/- (less than the price of stylus), plus 2/- post and insurance.

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 Photoconductor and Hood, 3 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 light—counter—stray light alarm—warbling tone electronic alarm—projector lamp stabiliser, etc., etc. Only 39/6 plus 2/- post and insurance.

THE SQUEALER

Sleight of hand—beat the beam

A game to amuse the children and defy the others is described in the Nov. issue of *Practical Electronics*. For this circuit we can supply as a kit: the light-cell, transistors and other components (not case or hardware) price is 50/- plus 3/6 post and insurance. Kit of Components for another game "The Might Light," also described, is available. Price 20/- plus 2/6 post and insurance.

MULLARD SILICON RECTIFIERS. 350 v. 100 mA. Removed from unused equipment, perfect. Ref. BY100, 4/6 each.

REED SWITCHES. A pair of contacts sealed into a glass tube. When a magnet comes close the contacts close immediately and the circuit is switched. For burglar alarms on doors or windows, moving displays for advertising, rev. or batch counting, relay circuits. New and perfect, price is 6/6 each.

MR. MEG. POTS. By Eric, standard 1in. spindle, 1in. long, 74. each in doz. lots, otherwise 10d.

MR. MEG. POTS WITH D.P. SWITCH. Again by Eric. Standard size spindle 1in. length. 10d. each in doz. lots, otherwise 1/3 each.

RELAY SWITCHES. These enable micro switches, delicate thermostats or other low current devices to control up to 30 amps. Ideal to switch thermal storage heaters, motors, etc., made by the famous A.E.I. group these are listed at 22s each—you can buy it if you hurry at a very keen price of 39/6 each and we will include diagrams and data. Mounted on panel size approximately 6 x 7 1/2 in. deep.

HEATER TRANSFORMERS. 6.3 v., 1 1/2 amps., 5/6.

SEMI-CONDUCTOR BARGAINS

Type No.	Price	Type	Price	Type	Price
2N1727	15/-	MAT101	8/6	OC71	4/-
2N1728	10/-	MAT120	7/6	OC72	5/-
2N1742	25/-	MAT121	8/6	OC76	6/-
2N1747	25/-	OA5	5/-	OC76	5/-
2N1748	10/-	OA10	6/-	OC77	7/-
AC107	9/-	OA47	8/-	OC78	5/-
AC127	9/-	OA70	2/-	OC78D	5/-
ACV17	8/6	OA79	2/6	OC81	5/-
ACV18	5/6	OA81	2/6	OC81D	5/-
ACV19	8/6	OA85	3/-	OC82	5/-
ACV20	5/6	OA80	2/6	OC83	5/-
ACV21	8/6	OA91	2/6	OC84	6/-
ACV22	4/6	OA200	3/6	OC139	8/6
AF114	7/-	OA202	4/3	OC140	12/6
AF115	8/6	OC22	10/-	OC170	5/-
AF116	7/-	OC23	17/6	OC171	6/-
AF117	5/-	OC24	22/6	OC200	9/-
AF118	12/6	OC26	7/6	OC201	12/6
AF139	17/6	OC28	15/-	OC202	13/6
AF186	19/6	OC29	17/6	OC203	12/6
AF212	15/-	OC35	12/6	OC212	19/6
AS221	15/-	OC36	15/-	OC213	8/6
BC107	14/6	OC42	8/6	ORP60	5/-
BY100	5/6	OC44	5/-	SB078	8/6
BY213	7/6	OC45	4/-	SB305	8/6
MAT100	7/6	OC70	4/-	SB251	10/-

The above is a list of three more popular types in stock—we can also supply almost every semi-conductor made—please send 1/6 for comprehensive list and equivalent data.

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 silver glass enclosed element, opal bowl for up to 100 watt lamp—non-rust spun reflector, white enamelled base heat shield, pull switch. Magnificent unit as sold normally at £4.5.0 only 55/- plus 5/- post and insurance.



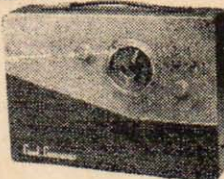
GOOD COMPANION Mk. V

Saves you work—

It's partly built—

Like its predecessors this latest Companion has full performance—such as only a good wooden cabinet and bi-flux 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 3 x AP117.
- Two-tone Cabinet, size 11 x 8 x 3 in.
- 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 I.F. stages complete with full instructions. Price only 34/12/6 plus 6/6 post and insurance.



THIS MONTH'S SNIPS

SCOTCH 3M TAPE

Brand new, unused and guaranteed perfect and not second in any way—a connoisseur's tape on normal spools.

Standard Play	5"	600"	9/-	Long Play	5"	900"	11/6
	51"	900"	11/6		51"	1200"	16/-
	71"	1200"	16/-		71"	1800"	23/-

23 post free, otherwise add 2/- post and ins.

CASSETTE LOADED DICTATING MACHINE

Mains operated and with all accessories. Really fantastic offer—a British made £31 outfit for only £10 brilliantly designed for speed and efficiency—cassette takes normal spools drops in and out for easy loading—all the normal functions—accessories include:—stethoscopic earpiece and footswitch for typist—crystal microphone has on/off switch—telephone pick-up—large reference pad—DON'T MISS THIS UNREPEATABLE OFFER—SEND TODAY £10 plus 7/6 post and ins.

Note: If you wish to record in unusual places we have some as above but battery operated same price also spare Cassettes at 7/6 each, three for £1.



GARRARD RECORD PLAYERS



2000	..	26. 9.6
3000	..	27.19.6
AT60	..	21.11.0
SP25	..	21.0. 9.6
LAB80	..	225. 0.0
SRP12	..	23. 9.6

7/6 for post and insurance.



F.M. TUNER

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 £12.10.0 tuner for only £8.10.0.

INTERCOM BARGAIN



Will save time and improve efficiency. Ideal in home, office, shop, surgery, etc. Complete outfit comprises Master unit and three sub-stations each of which can call the master and have full two-way working. No wiring problems as sub fitted with 60ft. twin flex and they plug into sockets. Also included is packet of staples and battery. Nothing else to buy—£8/9/6, plus 3/6 post and insurance.

PP3 ELIMINATOR

Play your pocket radio from the mains! Save £'s. Complete component kit comprises 4 rectifiers, mains dropper resistances, smoothing condenser and instructions. Only 6/6 plus 1/- post.

CIRCULAR FLUORESCENT

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 £41/6. 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.



THERMOSTATS

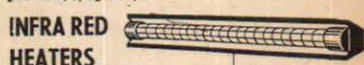
Type 'A' 15 amp. for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob, quickly adjustable from 30°-50°F. 9/6 plus 1/- post. Suitable box for wall mounting, 6/-, P. & P. 1/-

Type 'B' 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550°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 2/6 post and insurance.

Type 'C' is a small porcelain thermostat as fitted to electric blankets, etc. 1 1/2 amp. setting adjustable by screw through side, 3/6, P. & P. 1/1.

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. 7/6, P. & P. 1/1.

Type 'E'. This is a standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature, 7/6 plus 1/- P. & P.



Infra Red HEATERS
Kit to make this latest type heater. 750 watts silica enclosed element, enamelled metal casing, polished reflector and all parts, only 21/6 plus 3/6 post and ins. Pull switch 3/- extra.



SWAN KETTLE ELEMENTS

Made by famous "Best" company, suitable for most kettles. 1500 watts. 230/250 v. Normally 30/- each. Our price 17/6 each.

HALF PRICE OFFER

G.E.C. 13A SWITCHED SOCKETS
Suitable for ring mains, etc. Like the modern fused plug surface or sunk (flush) mounting type, 4/9 each, 54/- doz.

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 touch 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.—36/-, 12ft.—42/-
also in twin assemblies (one pipe above the other):
4ft.—40/-, 5ft.—46/-, 6ft.—52/-

FLUORESCENT LIGHT KITS. Comprising choke, lampholders, starter and two chrome tube clips 20 watt 19/6

NO SOLDERING POCKET 3

Lots of fun to build and good results when finished—complete kit with detailed instructions and crystal earpiece—batteries 1 1/2 extra. £5 value. only 19/6, plus 3/- post and insurance.



MOVING COIL METER BARGAIN

Panel meters are always being needed and they are really costly when you have to buy them in a hurry—so you should take advantage of this offer: 2in moving coil flush mounting meters only 5/6. These are actually R.F. meters and cost about £3 each but if you don't want them for R.F. then all you have to do is to remove the thermocouple and you will have a 2-3 in. meter which you can make into almost anything by adding shunts or series resistor. These are ex-government, of course.

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)



SINCLAIR MICRO FM

POCKET SIZE COMBINED FM
TUNER/RECEIVER

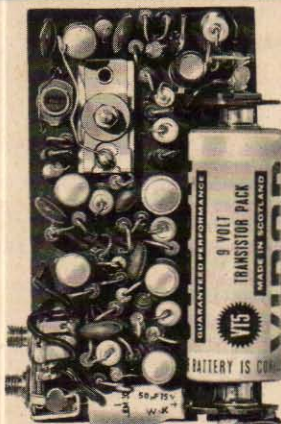
**THE ONLY SET OF ITS
KIND IN THE WORLD**

7 TRANSISTORS
2 DIODES

LOW I.F. ELIMINATES
NEED FOR
ALIGNMENT

OPERATES FROM
STANDARD SELF-CONTAINED
9v BATTERY

ONE OUTPUT FOR
AMPLIFIER ONE FOR
PERSONAL LISTENING



TECHNICAL DESCRIPTION

Self-contained double-purpose 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 detected to produce the original modulation exactly. The pulse-counting discriminator ensures better audio quality. Two outputs are provided—one 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. The telescopic aerial included is sufficient in all but the worst signal areas.

Anyone can build it!

This is a marvellous set to build and use. It has so many unique, original features that it is years ahead of any FM design ever produced for the home constructor. It is so professional in its appearance and performance too. With the Sinclair Micro FM there are simply no problems of alignment, so it is ready to use just as soon as you have built it. Unlike any other FM set in the world, the Micro FM is a double-purpose unit which you can use both to feed to a hi-fi system or tape recorder and as a self-contained pocket FM portable. The sensitivity of the Micro FM is such that it will operate satisfactorily using its own telescopic aerial in all but the very poorest reception areas. Quality is outstandingly good because of the system of pulse counting discrimination used, and although this set is no bigger than a packet of 10 cigarettes it uses a standard 9 volt self-contained battery. Powerful A.F.C. makes tuning simple. Backed by Sinclair service facilities and the Sinclair guarantee, anyone can go ahead and build the Micro FM straight away and with assured success.

Complete kit including transistors, telescopic aerial, case, earpiece and instructions.

£5.19.6

- ★ Size: 2 1/4 x 1 1/2 x 3/4 in.
- ★ Pulse counting discriminator
- ★ Low I.F. completely eliminates alignment problems
- ★ Tunes from 88 to 108 Mc/s
- ★ Audio response: 10 to 20,000 c/s $\pm$ 1dB
- ★ Signal to Noise Ratio: 30dB at 30 microvolts
- ★ Plastic case with brushed and polished aluminium front and spun aluminium tuning dial

sinclair *world pace-setter in electronics*

SINCLAIR MICRO-6

The kit that builds into the world's smallest radio

This is the kit that builds into a M.W. set against which a match-box looks enormous. Yet it is completely self-contained, including aerial and batteries and virtually plays anywhere. Its clever six-stage circuit (2 R.F., double diode detector, 3 A.F.) ensures all you want in a radio today—power, range, quality and selectivity. A.G.C. counteracts fading, bandspread brings in the "pop" stations like locals. There is great pleasure to be had in building the Micro-6, and it makes a highly acceptable gift with its white, gold and black case and amazing performance.

- Size 1 1/2 in. x 1 1/2 in. x 1/2 in.
- Weight: One Ounce
- Easily built in an evening

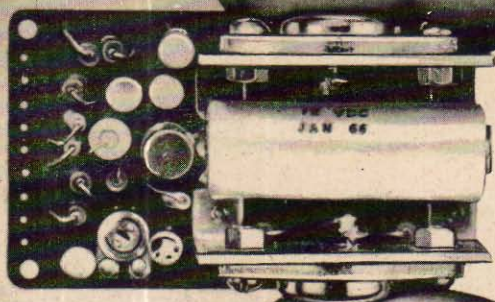


Complete kit with earpiece, case and instructions.

59/6

ORDER FORM AND MORE SINCLAIR DESIGNS ON FOLLOWING PAGES

sinclair



SINCLAIR Z.12

COMBINED 12 WATT HI-FI AMPLIFIER AND PRE-AMP FOR OPERATING FROM 6-20V. D.C.

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 only 89/6 and includes its own integrated pre-amplifier. The Z.12 accepts radio, microphone and

pick-up inputs. Detailed instructions for connecting these, matched for mono and stereo, are given in the manual supplied with every unit. 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 stereo-phonetic hi-fi possible—and the saving in cost is considerable.

USE IT FOR HI-FI, ELECTRICAL GUITAR, CAR RADIO, P.A. INTERCOM, INSTRUMENTATION, ETC.

- **SIZE** 3in. x 1½in. x 1½in.
- **FANTASTIC POWER!** 12 WATTS R.M.S. CONTINUOUS SINE WAVE (24 W. PEAK); 15 WATTS R.M.S. MUSIC POWER (30 W. PEAK)
- **REQUIRES FROM 6 TO 20V. OPERATING POWER**
- **HI-FI PERFORMANCE AT A FRACTION OF THE USUAL COST**

READY BUILT, TESTED AND GUARANTEED WITH MANUAL

89/6

If you prefer not to cut this page, please refer to P.E.167 when writing your order.

SINCLAIR PZ.3 POWER SUPPLY UNIT

Transistorised techniques are used to achieve phenomenally good smoothing, thus assuring ideal operating conditions. Ripple is a barely measurable 0.05 v. Will power two Z.12s and the Stereo 25 with ease.

79/6



THE SET THAT STOLE THE SHOW

THE SINCLAIR MICROVISION POCKET TV RECEIVER provided a world wide sensation when shown for the first time at the recent 1966 Radio and TV Exhibition. This fantastic British set tunes over 13 channels on bands 1 and 3, operates from six self-contained "Penlite" batteries and measures only 4in. x 2½in. x 2in. Despite the minute proportions of this 30 transistor receiver, quality from the exclusively designed tube and loudspeaker is superb. This amazing Sinclair triumph will be available early in 1967 at a cost of 49 gns.

SINCLAIR MICROVISION

The world's only pocket T.V.!

sinclair world pace-setter in electronics

YOUR SINCLAIR GUARANTEE

Should you not be completely satisfied with your purchase when you receive it from us, your money will be refunded in full and at once without question.

FULL SERVICE FACILITIES AVAILABLE TO SINCLAIR CUSTOMERS

To: SINCLAIR RADIONICS LTD., 22 NEWMARKET ROAD, CAMBRIDGE
Please send items detailed below:

.....
.....
.....
For which I enclose cash/cheque/money order

NAME
ADDRESS

sinclair

SINCLAIR RADIONICS LTD.
22 NEWMARKET ROAD, CAMBRIDGE
Telephone 52996 (STD CODE OCA3)

PE.167

FULLY GUARANTEED INDIVIDUALLY PACKED VALVES

ACHL 4/6	EBC41 8/8	EL37 10/-
AC4 6/-	EBC40 8/8	EL38 17/8
ACSPEN 5/-	EBF80 6/6	EL41 8/-
AL60 5/-	EBF83 7/8	EL42 8/-
AR3 5/-	EBF89 6/6	EL50 8/-
ARP3 3/-	EBL31 20/-	EL81 8/-
ARP12 2/6	EC52 4/-	EL83 6/3
ARP24 10/-	EC53 12/6	EL84 4/8
ATP4 2/3	EC70 4/-	EL85 7/8
ATP7 5/6	EC90 2/-	EL91 4/8
AU7 55/-	EC91 3/-	EL95 5/-
AZ31 9/-	EC881 4/-	EM80 6/-
B6H 15/-	EC82 7/-	EM81 7/-
BD78 40/-	EC83 6/-	EM84 6/3
BL63 10/-	EC84 5/6	EN31 10/-
B84 8/-	EC85 6/6	ESU74 80/-
B85 20/-	EC91 4/-	ESU208 6/-
B884 47/6	EC189 9/6	EY51 5/6
B2134 18/-	ECF80 7/-	EY36 6/6
CC3L 2/-	ECF82 7/-	EY91 3/-
CF23 10/6	ECF42 9/-	EZ40 6/6
CL33 9/6	ECF81 5/-	EZ41 6/6
CY31 6/6	ECF83 7/6	EZ80 5/6
D1 1/6	ECL80 6/-	EZ81 4/8
D41 3/3	ECL82 6/3	F/6057 5/-
D61 6/6	ECL83 10/-	F/6061 5/-
D77 3/3	ECL86 9/6	F/6063 4/-
DA30 12/6	EF36 3/6	FW4/500 6/6
DAF96 6/-	EF37A 7/-	FW4800 8/6
DD41 4/-	EF40 6/-	G1/236G28/-
DF73 5/-	EF41 6/-	G50/2G 5/-
DF81 3/-	EF60 2/6	GM4 45/-
DF82 3/-	EF62 9/6	GZ32 10/-
DF86 6/-	EF63 4/6	GZ34 10/-
DH63 5/-	EF65 8/-	HK54 22/6
DK96 5/6	EF71 7/6	HLK2 2/6
DL92 4/-	EF72 5/-	HL23 6/6
DL93 4/-	EF73 5/-	HL23DD 5/-
DL94 5/6	EF74 4/6	HL41 4/-
DL95 7/-	EF80 5/-	HVR2 9/-
DL810 8/-	EF85 4/6	K34 30/-
DY86 7/6	EF86 6/6	KT32 8/-
E80F 23/-	EF89 5/-	KT33C 6/-
E88CC 12/-	EF91 3/6	KT44 5/6
E90CC 10/-	EF92 2/-	KT63 4/6
EA50 1/-	EF95 5/-	KT66 18/-
EA73 7/-	EF95 5/-	KT67 25/-
EABCS0 5/9	EF183 6/6	KT76 8/6
EAC91 3/6	EF184 6/6	KT88 22/-
EAF42 3/-	EH90 7/6	KTW61 4/6
EB34 1/6	EL32 3/6	KTW63 5/-
EB91 3/-	EL34 10/-	KTZ41 9/-
EBC33 6/-	EL35 5/-	KTZ63 5/-

MH4 5/-	RK72 6/-	UCL82 8/-	1A5GT 5/-	3Q4 6/-	6AK6 6/-	6K6GT 5/6	12AH7 5/-	37 4/-
ML5 6/-	SL1E12 10/-	UCL83 9/-	1B22 30/-	3Q4GT 7/6	6AK7 6/-	6K7G 2/6	12AT6 5/-	38 4/-
N78 15/-	S130 25/-	UF41 8/6	1C6GT 8/-	384 4/-	6AK8 5/6	6K7GT 4/6	12AT7 4/-	50C6G 27/6
NE17 7/-	SP2 9/6	UF89 6/-	1DSGT 8/-	384 4/-	6AL5 5/6	6K8G 3/6	12AT7WA 5/6	50L6GT 27/6
OA2 5/6	SP41 1/6	UL41 7/6	1E7G 7/6	4C27 35/-	6AL6 5/6	6K8GT 8/3	12AU7 5/-	55A 7/6
OB2 6/-	SP61 1/6	UL84 5/6	1F2 3/-	4D1 4/-	6AM5 2/6	6K8M 8/6	12AV6 5/-	67 6/-
OB3 7/-	SP210 3/6	UU5 7/-	1GGGT 6/-	5A173G 5/-	6AM6 4/-	6L5G 9/6	12AX7 6/-	68 6/-
OC3 5/-	T41 12/6	UU9 8/6	1LA 2/6	5A174G 5/-	6AQ5 7/-	6L6GA 7/6	12AX7 10/-	69 6/-
OZ4A 5/-	TP22 5/-	UY21 7/6	1L6G 7/-	5B/251M 40/-	6AQ6W 9/-	6L7G 4/-	12BA6 5/6	75 5/6
PC86 9/-	TT11 5/-	UY23 3/-	1LH4 4/-	5B/253M 40/-	6ASG 9/-	6L84 3/6	12BBH 7/6	77 6/6
PC88 9/-	TT15 35/-	VP13 9/-	1N21B 5/-	5B/254M 15/-	6ASTG 15/-	6N7 6/-	12C8 3/6	78 5/6
PC97 9/6	TR31 45/-	VR99 5/-	1N43 4/-	5B/254M 40/-	6AT6 4/-	6N7G 5/6	12D6 2/6	81 9/6
PC980 12/-	TZ20 18/-	VR105/30 5/-	1N70 4/-	5B/255M 35/-	6AU6 6/-	6Q7G 5/6	12J5GT 6/6	82 8/6
PC984 5/6	U81 8/-	VR150/36 5/-	1R4 5/-	5B/255M 35/-	6AX4 9/-	6R7 5/6	12J7GT 6/6	84 8/6
PC989 10/-	U12/14 8/-	VR150/36 5/-	1R5 3/6	5B/255M 35/-	6B4G 9/-	6R7 5/6	12K7GT 6/6	85A2 8/6
PCF80 6/3	U17 5/-	VR150/36 5/-	1R4 5/-	5B/255M 35/-	6B7 6/-	6R7 5/6	12Q7GT 3/3	307A 5/6

TRANSISTORS

OC16 20/-	OC81D 5/-	OC201 12/6	XC141 10/-
OC22 28/-	OC81M 5/-	OC202 15/-	XC142 15/-
OC25 9/6	OC82 10/-	OC203 12/6	XC155 20/-
OC35 12/6	OC82DM 5/-	OC204 12/6	XC156 22/6
OC44 6/-	OC83 5/-	OC206 22/6	2N247 9/6
OC45 6/-	OC83B 5/-	AAZ12 7/6	2N412 7/6
OC71 4/6	OC122 5/-	AC128 7/6	2N562 47/6
OC72 5/-	OC170 6/-	BCZ11 7/6	2N585 10/6
OC73 9/-	OC170 6/-	BCZ11 7/6	2N1090 20/6
OC81 6/-	OC200 10/6	BY38 7/6	2N1091 20/-

U18 6/-	VU33A 4/-	185 4/6	5TR 7/-
U25 11/-	VU39 6/-	1T4 3/-	5U4G 4/6
U26 11/-	VX3208 5/-	2A3 5/-	5V4G 8/-
U27 8/-	W21 5/-	2B26 8/-	5X4G 8/6
U50 4/6	W118 8/-	2C26 7/6	5Y3G 4/6
U52 4/6	W119 8/-	2C26A 3/6	5Y3GT 5/6
U191 11/6	X66 7/6	2C34 7/6	5Y3WGTB 6/6
U501 17/-	X81M 18/-	2C46 22/6	5Z4G 8/6
UABCS0 6/-	X118 8/-	2C51 12/-	5Z4GT 8/6
UAF42 9/-	X145 8/-	2D21 5/-	6AB7 4/6
UBC41 9/-	YF 1/-	2D21 5/-	6AC7 3/6
UBF80 5/6	Y63 6/-	2X2 3/6	6AG5 2/6
UBF89 6/6	Y65 4/-	3A4 4/6	6AG7 6/6
UBL21 10/-	Y66 8/-	3B24 9/-	6AH6 10/-
UCC85 6/6	Z800U 20/-	3B24 9/-	6AJ7 3/6
UCH42 8/-	Z801U 10/-	3D6 4/-	6AK5 5/-
UCH81 6/-	IA3 3/-	3E229 50/-	

P.C. RADIO LTD

170 GOLDHAWK ROAD, W.12

Shepherds Bush 4946

Open 9-5.30 p.m. Thursday 9-1 p.m.

6AK6 6/-	6K6GT 5/6	12AH7 5/-	37 4/-
6AK7 6/-	6K7G 2/6	12AT6 5/-	38 4/-
6AK8 5/6	6K7GT 4/6	12AT7 4/-	50C6G 27/6
6AL5 5/6	6K8G 3/6	12AT7WA 5/6	50L6GT 27/6
6AM5 2/6	6K8GT 8/3	12AU7 5/-	55A 7/6
6AM6 4/-	6L5G 9/6	12AV6 5/-	67 6/-
6AQ5 7/-	6L6GA 7/6	12AX7 6/-	68 6/-
6AQ6W 9/-	6L7G 4/-	12AX7 10/-	69 6/-
6ASG 9/-	6L84 3/6	12BA6 5/6	75 5/6
6ASTG 15/-	6N7 6/-	12BBH 7/6	77 6/6
6AT6 4/-	6N7G 5/6	12C8 3/6	78 5/6
6AU6 6/-	6Q7G 5/6	12D6 2/6	81 9/6
6AX4 9/-	6R7 5/6	12J5GT 6/6	82 8/6
6B4G 9/-	6R7 5/6	12J7GT 6/6	84 8/6
6B7 6/-	6R7 5/6	12K7GT 6/6	85A2 8/6
6B8G 2/6	6R7GT 6/6	12K8M 10/-	307A 5/6
6BA6 5/-	6SK7GT 4/6	12Q7GT 3/3	313A 5/6
6BA7 6/-	6SK7 7/-	12S47 4/6	330A 25/-
6BE6 4/6	6SGT 6/-	12S47 4/6	357A 7/6
6BJ8 7/6	6SGTGT 5/6	12S47 4/6	360B 8/-
6BJ7 7/6	6SH7 3/6	12S47 4/6	368A 30/-
6BR7 9/-	6SJ7 5/-	12S47 4/6	393A 27/6
6BW6 7/6	6SJ7GT 5/6	12S47 4/6	446A 8/6
6C4 2/-	6SJ7 5/6	12S47 4/6	6080 22/-
6C5 2/6	6SK7 5/6	12S47 4/6	6146 25/-
6C6GT 6/-	6SL7GT 5/6	12Y4 2/-	703A 30/-
6C6 4/-	6SN7 3/6	14L7 7/-	705A 10/-
6C6G 3/6	6SQ7GT 6/-	1487 18/-	715B 60/-
6C8G 3/6	6SR7 2/-	14D2 6/-	717A 3/-
6CH6 4/6	6T4GT 9/6	20P4 12/6	724A 15/-
6CL6 9/-	6V6G 2/-	21B4 7/-	757 18/-
6CW4 12/-	6V6GT 7/6	25L6GT 5/6	807 6/-
6D6 3/-	6V6M 8/-	25Y6 6/-	803 22/6
6E5 6/-	6X4 3/6	25Z4G 8/6	807 8/-
6F6G 5/6	6X6G 5/6	25Z6 8/6	808 8/-
6F6GT 5/6	6X6GT 5/6	25Z6GT 8/6	815 25/-
6F6G 6/-	6Y6G 6/-	25Z7 8/6	829B 60/-
6F7 6/-	6Y6G 6/-	30 5/-	829B 60/-
6F7 5/-	6Z4 5/-	30C15 9/6	832 15/-
6F8G 6/6	7B7 7/6	30C18 11/-	832A 45/-
6F12 4/6	7C6 10/-	30F6 8/6	866A 14/-
6F13 8/6	7C6 10/-	30FL1 10/6	884 10/-
6F2 4/-	7C7 6/-	30L1 11/-	954 4/6
6F3 20/-	7H7 7/3	30P12 9/-	955 2/6
6G6G 2/6	7Q7 7/3	30P19 13/-	956 2/6
6H6M 1/6	7T7 5/-	30PL1 8/-	957 4/-
6JAWA 10/-	7Y4 8/-	30PL13 12/-	958A 5/-
6J3 6/-	7Z4 4/6	35L6GT 7/6	O.R. Tubes
6J5G 2/-	8D2 2/6	35W 17/6	VCR97 40/-
6J6 3/6	9D2 3/-	35W4 5/-	VCR51750/-
6J6W 6/-	9D6 2/-	35Z3 10/-	VCR517B55/-
6J7G 5/-	10P9 9/-	35Z4GT 6/-	VCR517C80/-
6J7M 8/-	12A6 2/6	35Z6GT 6/-	50P1 30/-

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.

CEECO proudly offers IDEAL GIFT



A new fully Transistorised 10 watt Pre-Amp and At a sensible price Amplifier

- ★ STEEL Cabinet (with ample room for you to add-on stages AM/FM, etc.) } **FREE** with the following:
- ★ 10 watt Hi-Fi Pre-amplifier and power amplifier
- ★ Volume, Tone and Treble Controls
- ★ Metal Knobs (Silver pointer marked)
- ★ Professionally designed Front Panel (Silver)
- ★ Operating/Instructions booklet
- ★ Ready built and tested (in our free cabinet)

ONLY £6.19.6

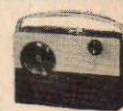
Postage/Ins./parcel and packing charges Extra, 25/-

Power supply for the same available separately. Price list on request

P.O./Cheques with orders. Write to

CEECO, 1a CARLYLE ROAD, CAMBRIDGE

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 £6.7.6 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.) Aldershot 22240

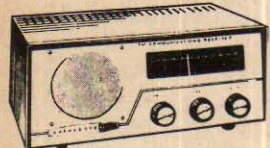
CLOSED WEDNESDAY AFTERNOON CATALOGUE 6d.

BULK ENQUIRIES INVITED FOR EXPORT



HA-63A COMMUNICATION RECEIVER OUTSTANDING VALUE

High class receiver covering 550 kc/s-31 Mc/s. on 4 bands. Incorporates 7 valves plus rectifier, RF stage, illuminated 'S' meter, 1.5V 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 115/220/240 v. A.C. Supplied brand new and guaranteed with manual. £24 gns. Carr. 10/-.



LAFAYETTE HA-55A AIRCRAFT RECEIVER

108-136 Mc/s. High selectivity and sensitivity. Incorporates 2 RF stages including 6CW4 triode, 8 tubes for 11 tube performance, solid state power supply, adjustable squelch control, slide rule dial, built in 4in. speaker and front panel phone jack. 220/240V. A.C. Supplied brand new and guaranteed. £15.7.5. Carr. 10/- 108-176 Mc/s Ground Plane Antenna 59/6.

HA.52A. FM. RECEIVER. Covering 162-174 Mc/s. Identical in appearance to HA.55A. Built-in speaker, etc. £20. 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. £16/18/0. Carr. 10/-.

GARRARD RECORD PLAYERS

BRAND NEW AND GUARANTEED
SRP-12 Player, mono £4 4 0
1000 Changer, mono or stereo £5 19 6
2000 Changer, mono or stereo £6 8 0
A50 Changer, mono or stereo £7 10 0
3000 Changer—Stereo £7 7 0
All plus P. & P. 5/-.

AT6 Mark II. £8 19 6
SP25 Player, mono or stereo... £9 19 6
AT 60 Changer mono or stereo £9 19 6
A70 (less cart.) £19 19 0
LAB80 £25 0 0
401 Transcription £27 10 0

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 Pre-Amplifier £29.19.6; Micro FM Radio Kits £25.19.6; Micro 6 Radio Kit 59/6; Micro Amp Kit 28/6. 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. £6.10.0. pair. P. & P. 3/6.

MAGNAVOX 363 TAPE DECKS

New 3-speed tape deck, supercedes old Collaro studio deck. 2-track £10.10.0. 4-track £13.10.0. Carr. Paid.

PCRI RECEIVERS

Brand new condition, fully tested and checked before despatch. 3 waveband with R.F. stage, wonderful value. 860-2080 metres, 190-570 metres, 5.6-18 Mc/s with internal speaker. £28.19.6. Carr. 10/6 with circuit. Plug in external power units 230 v.a.c. 35/- or 12 v.d.c. 19/6.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discounts for quantities.

3in., 225ft. L.P. acetate 4/-
3in., 600ft. T.P. mylar 10/-
5in., 600ft. std. plastic 8/6
5in., 900ft. L.P. acetate 10/-
5in., 1,200ft. D.P. mylar 15/-
5in., 1,800ft. T.P. mylar 35/-
5in., 1,200ft. L.P. acetate 12/6
5in., 1,800ft. D.P. mylar 22/6
5in., 2,400ft. T.P. mylar 45/-
7in., 1,200ft. std. mylar 15/6
7in., 1,800ft. L.P. acetate 15/6
7in., 1,800ft. L.P. mylar 20/-
7in., 2,400ft. D.P. mylar 25/-
7in., 3,600ft. T.P. mylar 58/6
Postage 2/- Over £3 post paid.

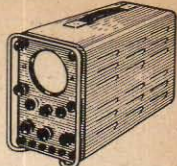
CALLERS WELCOME!

Open 9 a.m. to 6 p.m. every day Monday to Saturday. Trade supplied.

TEST EQUIPMENT

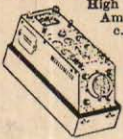
PORTABLE OSCILLOSCOPE CT.52

A compact (9" x 8" x 16 1/2") general purpose 'scope. T/B 10 c/s-40 kc/s. Band width 1 Mc/s. Mullard DG 7/5 2 1/2 CRT. For operation on 200/250 v. A.C. Supplied complete with metal transit case, strap, test leads, and visor hood. Brand new. £22.10.0. Carr. 10/- Supplied complete with instructions.



OS/88/U OSCILLOSCOPES

High quality Portable American Oscilloscope. 3" c.r.t. T/B 3 c/s-50 kc/s X Amp: 0-500 kc/s Y Amp: 0-2 Mc/s. Power requirements 105-125V. A.C. Supplied in brand new condition, fully tested. £25. Carr. 10/- Suitable 220/115V. Transformer 15/6.



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 5.5 Mc/s. Operation 110/230 volt A.C. Supplied in perfect working order. £22/10/- 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 R.F. attenuator. Operation 200/240 v. A.C. Brand new with instructions. £12.10.0. 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-90 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. 0/50 μA/110/100/500 mA/10 amp. D.C. 0/2K/200K/20 MEG. OHM. £12/19/6. P. & P. 5/-.



TE22 SINE SQUARE WAVE AUDIO GENERATORS

Sine 20 cps to 200 kc/s. on 4 bands. Square: 20 cps to 20 kc/s. Impedance 5,000 ohms. 200/240 v. A.C. operation. Supplied Brand New and Guaranteed with instruction manual and leads. £15. Carr. 7/6.



NOMBEX EQUIPMENT

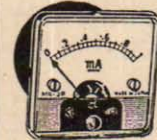
Transistorised Audio Generator 10-100,000 c/s. Sine or square wave. £15.15.0. Transistorised Signal Generator 150 kc/s. 350 Mc/s. £10.10.0. Transistorised resistance capacity bridge 1Ω. 100 MegΩ. 1 pf-100 pf. £9. Transistorised Induction bridge 1 μA-100H. £18. Mains operated Transistor power supply unit, output 1-15v. up to 100 mA. £6.10.0. All above post paid with battery.

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	27/6	200mA	22/6	100V D.C.	22/6
500-0-500μA	22/6	300mA	22/6	150V D.C.	22/6
1-0-1mA	22/6	300mA	22/6	300V D.C.	22/6
1mA	22/6	750mA	22/6	500V D.C.	22/6
2mA	22/6	1A D.C.	22/6	750V D.C.	22/6
5mA	22/6	2A D.C.	22/6	15V A.C.	22/6
10mA	22/6	5A D.C.	22/6	50V A.C.	22/6
20mA	22/6	3V D.C.	22/6	150V A.C.	22/6
50mA	22/6	10V D.C.	22/6	300V A.C.	22/6
100mA	22/6	20V D.C.	22/6	500V A.C.	22/6
150mA	22/6	50V D.C.	22/6	"S" Meter Im 29/6	

POST EXTRA. Larger sizes available—send for lists.



50μA	32/6
100μA	29/6
200μA	27/6
500μA	25/-
50-0-50μA	29/6

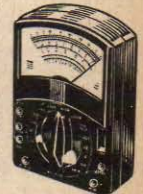
TE-51 NEW 20,000 Ω/VOLT MULTIMETER

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



MODEL TE-12

20,000 O.P.V. 0/0.6/6/30/120/600/1,200/3,000/6,000 V. D.C.
0 / 5 / 30 / 120 / 600 / 1,200 V. A.C. 0 / 60 μA / 6/60/600 MA.
0/6K/800K/6 Meg. 60 Meg. 0 60 PF.
.2 MFD. £25.19.6. P. & P. 3/6.



MODEL U50D. WITH METER PROTECTION.

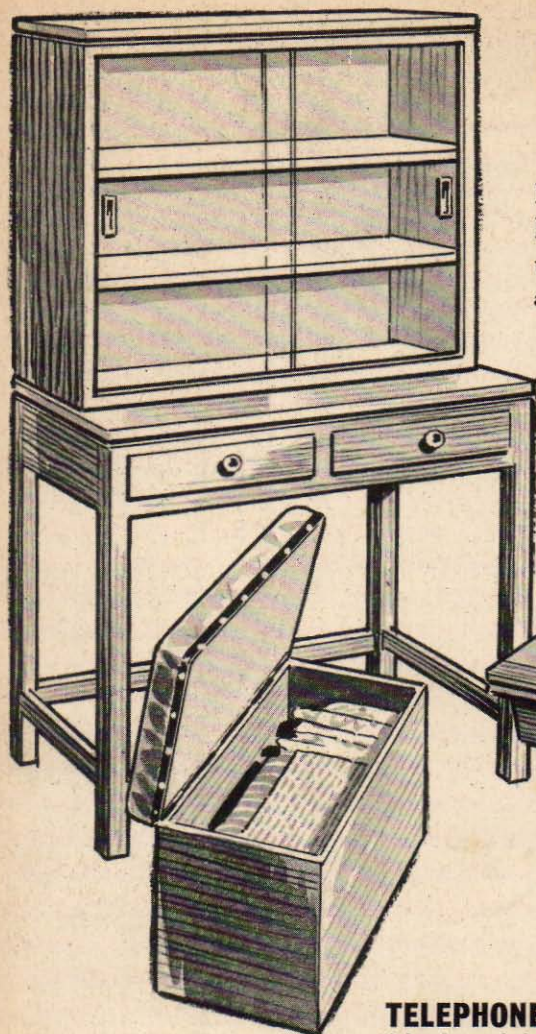
20,000 o.p.v. 0/1.1/5/50/250/1,000 v. D.C. 0/2.5/10/50/250 1,000 v. A.C. 0/0.5/1.5/5/50/250 mA. 0/5K/50K/500K/5 meg. Ω. .0001-2 mid.-20 -22 db. £25.19.6. P. & P. 3/-.



MODEL 560, 30,000 o.p.v. 0/1.1/2.5/10/25/100/250/500/1,000V. D.C. 0 / 2.5 / 10 / 25 / 100 / 250 500 / 1,000V. A.C. 0 / 50 μA / 5 / 50 / 500 mA. 12 amp. D.C. 0 / 60K / 6 Meg. / 60 Meg. Ω. £28/17/6 Post Paid.

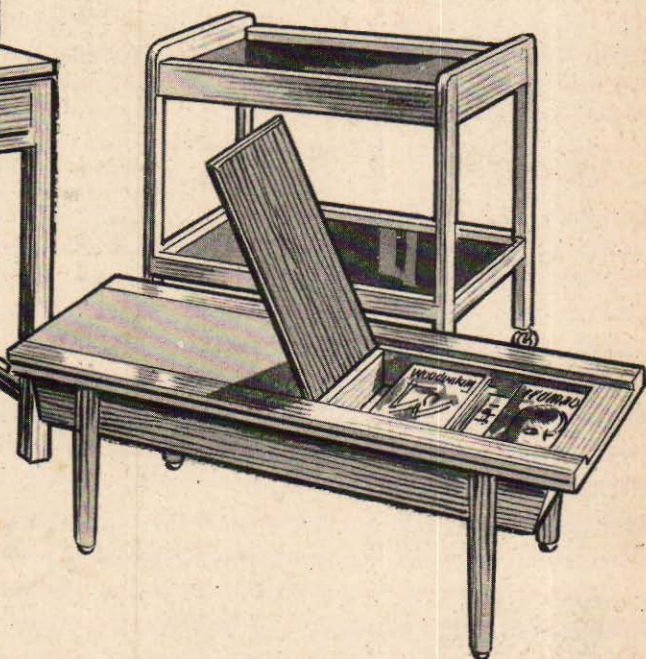
G.W. SMITH & CO. (RADIO) LIMITED

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



MAKE THESE FOR YOUR HOME!

Month by month PRACTICAL WOODWORKING brings the handyman just the know-how he needs on a wide range of useful woodworking jobs. Here are some of the attractive additions to the home fully covered in the January issue.



TELEPHONE DESK & SEAT

A handsome desk to house your telephone... a cupboard for directories... a cushioned seat for comfort... all easy to make from full constructional details.

CABINET, TABLE & TROLLEY SUITE

A space-saving 3-piecer.

OCCASIONAL TABLE

Modern, low-line in appearance and specially designed to store books and magazines.

BLANKET BOX

To store blankets when winter's over. Also makes a handy seat.

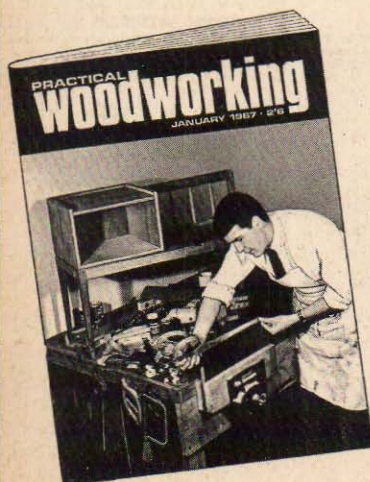
UTILITY DISPLAY SHELVES

Simple to make for those odd corners.

CLOAKROOM MIRROR

Framed in wood, with a generous shelf for clothes-brushes.

Plus PLAN SHEET FOR SINGLE-LIGHT, FULLY-GLAZED EXTERIOR DOOR



PRACTICAL Woodworking

MAKE SURE OF YOUR COPY!

JANUARY ISSUE OUT NOW - 2/6

RADIO • HI-FI • COMPONENTS • TEST EQUIPMENT

ALL ITEMS SENT POST FREE

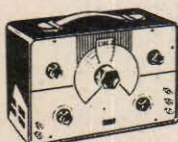
TT.144. Dynamic Transistor Tester
Tests in-circuit, or out of circuit. Identifies PNP and NPN types. Indicates electrode open circuits, short circuits, and current drain. Complete with instructions £4.10.0.



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.20KS 20,000 o.p.v.	£6.8.0
EP.30K 30,000 o.p.v.	£7.19.6
EP.30KN 30,000 o.p.v.	£9.0.0
EP.50KN 50,000 o.p.v.	£11.19.6
EP.100KN 100,000 o.p.v.	£14.19.6



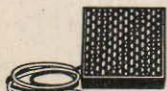
TE.188. RF SIGNAL GENERATOR
A stable wide range signal generator with a range of 120 Kcs-260Mc/s on 6 bands. Features a large 4in. vernier tuned, etched circular dial for easy accurate frequency adjustments. Complete with instructions. £20.15.0

TE.190. SINE SQUARE WAVE AUDIO GENERATOR

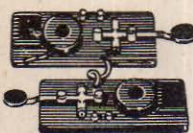
SINE WAVE: 20-200,000 cps in four bands.
SQUARE WAVE: 60-30,000 cps. Input impedance 0-5,000 ohms. Especially designed for Hi-Fi Radio and TV Service men who require a dependable instrument. £21.19.6



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



FSW.1. FOOT SWITCH
Snap action foot switch with skid proof rubber base pad. Plugs into your Tape Recorder remote control system but special adaptor supplied enables this to be used with all other 24/- Tape Recorders.



MCK.2. MORSE CODE KIT
Two station morse code kit supplied with instructions, 50ft. of connection wire and morse code charts. £2.2.0



UD40H CARDIOD DYNAMIC MICROPHONE

Features a pop-proof diaphragm and superior anti feed-back properties, reduces feedback and room reverberation. O/p: -42 db. Res. 12,000 cps; 50K ohm impedance £6.6.

SR165. ALL BAND COMMUNICATION RECEIVER

This entirely new professional type communication receiver features frequency coverage of 535 Kcs-30 Mc/s for complete general coverage. In particular ham bands are arranged in the same calibration scale, so that the band switching can be accomplished rapidly. £48.0.0

DM31C. CARDIOD DYNAMIC MICROPHONE

Superb quality with ball head for distributed cardioid frontal pick-up. Output: -52db. Response: 40-13,000 cps. Impedance 50K ohm. £7.7.0.

DM24HL

A goose-neck dual impedance microphone 600 ohm. 50K ohm. Response: 50-11,000 cps. £6.6.0.



27 other microphones available.

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 5 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

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 RMS. 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 14in. high x 10 1/2 in. wide x 8in. deep. £14.14.0

As well as this beautifully designed speaker there are two other models MS85. 10 watts RMS at £12.12.0 and MS40 5 watts RMS £8.10.0. All three speakers are finished in magnificent rosewood and the entire cabinet filled with acoustic damping material.

EAGLE PRODUCTS

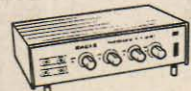
MAGNETIC STEREO CARTRIDGES

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

£6.12.6 £5.14.6

Both feature singularly smooth reproduction and incisive separation of stereo channels

ALL TRANSISTOR PUBLIC ADDRESS AMPLIFIERS



SC10F. RECTANGULAR REFLEX HORN SPEAKER

An outstanding combination of reflex horn and driver unit for car mounting, to deliver wide angle high quality reproduction. Weatherproof, waterproof and shockproof. Output 10 watts. £7.15.0

Also available SC5F: 5 watts, £4.2.6 and SC15F: 15 watts £14.12.6.

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

(Dept. P.E.13)
87 Tottenham Court Road, London, W.1.



EAGLE FMT41. 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



EG304

Sub-miniature 3 watt transistorised push-pull radio amplifier on printed circuit. Ideal unit for Intercoms, Baby Alarms, Radio Tuners, etc. Complete with circuit and instructions. £3.12.6

Also available EG104. £3.2.6

One Watt and EG2004 250 mW £2.5.0



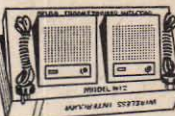
CSK.10

Self-powered crystal set kit with private earphone. Supplied complete with instructions. 18/6



ALL TRANSISTOR MONO & STEREO PRE AMPLIFIERS

Provide extra stages 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



WI-2. TRANSISTORISED WIRELESS INTERCOM

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

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.

WIRELESS MICROPHONES

WM909 (as illustrated) Pocket FM Wireless transmitter complete with tie-pin 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 WM808 Professional stick type FM Wireless Microphone. £21.0.0

These cannot be operated in U.K.

REDA RADIO LTD

HI-FI AMPLIFIERS — TUNERS — RECORD PLAYERS



**FM
TUNERS
FM-4U**



TFM-IS

HI-FI FM TUNER. Model FM-4U. Available in two units. R.F. tuning unit (£215.0 incl. P.T.) with I.F. output of 10.7 Mc/s and I.F. amplifier unit, with power supply and valves (£13.13.0).
Total Price Kit **£16.8.0**

HI-FI AM/FM TUNER. Model AFM-1. Available in two units which, for your convenience, are sold separately. Tuning heart (AFM-T1—£4.13.6 incl. P.T.) and I.F. amplifier (AFM-A1—£22.11.6). Printed circuit board, 8 valves. Covers L.W., M.W., S.W., and F.M. Built-in power supply. Total Price Kit **£27.5.0** STEREO DECODER available, please see below.

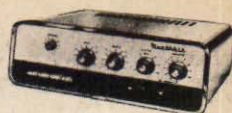
Hear the BBC stereo FM programmes on the **TRANSISTOR STEREO FM TUNER**. Elegantly designed to match the stereo Amplifier, AA-22U. Available in two units, sold separately, can be built for a Total Price:

Kit (STEREO) **£24.18.0** incl. P.T.
Kit (MONO) **£20.19.0** incl. P.T.



**10W
POWER
AMP.
MA-12**

**9 + 9W
STEREO
AMP.
S-99**



HI-FI MONO AMPLIFIER. Model MA-12. 10W output, wide freq. range, low distortion. Use with control unit.

Kit **£12.18.0** Assembled **£16.18.0**

3 + 3W STEREO AMPLIFIER. Model S-33. An easy-to-build, low cost unit. 2 inputs per channel. Kit **£13.7.6** Assembled **£18.18.0**

DE LUXE STEREO AMPLIFIER. Model S-33H. De luxe version of the S-33 with two-tone grey perspex panel, and high sensitivity necessary to accept the Decca Deram pick-up. Kit **£15.17.6** Assembled **£21.7.6**

HI-FI STEREO AMPLIFIER. Model S-99. 9 + 9W output. Ganged controls. Stereo/Mono gram, radio and tape inputs. Push-button selection. Printed circuit construction. Kit **£28.9.6** Assembled **£38.9.6**

TRANSISTOR MIXER. Model TM-1. A must for the tape enthusiast. Four channels. Battery operated. Similar styling to Model AA-22U Amplifier. Kit **£11.16.6** Assembled **£16.17.6**



Make the most of your leisure time..

Here's the STEREO DECODER you have been looking for

Add Stereo RADIO to your listening pleasure at low cost. **FM DECODER SD-1.** This model will convert Heathkit valve (Mono) FM and AM/FM tuners to stereo. It can also be used with most other makes of FM tuner having facilities for multiplex output. Own built-in power supply. Compact, 3½" x 3½" x 9" deep. Kit **£8.10.0**. Assembled **£12.5.0**. Send for full specification details.



TRANSISTOR RECEIVERS



Oxford



UXR-1



GC-1U

"OXFORD" LUXURY PORTABLE Model UXR-2. Specially designed for use as a domestic or personal portable receiver. Many features, including solid leather case. Kit **£14.18.0** incl. P.T.

TRANSISTOR PORTABLE. Model UXR-1. Pre-aligned I.F. transformers, printed circuit. Covers L.W. and M.W. Has 7" x 4" loudspeaker. Real hide case. Kit **£12.11.0** incl. P.T.

JUNIOR EXPERIMENTAL WORKSHOP. Model EW-1. More than a toy! Will make over 20 exciting electronic devices, incl.: Radios, Burglar Alarms, etc. 72 page Manual. The ideal present! Kit **£7.13.6** incl. P.T.

"MOHICAN" GENERAL COV. RECEIVER for Amateur or Short Wave listening. Send for leaflet. Kit **£37.17.6** Assembled **£45.17.6**

TEST INSTRUMENTS

Our wide range includes:

3" LOW-PRICED SERVICE OSCILLOSCOPE. Model OS-2. Compact size 5" x 7½" x 12" deep. Wt. only 9½lb. "Y" bandwidth 2 c/s-3 Mc/s ±3dB. Sensitivity 100mV/cm T/B 20 c/s-200 kc/s in four ranges, fitted mu-metal CRT Shield. Modern functional styling. Kit **£23.18.0** Assembled **£31.18.0**



OS-2

5" GEN.-PURPOSE OSCILLOSCOPE. Model 10-12U. An outstanding model with professional specification and styling. "Y" bandwidth 3 c/s-4.5 Mc/s ±3dB. T/B 10 c/s-500 kc/s. Kit **£35.17.6** Assembled **£45.15.0**

DE LUXE LARGE-SCALE VALVE VOLTMETER. Model IM-13U. Circuit and specification based on the well-known model V-7A but with many worth-while refinements. 6" Ernest Turner meter. Unique gimbal bracket allows operation of instrument in many positions. Modern styling. Kit **£18.18.0** Assembled **£26.18.0**



VVM, IM-13U

AUDIO SIGNAL GENERATOR. Model AG-9U. 10 c/s to 100 kc/s, switch selected. Distortion less than 0.1%, 10V sine wave output metered in volts and dB's. Kit **£23.15.0** Assembled **£31.15.0**

VALVE VOLTMETER. Model V-7A. 7 voltage ranges d.c. volts to 1,500. A.C. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0.1Ω to 1,000MΩ with internal battery. D.C. input resistance 11MΩ. dB measurement, has centre-zero scale. Complete with test prods, leads and standardising battery. Kit **£13.18.6** Assembled **£19.18.6**



V-7A

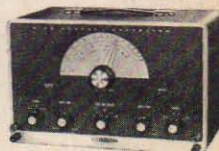


RF-1U

MULTIMETER. Model IM-1U. Ranges 0-1.5V to 1,500V a.c. and d.c.; 150μA to 15A d.c.; 0-2Ω to 20MΩ 4½" 50μA meter. Kit **£12.18.0** Assembled **£18.11.6**

R.F. SIGNAL GENERATOR. Model RF-1U. Up to 100 Mc/s fundamental and 200 Mc/s on harmonics. Up to 100mV output. Kit **£13.18.0** Assembled **£20.8.0**

SINE/SQUARE GENERATOR. Model IG-82U. Freq. range 20 c/s-1 Mc/s in 5 bands less than 0.5% sine wave dist. less than 0.15μ sec. sq. wave rise time. Kit **£25.15.0** Assembled **£37.15.0**



IG-82U

TRANSISTOR POWER SUPPLY. Model IP-20U. Up to 50V, 1.5A output. Ideal for Laboratory use. Compact size. Kit **£35.8.0** Assembled **£47.8.0**

Prices and specifications subject to change without notice

WELCOME TO OUR LONDON HEATHKIT CENTRE

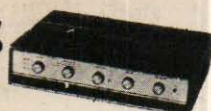
233 Tottenham Court Road, W.1

We open **MONDAY-SATURDAY** 9 a.m.-5.30 p.m.
THURSDAY ... 11 a.m.-2.30 p.m.
Telephone No.: MUSEUM 7349

WHEN YOU ARE IN TOWN, WE HOPE YOU WILL VISIT US THERE

TAPE AMPLIFIERS — TAPE DECKS — CONTROL UNITS

20 + 20W
STEREO
AMP.
AA-22U



GARRARD
PLAYER
AT-60



20+20W TRANSISTOR STEREO AMPLIFIER. Model AA-22U. Outstanding performance and appearance. Kit £39.10.0 (less cabinet). Attractive walnut veneered cabinet £25.0 extra. Assembled incl. cabinet, £59.15.0

GARRARD AUTO/RECORD PLAYER. Model AT-60, less cartridge £13.1.7. With Decca Deram pick-up £17.16.1 incl. P.T.

Many other Garrard models available, ask for Lists.

HI-FI MONO AMPLIFIER. Model MA-5. A general purpose 5W Amplifier, with inputs for Gram., Radio. Modern functional appearance. Kit £11.9.6 Assembled £15.15.0

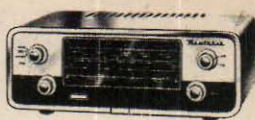
WIDE RANGE OF HI-FI CABINETS, send for details.

For example:

MALVERN Kit £18.1.0 incl. P.T.



TRUVOX
DECK



AM/FM
TUNER

TRUVOX D-93 TAPE DECKS. High quality stereo/mono tape decks. D93/2, 1/2 track, £36.15.0 D93/4, 1/4 track, £36.15.0

TRANSISTOR INTERCOM. Models XI-1U and XIR-1U. A time-saving device for office, shop or for the home. Master unit XI-1U will operate up to 5 remote stations. Master, XI-1U Kit £11.9.6 Assembled £17.9.6. Remote, XIR-1U Kit £4.9.6 Assembled £5.18.0. Send for full specification leaflet.

MONO CONTROL UNIT. Model UMC-1. Designed to work with the MA-12 or similar amplifier requiring 0.25V or less for full output. 5 inputs. Baxandall type controls. Kit £9.2.6 Assembled £14.2.6

STEREO CONTROL UNIT. Model USC-1. Push-button selection, accurately matched ganged controls to ± 1 dB. Rumble and variable low pass filters. Printed circuit boards. Kit £19.19.0 Assembled £27.5.0

Enjoy building a Heathkit model



SPEAKER SYSTEMS



SSU-1

HI-FI SPEAKER SYSTEM. Model SSU-1. Ducted-port bass reflex cabinet "in the white". Two speakers. Vertical horizontal models with legs, Kit £12.12.0, without legs, Kit £11.17.6 incl. P.T.

The BERKELEY SLIM-LINE SPEAKER SYSTEM, fully finished walnut veneered cabinet for faster construction. Special 12" bass unit and 4" mid/high frequency unit. Range 30-17,000 c/s. Size 26" x 17" only 7 1/2" deep. Modern attractive styling. Excellent value. Kit £19.10.0 Assembled £24.0.0

COTSWOLD SPEAKER SYSTEMS. Outstanding performance for price.

MFS: Size 36" x 16 1/2" x 14" deep. Kit £25.12.0 Assembled £33.17.0

STANDARD: Size 26" x 23" x 14 1/2" deep. Kit £25.12.0 Assembled £33.17.0



Berkeley

Complete your motoring pleasure with this outstanding car radio. Model CR-1.



Will give you superb LW and MW entertainment wherever you drive. Tastefully styled to harmonise with any car colour scheme. Available for your convenience in two parts. Can be built for a total price extra. Send for full details.

SEND FOR THE LATEST FREE CATALOGUE



Deferred terms available in U.K. over £10.

Prices quoted are Mail Order Prices

"AMATEUR" EQUIPMENT

80-10m TRANSMITTER. Model DX-40U. Power inputs 75W. C.W., 60W peak CC phone. Output 40W to aerial. Provision for VFO. Kit £29.19.0 Assembled £41.8.0

SSB ADAPTOR, SB-10U Kit £39.5.0 Assembled £45.18.0

AMATEUR BANDS RECEIVER. Model RA-1. To cover all the Amateur Bands from 160-10 metres. Many special features, including: half-lattice crystal filter; 8 valves; signal strength "S" meter; tuned R.F. Amp. stage. Kit £39.6.6 Assembled £52.10.0

160-10M TRANSMITTER. Model DX-100U. Careful design has achieved high performance and stability. Completely self-contained. Kit £81.10.0 Assembled £106.15.0

COMMUNICATIONS TYPE RECEIVER. Model RG-1. A high performance, low cost receiver for the discriminating listener. Frequency coverage: 600 kc/s-1.5 Mc/s and 1.7 Mc/s-32 Mc/s. Kit £39.16.0 Assembled £53.0.0

REFLECTED POWER METER and SWR BRIDGE. Model HM-11U. Indicates reliability, but inexpensively, whether the RF power output of your TX is being transferred efficiently to radiating antenna. Kit £8.10.0 Assembled £10.15.0



DX-40U



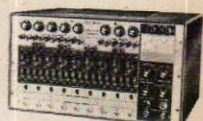
RA-1



HM-11U

LOW COST ANALOGUE COMPUTER, EC-1U

Excellent for training engineering, physics and maths students in the principles and applications of analogue computers. 9 d.c. operational amplifiers in one compact unit. Kit £97.8.0. Assembled £122.0.0. Full specification sheet available.



To DAYSTROM LTD., Dept. P.E.1, Gloucester

Without obligation please send me

(Tick here)

FREE BRITISH HEATHKIT CATALOGUE..... ☐

FULL DETAILS OF MODEL(S)..... ☐

(Please write in BLOCK CAPITALS)

NAME

ADDRESS

Please send FREE catalogue to my friend.

NAME

ADDRESS

P.E.1.

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 $\frac{1}{2}$, 3 $\frac{1}{2}$, 7 $\frac{1}{2}$ i.p.s. available with either $\frac{1}{2}$ track or $\frac{1}{4}$ 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 $\frac{1}{2}$ x 11 x 5 $\frac{1}{2}$ 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 $\frac{1}{2}$ track model £10.10.0

LASKY'S PRICE $\frac{1}{4}$ track model £13.9.6

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

$\frac{1}{2}$ track model LASKY'S PRICE £14.19.6

$\frac{1}{4}$ track model LASKY'S PRICE £15.19.6

Carriage and Packing 4/6 extra

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 $\frac{1}{2}$ in. Fully tunable—complete with PCC86 and PCC88 valves. LASKY'S PRICE 29/6. Without valves 12/6

TRANSISTORISED UHF MINIATURE MODEL I

Shielded metal case only 3 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 3 in. Fully tunable—complete with two AF 139 transistors. LASKY'S PRICE 39/6

TRANSISTORISED UHF MODEL 2

Metal case size 3 $\frac{1}{2}$ (plus spindle) x 2 $\frac{1}{2}$ x 1 $\frac{1}{2}$ in. Fully tunable with slow motion drive. Comp. with two AF186 transistors and leads. LASKY'S PRICE 25/6

TRANSISTORISED VHF TUNER

Sub-miniature turret type fitted with 12 sets of coils and 3 Mullard AF102 transistors. In metal case size 3 x 1 $\frac{1}{2}$ x 2 $\frac{1}{2}$ 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, 1XEB91, EF80, EF183 and EF184. Overall size 11 $\frac{1}{2}$ x 3 $\frac{1}{2}$ 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.C.2. Circuit supplied.

LASKY'S PRICE 39/6

Post 2/6

SPECIAL PACKAGE OFFER

Free standing table cabinet, size 37 $\frac{1}{2}$ x 9 x 5 $\frac{1}{2}$ in., finished in medium Mahogany. Scale marked 21 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 89/6

Post 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 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ with 18 in. capillary tube and 6 in. bulb. Single hole fixing—3/16 in. spindle.

LASKY'S PRICE 15/-

Post 2/-

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.

Tel.: STE 4821/2

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: 0.25-50-250-500 at 20,000 Ω/V . A.C. volts: 0.25-50-250-500 at 1,000 Ω/V . D.C. current: 0-50 μ A, 0.2-5-50-250 μ A. Resistance: 0-2,000 Ω , 0-200 k Ω , 0-20 M Ω . Basic movement: 40 μ A f.s.d. moving coil. With universal shunt full scale deflection current is 50 μ A. Black plastic case—3 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 1 $\frac{1}{2}$ 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 5v. and one 1.5v. battery. Complete with all parts and full construction details. H.P. Terms available.

LASKY'S PRICE £5.19.6.

P. & P. 5/-



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

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 in. PRICE 27/6

TYPE LRPC 2. 5 transistor. Input sens. 1mV, output 330 mV, output imp. 15 Ω , size 2 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 2 in. PRICE 22/6

TYPE LRPC 3. 5 transistor. Input sens. 5 mV, output 400 mV, output imp. 15 Ω , size 2 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 2 in. PRICE 25/6

TYPE LRPC 4. 5 transistor. Input sens. 150 mV, output 330 mV, output imp. 15 Ω , size 2 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 2 in. PRICE 22/6

TYPE LRPC 5. 6 transistor. Input sens. 8mV, output 3W, output imp. 3 Ω , size 5 $\frac{1}{2}$ x 1 $\frac{1}{2}$ 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 $\frac{1}{2}$ x 2 x 1 in. LASKY'S PRICE 39/6

FULLY ENCAPSULATED MODULES

Special function modules — all one size 1 $\frac{1}{2}$ x 1 x 1 $\frac{1}{2}$ 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 ind. 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 $\frac{1}{2}$ x 1 $\frac{1}{2}$ x 1 $\frac{1}{2}$ in. £2 19.6

THE MICRO-FM. (tuner/receiver) £2 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 £3 19.6

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

Boards	Accessories
42/1503 2 $\frac{1}{2}$ x 5 in.	3/11 Terminal pins — pkt. of 50 3/-
43/1504 2 $\frac{1}{2}$ x 3 $\frac{1}{2}$ in.	3/3 Spot face cutter tool 7/3
45/1507 3 $\frac{1}{2}$ x 5 in.	5/6 Pin inserting tool 9/6
46/1508 3 $\frac{1}{2}$ x 3 $\frac{1}{2}$ in.	3/11 Post 6d. per item extra.
44/1505 3 $\frac{1}{2}$ x 17 in.	15/6 Orders of 10/- and over post free.

TRANSISTORS ALL BRAND NEW AND GUARANTEED

GET S1, GET S5, GET S6 2/8; 873A, 874P 3/8; OC45, OC71, OC81D 4/8; OC 44, OC 70, OC 76, OC 81 5/8; pair (10/6); AF 117, OC 200 6/8; OC 42, OC 43, OC 73, OC 82D 7/8; OC 201, OC 204 15/-; OC 205, OC 206 19/8; OC28 24/8; OC 75 8/-.

TRANSISTORS BY BRUSH CRYSTAL CO. Available from stock.

TO—01B 465 kc/s. $\pm$ 2 kc/s.	TO—02B 470 kc/s. $\pm$ 1 kc/s.	9/6 EACH
TO—01D 470 kc/s. $\pm$ 2 kc/s.	TF—01B 465 kc/s. $\pm$ 2 kc/s.	
TO—02B 465 kc/s. $\pm$ 1 kc/s.	TF—01D 470 kc/s. $\pm$ 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.

LASKY'S FOR SPEEDY MAIL ORDER SERVICE

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

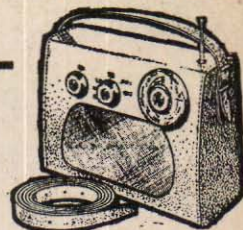
★ **7 WAVEBAND PORTABLE OR CAR RADIO**
Now with **PHILCO MICRO-ALLOY R.F. TRANSISTORS**

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.

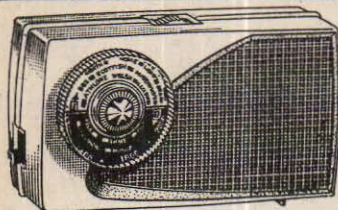
The perfect portable and the ideal car radio. (Uses PP7 batteries available anywhere.)

★ **EXTRA BAND FOR EASIER TUNING**
OF PIRATE STATIONS, etc.

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

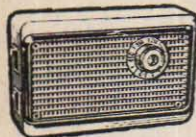
3 WAVEBAND PORTABLE. ● 8 stages. Six transistors and two diodes.

Covers Medium and Long Waves and extra Band for easier tuning of Pirate Stations, 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

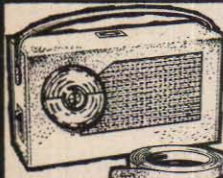
● 8 stages—6 transistors and 2 diodes

This is a top performance receiver covering full Medium and Long Waves and Trawler Band. High-grade approx. 3in. 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, 3in. heavy duty speaker, top grade transistors, volume control, tuning condenser, wave change slide switch, sensitive 6in. 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, 3in. speaker (will drive

large speaker). anywhere.)

Size 7½ x 5½ x 1½ in. (Uses 9v battery, available

Total cost of all
parts now only

£3.19.6 P. & P. 3/6

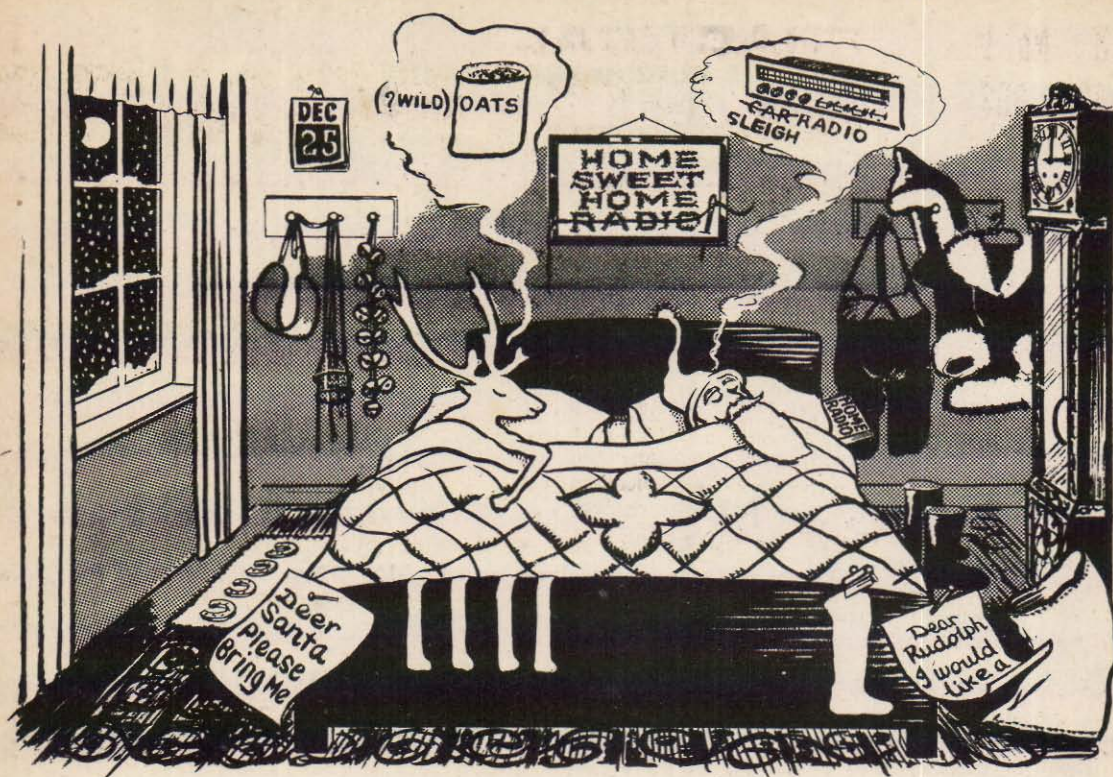
Parts Price List and easy build
plans 2/- (Free with kit)

Callers side entrance
Barratts Shoe Shop.

RADIO EXCHANGE Ltd

61a HIGH STREET, BEDFORD. Phone: 52367

Open 9—5 p.m.
Saturdays 9—12.30 p.m.



A MERRY CHRISTMAS TO YOU ALL

Well—we've caught the 'old gentleman asleep at last. However, by the look of his empty sack all his deliveries have been made; so he has earned his rest. I cannot help noticing that the crafty old fellow has a Home Radio Catalogue tucked under his pillow, no doubt a great help to him for choosing his gifts!! Do **you** lack inspiration for choosing presents?

Then send for a Home Radio Catalogue—over 6,000 items to choose from (1000 illustrated). Why not give the actual catalogue as a present? The price is modest, only 7/6 plus 1/6 *postage and packing* and every one contains five vouchers each worth 1/- if used as directed. Send off coupon today, along with P.O. or cheque for 9/- and solve your present problem.

Please write your Name and Address in block capitals

Name.....

Address.....

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

TOO MUCH MUSIC?

WITH an important White Paper concerning the future of broadcasting in this country in the offing, strident voices have been heard in recent months campaigning on behalf of a host of different interests. Perhaps the least bashful of these are the pop pirates with their undoubted enthusiastic followers, drawn mainly from, one supposes, the teenage section of the population. Other voices in this chorus represent local radio interests, the recording companies, The Performing Right Society, musicians, and composers.

There is violent discord in this chorus and clearly whatever the Postmaster-General decides, he will not be able to weld this motley assembly into a harmonious whole.

Is there too much music broadcast already?

This is one of the more surprising points of view to emerge from this "concert" performance. A select body of well known composers representing the whole musical scale from pop to symphony thinks there is already a sufficiency of music for all tastes available on tap from the broadcasting stations each day.

The record companies would appear to lend support to this opinion since their products are intended for private individuals to play at home as the mood takes them. The disc was never intended to provide fodder for the insatiable appetites of broadcasting stations which, incidentally, modern techniques have made relatively simple to set up and operate.

If modern electronic engineering has in this respect been kind to the pop pirates, it has been no less bounteous to land based purveyors of music in public places through wired relay and public address type systems. This kind of broadcasting is in many respects more open to objection than the radio transmission kind—the audience has no means to switch it off!

A little background music of the right type at the right time can be valuable as either a tonic or a sedative. Like all drugs its effectiveness diminishes with prolonged use; at best it becomes "musical wallpaper"—an accompaniment that can be tolerated (but this is hardly complimentary to composer and performers); at worst it degenerates to "noise" which may become a severe irritant.

An abundance of music is indeed a mixed blessing.

THIS MONTH

CONSTRUCTIONAL PROJECTS

REMOTE TEMPERATURE MEASUREMENT	20
TAPE RECORDER AUTO-SWITCH	27
MODEL CONTROL AMPLIFIERS	38
INTEGRATED STEREO AMPLIFIER	50
THE LUMOSTAT	61

SPECIAL SERIES

THE ELECTRONIC ORGAN—2	31
------------------------	----

GENERAL FEATURES

LASERS	16
FREQUENCY DIVISION	46
CHARGE STORAGE IN TRANSISTORS	55

NEWS AND COMMENT

EDITORIAL	15
AUDIO TRENDS	24
NEWS BRIEFS	36, 54
MARKET PLACE	37
BOOK REVIEWS	43
MEETINGS	43
ELECTRONORAMA	44
DETACHED PARTICLES	69
READOUT	70

Our February issue will be published on
Friday, January 13

LASERS

By J. B. Dance M.Sc.

PART 1

The laser is one of the most important devices invented by physicists during the past decade. Apart from its numerous uses in pure research, the laser has many practical applications; one of the most interesting applications is the use of laser light as a carrier wave for conveying a great deal of information in a short time.

It is not possible to explain in only a few words what precisely a laser is, but basically it is a means of generating a rather special kind of light contained in a very narrow, almost parallel beam. This article sets out to explain the principles of operation and applications of lasers.

IN ORDER to understand the operation of a laser, it is first necessary to consider the various ways in which radiation can interact with matter. In the same way that matter is considered to consist of a large number of atoms, light (and also other forms of electromagnetic radiation) can be thought of as a large number of particles which are known as photons.

Indeed, individual gamma photons can be counted with Geiger counting equipment. The energy of a single photon E is equal to the frequency of the light f multiplied by a constant h (Planck's constant). Thus a photon of blue light contains more energy than a photon of red light.

We may picture the atom (after Niels Bohr) as a

number of electrons travelling in orbits around a central nucleus in much the same way that the planets travel around the sun. However, only those orbits which satisfy certain conditions set by the quantum theory are stable. In general the farther an electron in a certain atom is from the central nucleus, the higher is its energy.

An atom is said to be in the ground state when it has the least possible energy. If the atom absorbs energy and this causes an electron to move further from the nucleus, the atom is then said to be in an excited state. However, an atom can absorb only an amount of energy which will cause one of its electrons to move into a stable orbit of higher energy.

PROCESSES OF ABSORPTION AND EMISSION

Absorption

- ☐ One photon + Atom in the ground state $\longrightarrow$ Excited atom

Normal Emission

- ☐ Excited atom $\longrightarrow$ Atom in a state of lower energy + One photon

Stimulated Emission

- ☐ Excited atom + One photon $\longrightarrow$ Atom in a state of lower energy + Two identical photons

PHOTON ABSORPTION

One of the ways in which an atom is given extra energy involves the absorption of a photon of light. The photon disappears and an excited atom is produced. However, the photon will be absorbed only if it has almost exactly the amount of energy required to raise the electron into a stable higher orbit.

If a photon has either too much energy or too little energy, it will not be able to effect the change, although it may possibly have a suitable amount of energy to cause another change in electron energy levels. In other words, a given atom in the ground state will absorb only light of certain specified colours.

Complications occur when one considers absorption in a substance, since each atom can interact with its neighbours in such a way that many stable energy levels are created. Thus the material may absorb a band of colours rather than one specified frequency.

EMISSION

If an atom is in an excited state, it tends to lose its energy very quickly indeed. In a typical case the energy is lost in less than one hundred millionth of a second. Some forms of excited atoms lose their energy about one million times more slowly; they are known as metastable atoms.

When an atom loses its energy, a photon may be formed. The frequency of the light of which this photon forms a part is thus proportional to the difference in energy between the two states of the atom. If this difference is large, ultra-violet or violet light may be emitted, but if the atom loses a smaller amount of energy, yellow or red light may be emitted. Each energy difference causes light of one particular frequency to be emitted.

Electrons jumping between two of the energy levels in the sodium atom give rise to the characteristic yellow light emitted by street lamps filled with sodium vapour. Similarly neon filled tubes, including voltage stabiliser tubes, emit red light. Any atom will emit light (when excited) of the same colour as the light which the unexcited atom will absorb.

STIMULATED EMISSION

Let us consider the case of an atom which, when in the ground state, will absorb a photon of energy E to become an excited atom. If a photon of this same energy meets the excited atom, it will cause the atom to emit a photon virtually instantaneously. The fact that the two photons have the same frequency, the same plane of polarisation, the same phase, and the same direction of travel renders the operation of a laser possible.

The photon produced when the original photon strikes the excited atom is an exact replica of the

original photon. Thus stimulated emission may be considered to be the amplification of light. If the photons meet further excited atoms, further amplification by stimulated emission will occur.

FEEDBACK

As in the case of a radio transmitter, it is necessary to convert the amplifier into an oscillator if the system is to be used to generate electromagnetic oscillations. This is accomplished by the use of a system such as that shown in Fig. 1. The two mirrors must be accurately parallel to one another and must face each other.

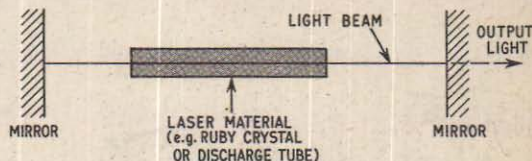
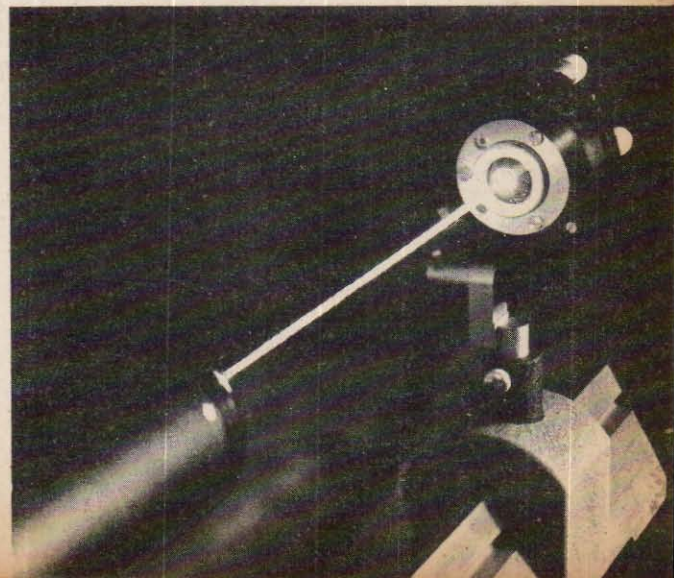


Fig. 1. A simplified diagram of a laser

Any light passing along the axis of the system is reflected back into the system so that further amplification occurs. Light which deviates from the axis by even a very small angle soon passes out of the system and is lost.

One of the mirrors of the system is only partially reflecting so that the output beam from the laser can pass through it. The divergence of this beam is extremely small. In other words the output from the laser is obtained as a beam of light which is almost exactly parallel.

This photograph and that on the opposite page show the beam from a Mullard gas laser



MASERS AND LASERS

The phenomenon of stimulated emission was first discovered at microwave frequencies in ruby crystals. The apparatus used became known as a MASER, this name being taken from the abbreviation for "Micro-wave Amplification by the Stimulated Emission of Radiation".

Masers are the best low noise amplifiers known at the present time and are used in satellite communication systems and in radio astronomy. However, they are too complicated for use as a normal electronic component and many types must be cooled in liquid helium.

A somewhat similar device, using light instead of microwaves, was developed and was called a LASER—"Light Amplification by the Stimulated Emission of Radiation".

PUMPING

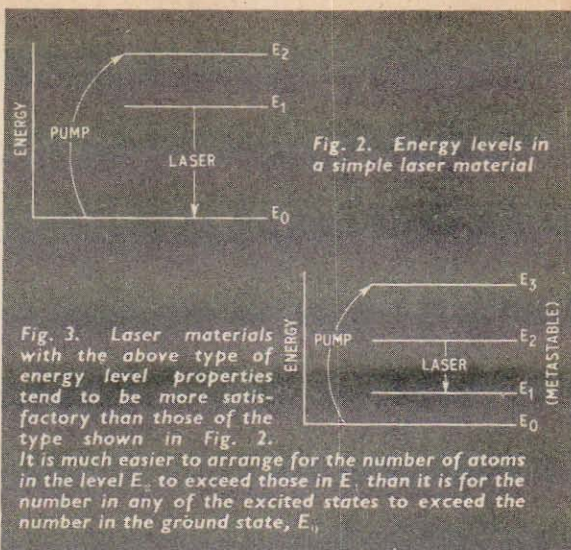
In order for light amplification to occur in a laser material, there must be more atoms in the excited state than there are in the ground state; otherwise the probability of a photon being absorbed is greater than the probability that it will cause stimulated emission and thus be amplified. For laser action to occur, the chance that a photon travelling through the material will be absorbed must be less than the chance that it will be amplified.

In order to produce a material in which the number of excited atoms exceeds the number in the ground state, some method of supplying energy to the atoms must be incorporated in the system.

The energy supply is known as a "pump", since it pumps the atoms up from the ground state into an excited state. It supplies the energy in a somewhat similar way to that in which the power supply of a radio transmitter supplies energy to the circuits.

The energy required may be used to raise the atoms of the laser material from a level E_0 (see Fig. 2) to a level E_2 . The atoms lose a part of their excess energy almost immediately and fall to the energy level marked E_1 in Fig. 2. If the energy level E_1 is a metastable one, the number of atoms with this energy may exceed the number of atoms in the ground state E_0 ; laser action then becomes possible.

A Ferranti gas laser in operation. The three screws on the right-hand side are for the adjustment of the mirror. The Brewster window can be seen at the end of the inner tube containing the glowing gas



Actual laser materials normally have a much more complicated energy level diagram than that shown in Fig. 2. In particular, the laser action is chosen so that the atoms are left in a state of slightly greater energy than the ground state (see Fig. 3). This enables an improved efficiency to be obtained.

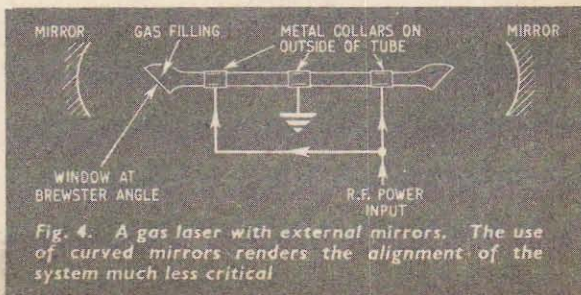
COHERENT LIGHT

The word "cohere" means "stick together" or "reinforce". Coherent light is light in which the peaks of the waves are in phase and which stick together as the wavefront moves. Coherent light is therefore light of a single frequency.

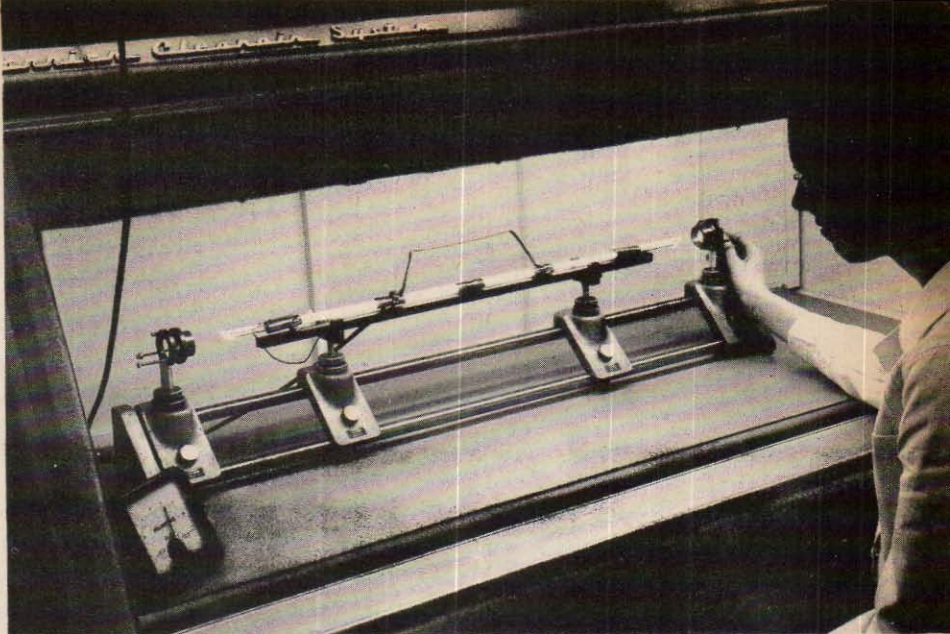
Theoretically it is impossible for light to be of one frequency and therefore for coherent light to be obtained. However, light from the most coherent source at present known (the gas laser) has a frequency spread of less than one cycle per second; this is negligible compared with the frequency of light itself of some hundreds of millions of megacycles per second.

Coherent electromagnetic waves are needed for the efficient transmission of information. Incoherent electromagnetic waves (such as the old spark transmitters) cannot be used for the efficient transmission of information, since the various frequencies present effectively constitute "noise" signals. Incoherent waves can only be used to convey information by switching the carrier on and off.

Lasers have provided the first reasonably coherent sources of light and the possibility of using them for carrying many speech and television channels has aroused considerable interest.



A gas laser tube being tested in the laboratories of the English Electric Valve Company at Chelmsford. The Brewster window can be seen at each end of the tube



THE GAS LASER

The most common form of gas laser employs a gas discharge tube filled with a mixture of helium and neon at a low pressure. The electrical discharge in the gas provides a large number of free electrons travelling at high speeds. These electrons give up their energy to helium atoms which in turn pass on the energy to the neon atoms.

The neon atoms have suitable energy levels for laser action to occur with either red light or with near infra-red light or in the far infra-red region. If the mirrors are chosen so that they reflect almost all the red light which falls on them, the output from the laser will consist of red light. Another type of mirror must be selected for the near infra-red and yet another type for the far infra-red region.

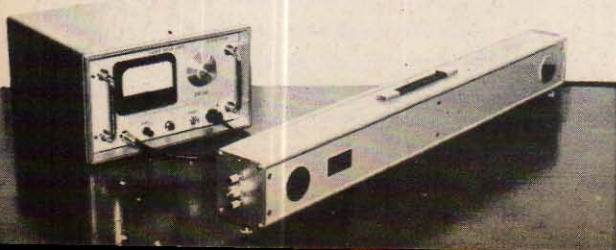
The length of the gas filled tube is normally about 100cm. The power input is often about 100 watts of radio frequency power at about 27Mc/s. Some lasers are powered by a d.c. supply, but heated cathodes must then be employed.

The amplification obtained each time the light passes through the gas filled tube is only a few per cent, therefore it is essential that little light is lost at the mirrors.

Specially designed mirrors with suitable dielectric coatings are required; they reflect about 99 per cent of the light incident upon them. The mirrors are often placed outside the gas discharge tube so that they can be aligned more easily (Fig. 4).

In this case the ends of the tube must be fitted with windows cut to the "Brewster" angle so that reflection losses are minimised. The Brewster angle is the angle whose tangent is equal to the refractive index of the material concerned—in this case the glass at each end of the tube.

Portable d.c. gas laser and drive unit developed by Scientifica & Cook Ltd.



Only light polarised in one particular plane can pass easily through the Brewster windows and hence it is only in this plane that the light is adequately amplified for laser action to occur.

The output from a helium-neon gas laser, operating in the visible region of the spectrum, appears as a bright red circle if it is allowed to fall onto a sheet of white paper. The output is typically some tens of milliwatts and this is not enough to burn the skin. However, great care should be taken to ensure that the light does not enter any person's eye, even after being reflected from a metallic object (see Part 2 next month).

It has been suggested¹ that the gas laser will be commonly used by the amateur experimenter and the transmitting "ham". The writer does not share this view.

Lasers can be used to carry information only between places which are in a direct line of sight of one another and in fog or mist cannot be employed. However, it might be possible for professional communication links using lasers linked by pipes to be established to prevent interference from fog, but amateurs will not be able to employ such methods.

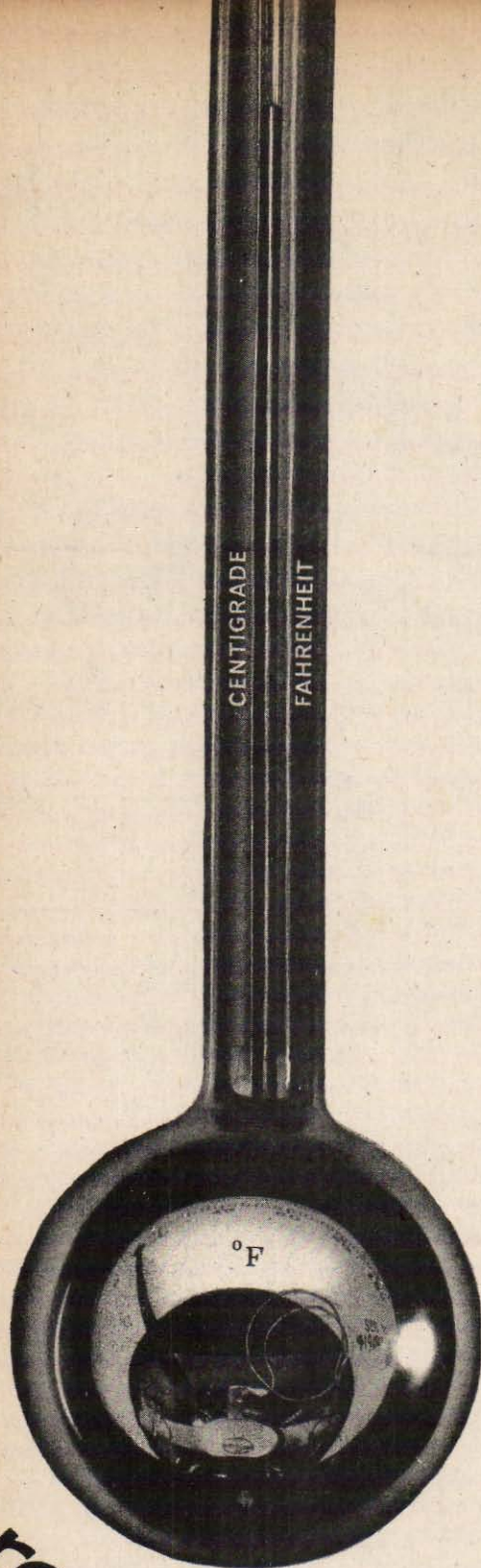
Although the gas laser is probably the easiest type of laser for the amateur to construct,² it is nevertheless a very difficult task to make one. The gas filling is fairly critical and suitable high vacuum apparatus and gas handling equipment is essential. Filled laser tubes which have been tested can be purchased, but are not cheap by the standards of the amateur enthusiast.

Similarly the mirrors are also expensive. The total cost is not likely to be less than about £120 and in addition a unit to supply the radio frequency or other power will be required. The construction of a laser by the amateur is therefore a project which requires a considerable amount of thought before it is begun.

Next month we will have a look at ruby lasers, semiconductor lasers, and the safeguards necessary when working with lasers generally.

References

1. Leinwoll, S. Lasers. *CQ*, Vol. 20, No. 9, September 1964, page 32.
2. Strong, C. L. How a Persevering Amateur can build a Gas Laser at Home. *Scientific American*, Vol. 211, No. 3, September 1964, page 227.



KEEPING control on the temperature of a greenhouse, hot water tank, loft, or any environment where drastic temperature changes can lead to damage, is sometimes done with a thermostat. But where this is either inconvenient or non-existent, some means of monitoring environmental temperature may be necessary.

The obvious solution, on first thoughts, is the conventional thermometer, but how often does one wish to climb up into a loft, or go out in cold weather to a greenhouse, just to see if heat is being maintained?

Perhaps then some method of monitoring in a remote position is desirable. One cannot haul in a thermometer by a rope and pulley system, so the best thing is some electronic device capable of indicating temperature at almost any reasonable distance from the measuring locality.

A pair of wires are required from the place of measurement to a central point. The wires are connected to a thermistor (negative temperature coefficient resistor) whose resistance varies with temperature. This variation alters the mark/space ratio of a pulse generator; the mean voltage level output is displayed on a meter.

The main circuitry utilises a multivibrator and a monostable trigger in such a way that the current consumption is kept low, so that a battery can be used for powering the device.

FREE RUNNING

Transistors TR1 and TR2 form a free running multivibrator at a frequency of 50c/s. The cycle time of the multivibrator is determined from the formula $t = 0.7(C_1 + C_2)(R_1 + R_2)$. See Fig. 1.

The waveform at the collector of TR2 is shown in Fig. 2a, this is fed via C3 to the base of TR3. The negative going square wave is differentiated by C3 and the input impedance at TR3 base.

As shown on the waveform the negative going wavefront is slow but the positive going wavefront is fast, therefore only the positive going wavefront will appear at TR3 base. This will switch TR3 off and by coupling from TR3 collector to TR4 base via R8 and using a common emitter resistor R9, TR4 will switch on.

TR3 will remain in the off condition and TR4 in the on condition until C4 charges towards the supply voltage via X1, VR1, and R6. TR3 then switches on and in turn switches TR4 off.

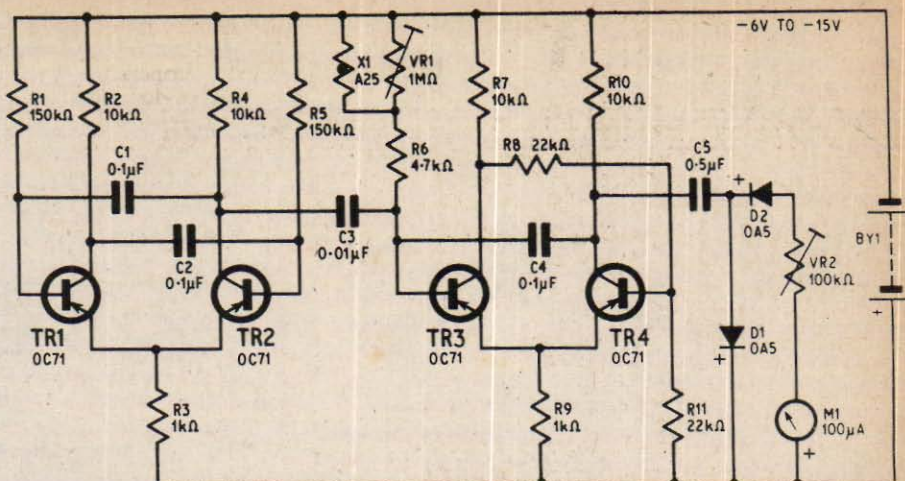
The time that TR3 is held in the off condition is determined from the formula $t = 0.7C_4R_x$, where R_x in this instance is the combined resistance of X1, VR1, and R6.

The nominal resistance of this thermistor (type A25) at 20°C is 200 kilohms. The "A" describes the type; the "2" is the first significant digit and "5" indicates the number of noughts following this digit. The thermistor is shunted by a 1 megohm potentiometer, thus enabling the temperature range required to be preset.

The output from TR4 collector is as shown in Fig. 2. This is fed via a capacitor C5 and d.c. restoring network D1 and D2, to a 100μA meter. The circuit has been

remote temperature

Fig. 1. Circuit diagram of the temperature monitoring instrument using a 100 μ A meter. An on/off switch may be inserted in series with the battery negative lead



designed to work with battery voltages between 6 and 15 volts and the consumption is only 3mA, thus giving a very long battery life as the circuit is only switched on when a reading is to be taken.

The self-heating of the thermistor due to the current flowing through it is negligible and settles down almost immediately.

Fig. 3 shows a typical resistance versus temperature curve for a thermistor and where more than one thermistor is being used it is necessary to match them as far as possible. As they are relatively cheap it may be possible to purchase more than this application requires and select one or more from them.

The transistors used in this circuit have no special requirements, the frequency of operation has been chosen low so that almost any type can be used to switch at this speed. Tests can be carried out with earphones at a frequency easily recognisable (50c/s). Transistors with a current gain in the range 30 to 150 will work suitably; these may be *pn*p or *np*n with the battery correctly connected.

If a 1mA meter is available and a larger battery drain can be tolerated, then the modification in Fig. 4 may be used. The circuit is basically the same; only component values have been altered.

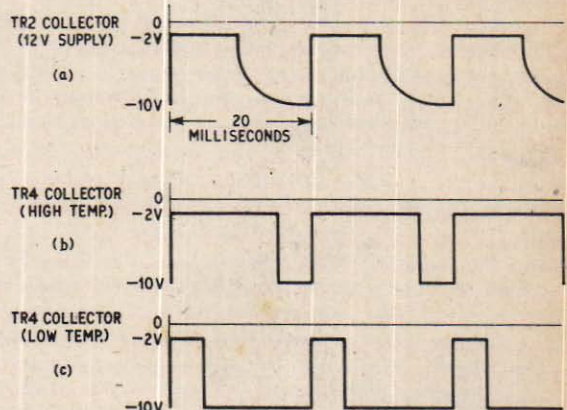


Fig. 2. Waveforms of the master pulse signal

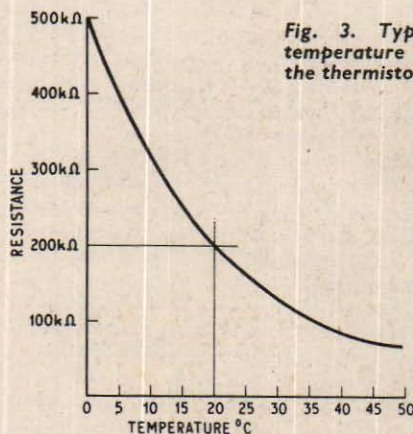


Fig. 3. Typical resistance temperature characteristic of the thermistor

CONSTRUCTION

Veroboard is a convenient method of mounting the components and a layout is shown in Fig. 5a with the underside view shown in Fig. 5b. Alternative methods may be preferred.

The thermistors are encapsulated in small glass tubes and should be suitably protected without interfering with the normal working conditions. If they are in a severe environment the leads should be protected to prevent corrosion. If they are immersed in water they should be contained in a sealed tube so that the water does not shunt the leads.

measurement By A.Thomas

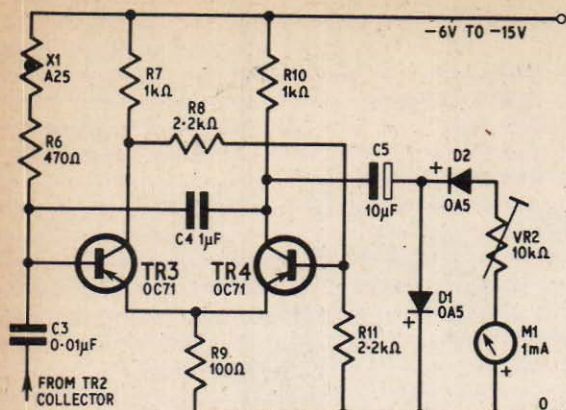


Fig. 4. Alternative circuit values of components for use with a 1mA meter

If more than one thermistor is used a rotary selector switch must be incorporated. The wiper would be connected to the negative supply line and each "way" tag connected to each of the thermistors used (Fig. 6).

The unit may be constructed in any small wooden or metal box, just big enough to house the component board, meter, and thermistor-selector switch if required. The front panel is shown in Fig. 8 with this selector switch mounted on it.

SETTING UP

Fig. 7 shows a bootstrap emitter-follower circuit which will enable a pair of headphones to be connected to any of the four collectors to determine if the stages

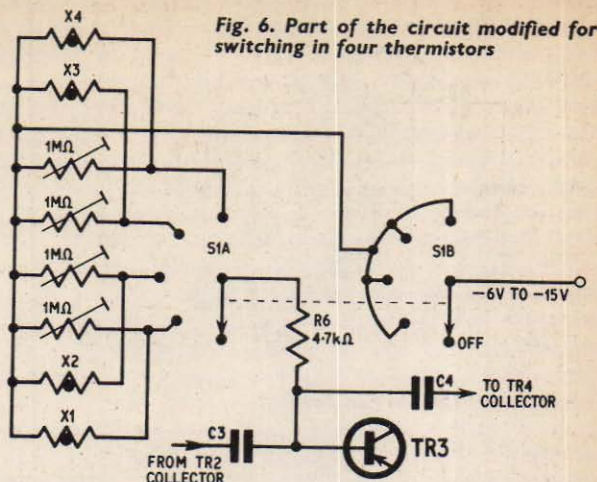


Fig. 6. Part of the circuit modified for switching in four thermistors

are working. The emitter follower has the property of having a very high input impedance and a low output impedance; this is necessary so that the headphones do not load the circuit being tested.

A thermometer, a refrigerator, and/or a source of heat is required to calibrate the meter and thermistors depending on the ranges required. For general purposes a temperature range of 20-80°F may easily be accommodated. If selected thermistors are used, then the meter scale will be the same for each. The potentiometer VR1 provides adjustment of the temperature linearity and range, and may be replaced by a

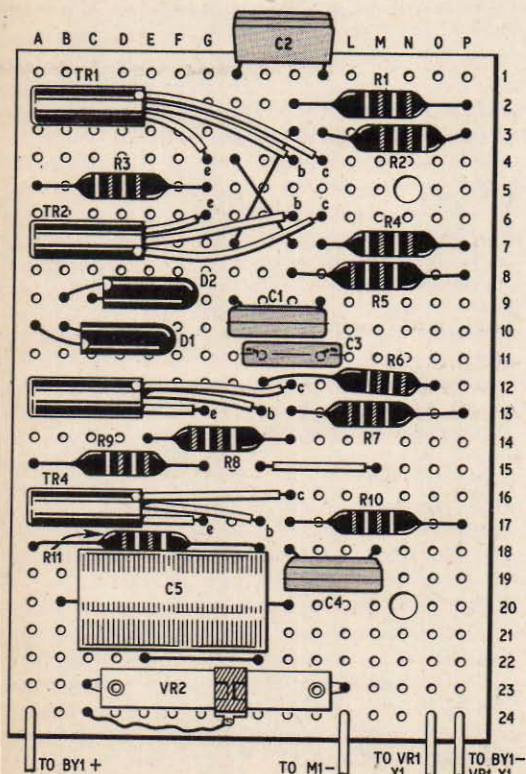


Fig. 5a. Component layout on the perforated wiring board

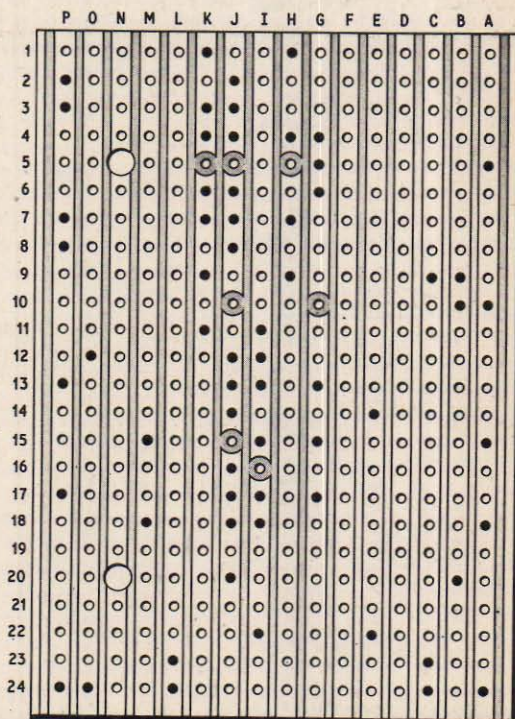


Fig. 5b. Underside of the board showing the breaks in the copper strips and connection points

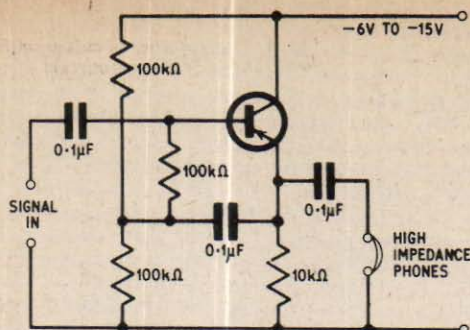


Fig. 7 (above). Suggested circuit for checking the functioning of each stage

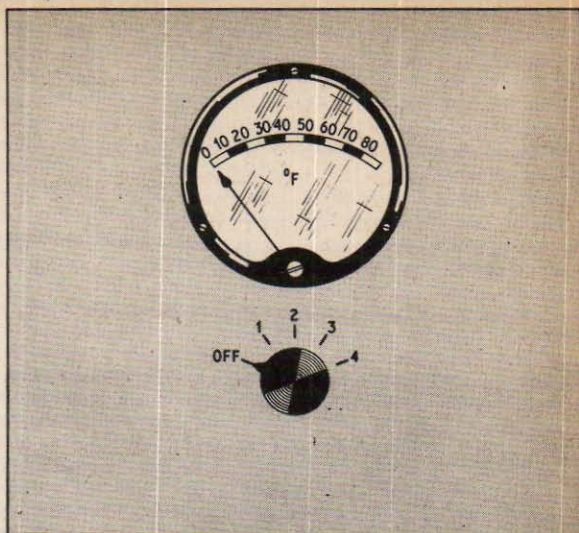
Fig. 8 (right). Front panel layout

fixed resistor of the same value when known.

It is recommended that calibration of the thermistors is carried out all at the same time, the length of lead connecting the thermistors to the unit will not affect the calibration.

For calibration, the thermistors are supported in free space inside a refrigerator in close proximity to a suitable thermometer. Adjust the refrigerator control for a temperature in the middle of the range required (e.g., 50°F). On the range required VR1 is set to approximately 500 kilohms and VR2 is adjusted such that the meter reads half scale.

The refrigerator is then reduced in temperature to the lowest temperature reading required and, if this is on a suitable part of the meter scale, this may be marked.



The thermistors and thermometer are then placed in cold tap water, this is then slowly heated until the highest temperature reading required is reached. This point may then be marked on the meter scale. The intermediate points can be marked as necessary.

It can be pointed out at this stage that a thermistor is not the only device that may be used to control this circuit. One can use a photo-sensitive cell, which changes resistance depending how much light falls on it, to give an indication of light intensity. ★

The greenhouse photograph on the cover is reproduced by permission of T. Bath & Co. Ltd.

COMPONENTS . . .

Resistors

- R1 150kΩ
- R2 10kΩ
- R3 1kΩ
- R4 10kΩ
- R5 150kΩ
- *R6 4.7kΩ
- *R7 10kΩ
- *R8 22kΩ
- *R9 1kΩ
- *R10 10kΩ
- *R11 22kΩ

All 5% 1/4 watt carbon high stability

Potentiometers

- VR1 1MΩ linear carbon preset (see text)
- *VR2 100kΩ linear carbon preset

Capacitors

- C1 0.1μF polyester 125V
 - C2 0.1μF polyester 125V
 - C3 0.01μF polyester 125V
 - *C4 0.1μF polyester 125V
 - *C5 0.47μF or 0.5μF polyester 125V
- (Lower voltage ratings can be used but should not be less than 15 volts)

Thermistor(s)

- X1 200kΩ at 20°C (S.T.C. type A25) (see text)

Transistors

- TR1 to TR4 OC71 (Mullard) (4 off)

Diodes

- D1 and D2 OA5 (Mullard) (2 off)

Meter

- *M1 100μA moving coil

Battery

- BY1 6 to 15 volts

Miscellaneous

- Veroboard 3.75in × 2.5 in, 0.15in hole matrix
- P.V.C. wire and box housing
- Rotary switch, optional (see text)

*Modifications for 1mA meter circuit

Resistors

- R6 470Ω
- R7 1kΩ
- R8 2.2kΩ
- R9 100Ω
- R10 1kΩ
- R11 2.2kΩ

Potentiometer

- VR2 10kΩ linear carbon preset

Capacitors

- C4 1μF polyester 125V
- C5 10μF elect. 16V

Meter

- M1 1mA moving coil

MANY keen record collectors, non-technical amateurs as well as more knowledgeable enthusiasts, would gladly settle for a stereo system which, while clearly superior to the run-of-the-mill player, does not boast true hi fi facilities or performance. Compactness, relative simplicity and low cost are usually the main aims.

Unfortunately it is with this category of product that choice is so limited; to the few British made outfits there have only recently been added some isolated examples from foreign sources. They do, however, illustrate the trend in this field, particularly the use of transistors to produce very compact systems which are easy to instal, use and service.

STEREO SYSTEMS

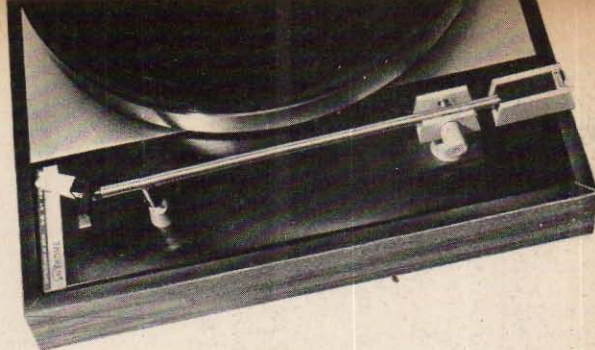
Stereo systems by Arena and Veritone are typical. The Arena GF1225, imported by Highgate Acoustics of London, exemplifies the Scandinavian approach with its teak finish and clean styling. The lid of this neat player, as well as the base, is of wood and the overall height is only about 6in. Priced at 65 guineas, this unit incorporates the Garrard SP25 turntable and a 16-transistor amplifier with 6 watts output per channel.

A real innovation in this class of player is the use of a magnetic cartridge—the Pickering V-15. Many small but specialised players would benefit from a pick-up of this quality, but it must be remembered that a magnetic (when compared with a ceramic) gives a low output and that consequently extra pre-amplification has to be built in. Speakers for the GF1225 are priced separately; the user can devise his own or choose from the Arena range.

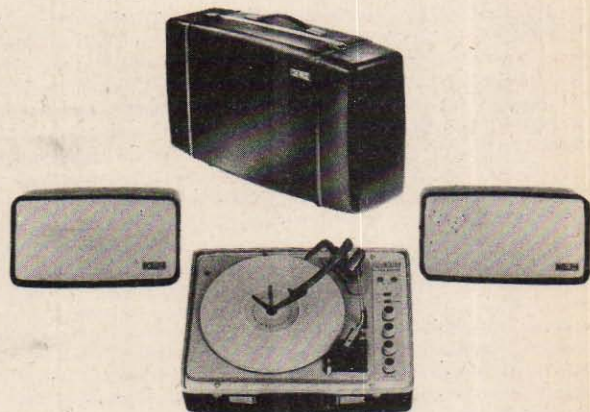
The “Gemini” system by Veritone is basically similar but incorporates a record changer and is supplied with bookshelf speakers finished in rosewood. Each employs a 5in bass unit with high compliance cone plus matching tweeter. The transistor amplifier, rated at 5 watts output per channel, has the usual control complement and 200mV outlets for tape recording.

FROM THE U.S.A.

Three-piece music systems by KLH of America have been introduced here by agents P.J.N. Collaro Electronics. One of these, Model Eleven, packs away



“Miniconic” semiconductor pick-up



KLH Model Eleven stereo system

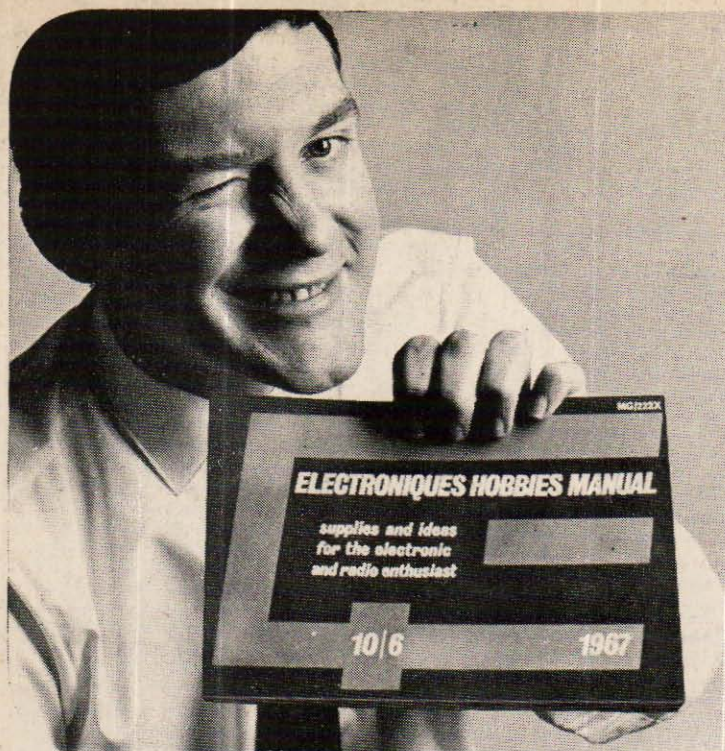
in suitcase form and weighs 28 pounds. It incorporates a Garrard auto changer, Pickering cartridge and a solid state amplifier rated, American style, at 7½ watts “music power” each channel. The speakers each house a single wide range drive unit of special type and the price of the complete system is £91 5s.

Other outfits from this firm are the Model Fifteen, priced at £99 19s including bookshelf speakers, and the more costly Model Twenty which, while still in compact, shelf-mounting form, includes a stereo f.m. radio tuner and connections for tape equipment and headphones. The multi-unit speakers included with this system are also available separately at £29 16s 9d.

A new version of the novel Larsen & Høedholt “Signalmaster” f.m. tuner arrived recently from Denmark via Britimpex Ltd. This small, portable and battery powered tuner (for mono only) can be used in a hi fi outfit, but is also invaluable for tape recording purposes or for connecting to the gram input of a radio set to upgrade performance. Headphones can be used with this system. The Mk2 version differs from the original “Signalmaster” in having automatic frequency control and inputs for either coaxial feeder or a telescopic aerial. Price is £21 16s 5d.

The Miniconic semiconductor pick-up, mentioned in the September *Audio Trends*, is now illustrated. This interesting device, different in principle from other pick-ups in general use, does not generate a voltage but instead produces a signal by modulating the supply from an external power source. The heads are examples of miniaturisation, featuring tiny moving mass, high compliance and wide response. Arm type TA-15 is shown in the picture.





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

NAME

ADDRESS

P.E. 1

Available now!

The enthusiasts' greatest-ever components guide!

Over 600 pages packed full of tips, kits and details of over 11,350 different parts from 85 leading manufacturers!

Whatever your particular interest in electronics, you'll find the Electronics Hobbies Manual a first-class investment.

It saves you time. No searching around for the parts you need. Every type of equipment—from stock components to sophisticated professional items—is here. Supplied by over 85 leading manufacturers, this equipment is *all* available by mail order on fast despatch.

It aids your projects. Complete designs, and details of kits available for beginners and experts, are all contained in the Manual. Inside, too, there's a wealth of technical data, practical tips and formulae to help you build with confidence.

It costs just 10/6 post free. And it puts the whole electronic industry at your service, including the specialised knowledge of Electronics. Behind this brilli-

ant new venture are the vast resources of STC and ITT, so you're assured of a first-class service!

Be sure of your Electronics Hobbies Manual. Clip the coupon, and send today—while stocks last!

Electronics (Prop. STC Ltd.)
Edinburgh Way, Harlow, Essex.
Telephone: Harlow 26777.

High-grade components for amateur communications

e
electronics

THE AMPLIFIER FOR CERAMIC PICKUPS



222 STEREO AMPLIFIER

There are a number of ceramic pickups capable of giving excellent results with a good amplifier. Our 222 was expressly designed for these pickups. It has all the other facilities you look for in a high fidelity amplifier and a choice of matching FM and AM-FM tuners.

222 STEREO AMPLIFIER	£28-15-0
223 AM-FM TUNER	£31- 9-0
224 FM TUNER	£25- 2-3
OPTIONAL CASE, teak and vinyl hide as illustrated. All models	£3-10-0
M5 STEREO RADIO DECODER	£14-10-0

For full details and technical specifications of all models, plus list of stockists, post coupon or write mentioning 1PE/67.

ARMSTRONG AUDIO LIMITED
WARTLERS ROAD, LONDON, N.7
Telephone: NORTH 3213



Armstrong

name
address
1PE/67

THE MOTORIST'S REV COUNTER FULLY TRANSISTORISED



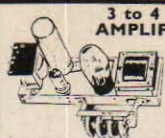
Suits 4 or 6 cyl. engines. Would cost at least £8 to buy. Kit contains moving coil movement and all parts including transistors, a circuit diagram and full instructions. Maximum reading 8,000 r.p.m. Send P.O. for 22/-, which includes 2/6 postage.

CYLDON U.H.F. TUNER

complete with PC.88 and PC.86 Valves. Full variable tuning. New and unused. Size $4\frac{1}{2} \times 5\frac{1}{2} \times 1\frac{1}{2}$ ". Complete with circuit diagram. 35/- plus 3/6 P. & P.



3 to 4 WATT AMPLIFIER KIT



comprising chassis $8\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$ ". Double wound mains transformer, output transformer, volume and tone controls, resistors, condensers, etc. 6V6, ECC81 and metal rectifier. Circuit 1/6 free with kit. 29/6 plus 5/6 P. & P. The above Amplifier built and tested 10/6 extra.

MULTIPLEX DECODER

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 0.5 - 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 $5\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{1}{2}$ ". Fully built and tested, price £4.4.0 plus 3/- P. & P. charges.

"MUSETTE" 6-TRANSISTOR SUPERHET PORTABLE RADIO

- ★ $2\frac{1}{2}$ " Speaker.
- ★ 6 Transistors Superhet Output 200 mw.
- ★ Plastic Cabinet in red, size $4\frac{1}{2} \times 3 \times 1\frac{1}{2}$ " and gold speaker louvre.
- ★ Horizontal Tuning Scale.
- ★ Ferrite Rod Internal Aerial.
- ★ IF 460 Kc/s.
- ★ All components Ferrite Rod and Tuning Assembly mount on printed board.
- ★ Operated from PP3 Battery.
- ★ Fully comprehensive instructions and point-to-point wiring diagram.



39/6

Inc. carrying strap. Circuit Diagram 2/6—

P. & P. 3/6 free with parts

- ★ Printed Circuit Board.
- ★ Tunable over medium and long waveband.
- ★ Car aerial and earpiece socket.

TRANSISTORISED SIGNAL GENERATOR

Size $5\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{1}{2}$ ". 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.

ELEGANT SEVEN Mk. II

SPECIAL OFFER. 7" x 4" P.M. Speaker at 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 $12\frac{1}{2} \times 8\frac{1}{2} \times 3\frac{1}{2}$ ".
- ★ Horizontal easy to read tuning scale printed grey with black letters, size $11\frac{1}{2} \times 2$ ".
- ★ 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

Shop Hours 9 a.m. — 6 p.m. Early Closing Wednesday
All enquiries stamped addressed envelope

RADIO & T.V. COMPONENTS (ACTON) LTD.
21D, HIGH STREET, ACTON, LONDON, W.3

TAPE RECORDER AUTO - SWITCH

by P.RUSH, B.A. (Cantab)

OFTEN the occasion arises when one wishes to hear a performance of a particular piece of music, or some other programme, broadcast when one is away from home.

Ideally, a request for another member of the family to record the programme is probably the best solution, but this is not always possible. An alternative method is described here whereby the tape recorder can be set to switch on at a pre-determined time and undertake the job automatically.

The circuit involved is not elaborate; although originally designed for a mains operated recorder, it is a simple task to adapt the technique to battery models.

Before contemplating the recording of any broadcast or recorded matter the reader should acquaint himself with the laws of copyright which are outlined at the end of this article.

CONTROLLED RELAY

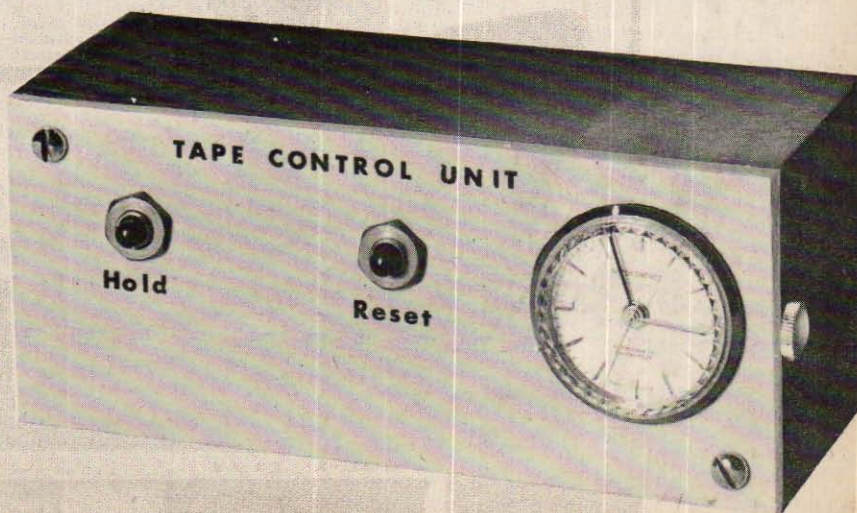
The auto-switch circuit incorporates a means of switching on the tape recorder at the desired time and switching it off again at the end of the spool of tape. The two facilities can also be used independently. This device therefore gives even the most inexpensive of machines some of the features sometimes found on expensive recorders.

The switching of the tape recorder is done by means of a relay with heavy duty contacts mounted in the recorder itself. This relay is triggered into operation by the separate control unit, although if desired this, too, can be housed in the recorder. This arrangement means that the connecting cable will have to carry only low voltages.

A bistable circuit, designed to give a high on/off voltage ratio across the relay coil, forms the driving circuit. This is switched in one direction by a "hold" press button and a stop-foil at the end of the tape shorting an insulated bollard to earth. These two conditions switch the relay to the "on" position.

It is switched off by

- (a) A "reset" press button;
- (b) A watch movement closing a pair of contacts;



WIRING AND PRINTED CIRCUIT BOARD DETAILS

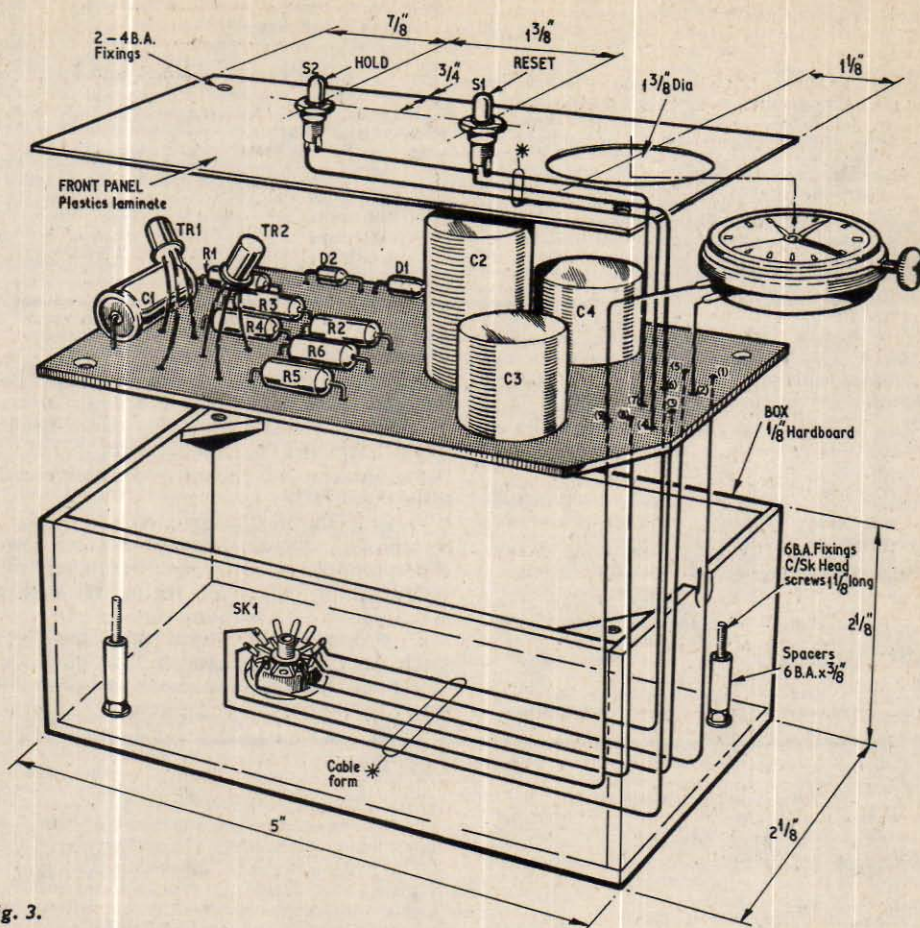


Fig. 3.

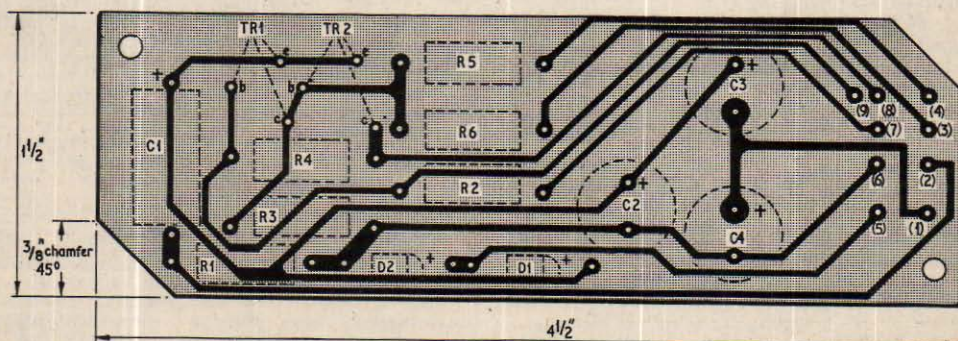


Fig. 4.

COMPONENTS . . .

Resistors

R1 56k Ω	*R4 18k Ω
R2 33k Ω	R5 2.2k Ω
*R3 560 Ω	R6 1.5k Ω
All 10% $\frac{1}{4}$ watt carbon.	
*See text.	

Capacitors

C1 8 μ F elect. 15V
C2 200 μ F elect. 18V (or 2 $\times$ 100 μ F in parallel)
C3 160 μ F elect. 25V
C4 160 μ F elect. 25V

Transistors and Diodes

TR1 and TR2 2G381 or OC81 (2 off)
D1 and D2 DD000 (Lucas) or OA200 (Mullard) (2 off)

Relay

12V 150 Ω (Omron type MK3) (see text) (Key-switch Relays Ltd., 120-132 Cricklewood Lane, London N.W.2)

Switches

S1 and S2 Single-pole press on, release off push button switches (2 off)
S3 Single-pole, on/off switch mounted in tape recorder

Plug and Socket

PL1 and SK1 Multi-way (minimum 6 ways) e.g. B9A or B7G valveholder and plug

Miscellaneous

Printed circuit board $4\frac{1}{2}$ in $\times$ $1\frac{1}{2}$ in with etching chemicals. Watch movement with contacts (see text). Hardboard for box.

mounted near the heads. This should be insulated from the deck by a mica washer; the existing metal fixing screw should be replaced by a nylon screw of the same size. The bollard is now connected to a fine p.v.c. covered wire which is led through a small hole in the deck plate. This wire is connected to R6 in the control unit.

At the end of the tape about 6in of "stop" foil should be inserted. This will short-circuit the insulated bollard to chassis via another tape guide electrically connected to chassis by its metal fixing screw.

LAYOUT AND WIRING

Construction is very simple, the control circuit being made up on a printed circuit board and mounted

in a small box with the push-button switches, watch and outlet socket.

Most of the layout and wiring details are shown in Fig. 3. The watch winder spindle is fitted in a slot at one end of the box, the watch itself being fitted in an aperture on the control panel. For a firm mounting it may be glued to this panel with an impact adhesive.

Fig. 4 shows the pattern of the printed circuit board with dotted shapes indicating the positions of the components. It is possible to redesign the layout to suit other kinds of wiring systems such as perforated board or Veroboard.

If printed circuit techniques are used, a special pack for the constructor can be obtained from some of our advertisers. The instructions included with the pack should be followed carefully.



COPYRIGHT

Under the Copyright Act of 1956 and the Performers' Protection Acts 1958 and 1963 the following permissions have to be obtained before a record or film is made of any BBC programme:

(a) Rights of the BBC

The permission of the BBC is not needed where a record or film is made for private purposes, but prior permission must be obtained from the BBC in the following cases:

- Making a record of a sound broadcast or of the sound part of television broadcast, otherwise than for private purposes.
- Making a film of any sequence of images in a television broadcast sufficient to be seen as a moving picture, otherwise than for private purposes.
- Showing a television broadcast in public to a paying audience.

(b) Copyright Musical and Literary Material

The permission of the owners of the copyright in musical and literary materials used in BBC sound or television broadcasts must be obtained under the Copyright Act, 1956, before such material is recorded or filmed (unless the recording can be described as fair dealing for the purposes of research or private study) or before it is performed in public (whether the audience pays or not).

(c) Gramophone Records

Gramophone records are covered by a separate copyright protection under the Copyright Act, 1956, and any unauthorised re-recording of gramophone records either directly or from a broadcast (including re-recording on to tape whether for private purposes or otherwise) is an infringement of the copyright in the gramophone records which is normally controlled by the issuing record company.

(d) Performers' Rights

Under the Performers' Protection Acts 1958 and 1963 the permission of any performers taking part in a broadcast must be obtained for the recording or filming of their performances unless the record or film is to be used only for the private and domestic purposes of the person making it.

(e) BBC Schools Broadcasts

As a result of special arrangements made by the BBC with copyright owners and artists' unions, records of BBC Schools Broadcasts in its sound services only (but not other broadcasts) may be made by Schools without obtaining the above permissions provided that the records are used only for instructional purposes in class and that they are destroyed at the end of the school year (or, in the case of radiovision programmes only, at the end of the third school year).

Reproduced by courtesy of Radio Times

THE ELECTRONIC ORGAN

PART TWO

MUSICAL SOUND PATTERNS

Our opening article reviewed the historical background of the electronic organ; subsequent articles will survey the problems in a general sense, culminating in a considered design study for a romantic type instrument suitable for the small home. This organ will be featured as a constructional project shortly following the conclusion of the present series.

While these articles are essential reading for those who intend in due course to build the PRACTICAL ELECTRONICS Organ, it must be emphasised that they have been written so as to provide an introduction to the specialised techniques employed in this fascinating branch of the electronic art and are not limited solely to a discussion of one particular design.

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

ARTICLES about electronic organs all seem to be so anxious to get down to the circuit design that they often quite overlook the fact that we are attempting to produce a sound pattern having characteristics which can be described and identified in conventional musical terms.

But this is just where the experimenter may feel some uncertainty. Is it necessary, or even desirable, to have a 2ft piccolo or fifteenth, and what do these expressions mean? Apart from this, can we really produce the proper sound that would be heard from pipes bearing these names? So I feel that it is only right and proper that we should forget circuitry for a little and find out what we want.

DIFFICULTIES OF SIMULATION

There are several things to remember first of all. (1) If the reader wishes to make something that sounds like a church or concert organ, he will not be able to simulate the wind noise which is very prominent in this kind of organ. (2) All pipes have differing rates of speech, that is, for any stop the higher pitched pipes may sound instantly, the lower ones have some time delay. It is extremely difficult to imitate this electrically. (3) Only very small flute-like pipes and reeds of all kinds immediately sound the complete waveform; in all other cases some harmonic sounds first, and the spectrum is gradually built up, see Fig. 2.1. We cannot imitate this. Lastly, we must remember that every single pipe in an organ is its own complete harmonic generator, so that the fundamental adds to these harmonics and the builder can so proportion his pipes that any required harmonic structure can be formed. This is virtually impossible for us, since we can only generate a limited number of similar waveforms, from which by means of circuitry we can derive the sounds we want.

However, by *completely enclosing* all the pipes in soundproof boxes having adjustable louvred openings, some of the foregoing effects are reduced and this is the basis of the theatre organ. Organs have been built in which the best of both worlds have been combined, and this is what we will do when considering the design of a "popular" type of instrument; for the demands of the purist call for elaborate circuitry, whereas the romanticist is much more easily satisfied.

STANDARD ORGAN KEYBOARD

Now organs usually have more than one keyboard, which is called a manual. This is so that contrasting effects can be used together, a simple example being a melody with accompaniment. These manuals contain from 37 to 61 notes each, and the range of the notes is called the compass. There are 12 notes to each octave, but if we start on C then we end on B, so an extra note is always put in to make the compass C to C. The standard organ keyboard is 5 octaves, 61 notes.

PITCH OR FREQUENCY STANDARD

Some standard must be established for pitch, which is a subjective interpretation of frequency, and this applies in two ways: first, a standard for *tuning*.

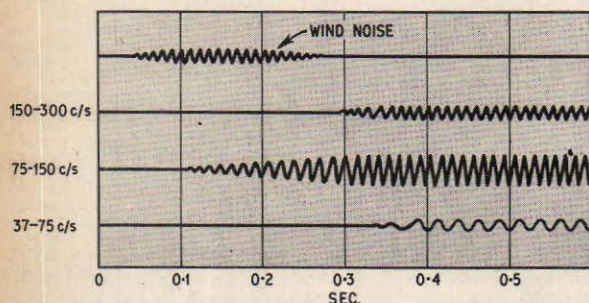


Fig. 2.1. This diagram shows how the sound builds up in a large organ pipe

From Trendelburg, F.; Thienhaus, E.; Franz, E. *Akust. Z.* 1936, No. 50

Today this is always based on $A=440\text{c/s}$ which is the third "A" up from the bottom of the keyboard, and you may ask why. This brings us to the second standard of pitch—that of the *basic* or *unison* pitch. For centuries this has been called 8ft pitch, because that is the speaking length of the longest open pipe which will sound bottom C on any manual, approximately 64c/s . Thus, by simple arithmetic, the octave above that would sound 4ft and the octave below, 16ft. So that if we had three pipes, one 8ft long, one 4ft and one 16ft, and sounded them all together, then provided they were all tuned to C we would hear three octaves from the one note. This variety in pitch is the very essence of organ design.

Note that these pitches do not imply any particular tonal quality; they may, and do, exist for all tonalities.

In a small organ, especially with amplifiers driving free cone loudspeakers in conventional enclosures, there is usually a tendency to emphasise the lower frequencies at the expense of the upper ones. To offset this to some extent, we introduce yet another pitch, $2\frac{3}{4}\text{ft}$. This is the G above C 4ft, and produces sum and difference tones which, used with discretion, are of great value in a relatively simple organ. So, on the manuals we find 16, 8, 4, $2\frac{3}{4}$ and possibly 2ft pitches, any or all of which can be sounded singly or in combination.

Normally the pedal clavier is used to provide the bass, and in small organs, always so. By popular usage, this keyboard plays one octave lower than the manuals, and it is the practice to confine it to 16ft pitch. But this is not a good thing, and we can vary this somewhat by introducing 8ft and even 4ft pitches by other means.

The other essential ingredient of the small organ is vibrato or tremulant. In a pipe organ, the mechanism used varies both the frequency and amplitude of the note. Vibrato adds character to "soulless" voices like the flute or tibia, and is really essential for romantic and popular music.

TONE COLOUR GROUPS

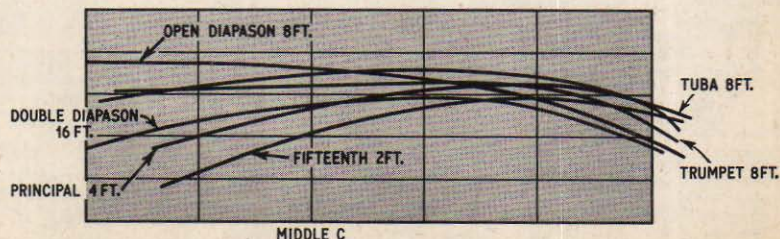
Of course, there are a vast number of other design features of the organ proper which could be explained, but they serve no useful purpose so far as readers of this journal are concerned. However, it seems reasonable to explain that the families of tone colour which we shall need can be divided into three—flute, string and reed. Within each category there are hundreds of possible variations in character, but we can note that the flute (essentially a small, smooth voice) can be expanded to form a tibia (which is the basis of the theatre organ) and further, to form a diapason (which is the basis of the church organ).

Strings are not susceptible to much variation except in pitch, but reeds can indeed be produced in many contrasts; oboe, clarinet, French horn, trumpet, clarion, etc. So that, bearing in mind the fact that any of these sounds can be produced in any of the pitches mentioned (except for reeds in the $2\frac{3}{4}$ and 2ft range, where their upper harmonics would be beyond audibility), we shall not be so badly off for tone colours.

However, there must be a pattern on which to build possible combinations of "stops"; it would not do to play everything at 16ft pitch, nor would a solo at $2\frac{3}{4}\text{ft}$ accompanied at 16ft be very well received. We will attempt to explain how this is arrived at in due course, but if we look at the sound pattern of an ideal organ having the voices previously mentioned, and bearing in mind that loud sounds always mask quieter ones, then

Fig. 2.2. Relative loudness of well-voiced organ

From Thienhaus-Willms, *Die Lautstärke von Orgelregistern*, Vol. 3, p. 284



INCREASE YOUR KNOWLEDGE



CHOOSE THE RIGHT COURSE FROM

RADIO AND TELEVISION ENGINEERING,
INDUSTRIAL TELEVISION, RADIO AND
TELEVISION SERVICING, ELECTRONICS,
COMPUTERS AND PROGRAMMING,
ELECTRONIC TECHNICIANS, SERVOMECH-
ANISMS, TELEMETRY, 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 Multimeter. At the end of the course you have invaluable practical equipment and a fund of personal knowledge and skill. ICS Practical Radio Courses open a new world to the keen amateur.

**YOUR
CAREER
IN**

ELECTRONIC ENGINEERING
RADIO AND TELEVISION
ENGINEERING
ELECTRICAL ENGINEERING

INTERNATIONAL CORRESPONDENCE SCHOOLS - LONDON

RADIO TELEVISION ELECTRONIC ENGINEERING

MEMBER OF THE ASSOCIATION
OF BRITISH CORRESPONDENCE COLLEGES

THERE IS AN **ICS** COURSE FOR YOU

Whether you need a basic grounding, tuition to complete your technical qualifications, or further specialised 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.....

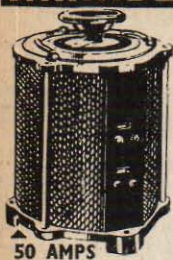
AGE.....

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. 150, INTERTEXT HOUSE, PARKGATE ROAD, London, SW11

1/67

VARIABLE VOLTAGE TRANSFORMERS



50 AMPS

1/2 AMP

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 1/2 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
voltage meter, lamp, switch, etc. £8.10.0
P. & C. 10/- Similar to above 2.5
amp. £9.17.6. P. & C. 10/-.

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 3 1/2 in., dia. 1/2 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.; 250 ohm, .2 a.; 1,000 ohm, .15 a.; 1,500 ohm,
125 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 test-
ing. 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 Volt-
meter, Neon Indicator, Fully Fused.
Strong attractive metal case 15" x 8 1/2"
x 6". Weight 24lbs. Infinitely Vari-
able, 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



L.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 9/6
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 9/6
7	24 v. at 10 amps.	£3.15.0 7/6

LIGHT SENSITIVE SWITCH

Kit of parts, including ORP12 Cad-
mium Sulphide Photocell, Relay,
Transistor and Circuit, etc., price
25/- plus 2/6 P. & P. ORP 12 in-
cluding 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
focusible lens assembly and ventilated lamp
housing, to take MBC bulb. Separate photo
cell mounting assembly for ORP 12 or simi-
lar 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
Bridging Wiper
5 Bank 25 position, 4 non-bridging
Bridging Wiper
6 Bank arranged to give 3 bank, 50 wiper
8 Bank arranged to give 4 bank, 50 wiper
These switches have been carefully
removed from equipment.
All at 35/- each. P. & P. 2/6.

BRAND NEW 4 Bank 25

Way Uniselectors, 3 Bank, 4-
Homing 25 ohm coil, 12-24v.
D.C. operation £4.17.6 plus 2/6 P. & P.

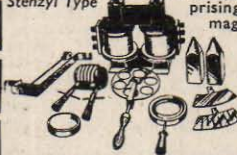
230 VOLT A.C. GEARED MOTORS
5 r.p.m. 1-7 lb. inch £2.9.6. P. & P. 2/6
13 r.p.m. 1-45 lb. inch £2.17.6. P. & P. 2/6
80 r.p.m. 26 lb. inch £2.2.0. P. & P. 2/6

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
£1.9.0



UNIVERSAL DEMONSTRATION TRANSFORMER

Stenzyl Type
A complete composite apparatus, com-
prising a Transformer and electro-
magnet 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. experi-
ments. Complete with all
accessories as shown. £17 +
15/- carriage. Leaflet on
request.



WIMSHURST ELECTROSTATIC GENERATORS

£13/17/6, carr. U.K. (B.R.S.) 10/- Leaflet on request.

YENNER 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.

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/-.

NEW ELECTRONICS CATALOGUE

THE SHOP AT YOUR ELBOW
FULLY COMPREHENSIVE

INCLUDING:

- COMPONENTS
- TEST EQUIPMENT
- VALVES
- TRANSISTORS
- HI-FI EQUIPMENT
- ELECTRONIC APPLIANCES
- RECEIVERS
- AMPLIFIERS
- AND SPECIAL SERVICES

SEND P.O. FOR 1/6 TO:

DEPT. PE/2

dca ELECTRONICS LTD.

28 UXBRIDGE ROAD

EALING, W.5

TRANSISTOR

SPECIFICATION & SUBSTITUTION HANDBOOK

New 1967 Ed. By Tec-Press 23/6

Contains over 5,000 American, Japanese,
British, etc., types, and over 30,000 com-
puter selected substitutes.

Radio Valve Data, new 8th ed., by
Wireless World. 10/6

ABC's of Silicon Controlled Rectifiers,
by Lytel. 17/-

Hi-Fi Year Book, 1967 edition. 18/-

Transistors in Logical Circuits, by Altes.
16/-

Having Fun with Transistors, by
Buckwalter. 22/-

Computer Basics, Introduction to
Analog Computers. 31/6

Questions and Answers on Electronics,
by Clement Brown, also on Transistors, each
book 9/3

Transistor Pocket Book, by Hibberd. 26/6

Servicing Transistor T.V. by Middleton.
31/6

All prices include U.K. postage

Where possible 24-hour service guaranteed

UNIVERSAL BOOK CO.

12 LITTLE NEWPORT ST., LONDON, W.C.2
(Leicester Square Tube Station)

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: GERard 0576

if properly adjusted the spectrum of the organ should look like Fig. 2.2. These curves take no account of any acoustic reinforcement of the sound due to the building, this condition also applying almost certainly to the small organ for domestic use.

WAVEFORM GENERATORS

Now we said—or inferred—that in a pipe organ there was one pipe for every note of every stop. This is very largely true, though certain economies are possible. We cannot hope to do the same thing electrically, but in our ultimate design for an electronic organ we are in fact going to use a frequency dividing

generator having 85 pitch sources which can be used to feed either one or two other manuals. Then there is a separate pedal generator, so that there will be square, sine and sawtooth waveforms separately available, and this will help synthesis since *all* voices are derived by subtractive methods—that is, removing unwanted harmonics from an initially complex waveform.

It is commonly assumed that flutes are almost sinusoidal, but this is by no means true. So to simulate flutes and tibias, one waveform generates f , $2f$, $4f$ and a trace of $8f$. To produce string tones, it does not matter much whether a sawtooth or square wave is used, the main characteristic being a weak fundamental and strong upper harmonics. See Fig. 2.3a. Smooth "reeds" like a French horn call for a sawtooth, because they have many even harmonics as well as odd ones, Fig. 2.3b. A clarinet does in fact contain traces of even harmonics, but is well synthesised from a square wave having only odd harmonics, Fig. 2.3c. And so on. More details will be given when appropriate.

EXPRESSION OR LOUDNESS CONTROL

Variation of loudness in a pipe organ can only be accomplished by adding or subtracting stops, or by manipulating shutters which let more or less sound escape from a soundproof enclosure containing pipes.

The overall variation in loudness thus obtained is quite small, certainly by electrical means we can do much better and of course we can reduce the level far below that at which any pipe would speak (e.g. for headphones). To increase the range of expression on this organ we couple the lower manual and pedal stops to one expression control, the upper manual to another. We thus avoid the accompaniment "hooting" when a solo is increased in volume, a common failing with small organs.

OCTAVE COUPLER

Finally, we do not often find couplers on this kind of organ. A coupler is a device which enables the player to add notes either an octave higher, an octave lower, or from another manual to those which he is playing. For example, if we depress middle C at 8ft pitch, then drawing the octave coupler adds the C above. Any chord played sounds the same notes in the octave above. Clearly this is a way to extend the apparent pitch range of the organ without extra generators. Naturally it cannot operate above the octave below the highest note unless the generators are extended.

In our particular instrument, the generators are extended: there is an octave coupler on the main manual, and a coupler transferring any stops drawn on this manual to the pedals when required. The harmonics thus made available reinforce the simpler tones of the pedal generator.

To sum up, therefore, in this instrument we shall produce pitch ranges of 16, 8, 4, $2\frac{1}{2}$ and 2ft—though not on both keyboards—and these will be reinforced by the couplers above. Expression is applied to each manual independently, and there are two tremulants. The manuals are of full compass, 61 notes, and the pedals of 30 notes compass. This could be reduced to 25 notes if desired. The dimensions and other mechanical details are of full scale and equivalent to pipe organ practice. This makes it far easier to play. There are no loudspeakers in the console, which is the name given to the case enclosing the playing mechanism and, in this instance, all the generators, etc.

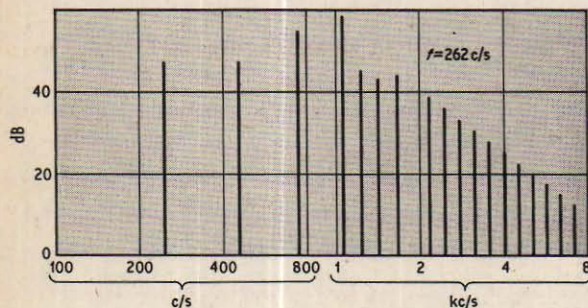


Fig. 2.3a. Harmonic content of a string tone organ pipe

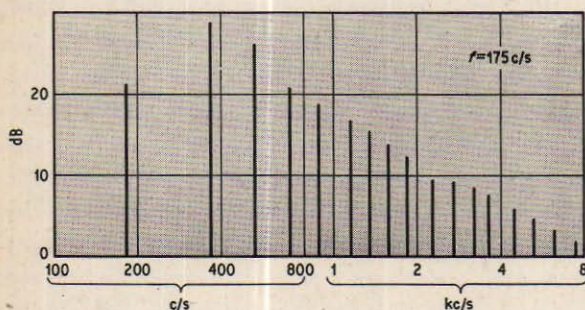


Fig. 2.3b. Spectrum of French horn

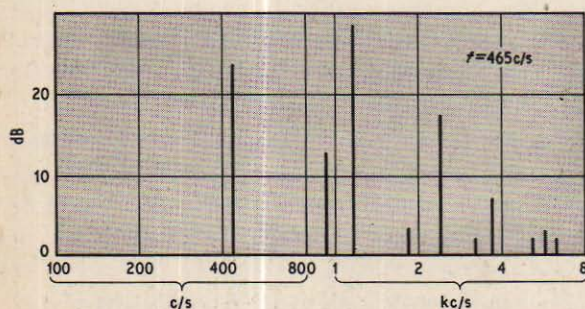


Fig. 2.3c. The organ clarinet spectrum

From Douglas, A., *The Electrical Reproduction of Music* (Published by MacDonald, London)

INSTRUMENTAL AND ORGAN SOUNDS

The reader will have seen, on commercial organs, the names and pitches of the various stops and must have noticed that some are familiar, some perhaps not. We must remember that even in the finest pipe organs, there is a great difference between the names of orchestral instruments appearing on stops and the actual sounds produced. Since an organ works on fixed wind pressures, there can be no variation in the character of, say, a trumpet such as is possible by a human being changing his wind pressure and the position of his lips. Further, the compass of pipes greatly exceeds that of any orchestral instrument, so that we find 61 trumpet notes against the 30 odd of the trumpeter. Thus, higher and lower notes are an extension to the instrumental range, so there are bound to be differences in the sound.

Then the way the sound starts and stops is quite different from the way an instrumentalist controls his strings or valves, and this leads to a major difficulty with most electronic organ systems—keying. This subject requires careful examination and we will commence to deal with this in the next article. However, to conclude this part we assume that stops marked *oboe*, *clarinet*, *flute*, etc. bear sufficient resemblance to these sounds as to be self-evident, whereas the organ tones proper, which we use and which are not to be found on any other instrument are as follows:

Open diapason. Found in 8 and 16ft pitches. A rather loud flute with strong harmonic development and very pronounced wind noise. Pipes always made of metal.

Stopped diapason. 8ft pitch and, if somewhat more powerful, found in 16ft pitch and called a bourdon. Mainly odd harmonics with a pleasing "hollow" tone. Pipes made of wood.

Principal, 4ft. An octave extension of the open diapason. Metal pipes.

Fifteenth, 2ft. An octave extension of the principal. Metal pipes.

Dulciana. 8ft and occasionally 16ft. Quiet string-toned stop of great value. Metal pipes.

Vox Humana 8ft. A curious throaty sound, having a possible slight resemblance to a male singing voice. This is a reed, not of much value in itself but very useful to add to other sounds like the stopped diapason, tibia, etc. Metal pipes of $\frac{1}{2}$ or $\frac{3}{4}$ normal length.

No provision has been made in this proposed design for such non-tonal effects like percussion, sustain, reverberation, etc. However some of the latest circuits for producing these adjuncts will be explained after we have tackled the keying problem; the individual constructor can then decide if any of these facilities should be incorporated in his own instrument.

INDEX

An index for Practical Electronics volume two (January 1966 to December 1966) is now available price 1s 6d inclusive of postage.

Orders for copies of the Index should be addressed to the Post Sales Department, George Newnes Ltd., Tower House, Southampton Street, London, W.C.2.

NEWS BRIEFS

The Royal Television Society

It was announced on October 21 that Her Majesty The Queen has been graciously pleased to command that the Television Society shall now be known as the Royal Television Society.

This is a great honour for the first Society in the world for the furtherance of study and research in television and allied subjects. Since it was founded in 1927 it has had many eminent workers in this field amongst its members.

The Society has in more recent times broadened its scope to include the artistic side of television—programme production and direction. The various specialised applications of television are covered, as are also the servicing and retailing aspects of the receiver market.

Applications for membership are accepted from all branches of the profession. Full particulars are obtainable from the Secretary, 166, Shaftesbury Avenue, London, W.C.2.

New Postal Supply Service

A NEW component and equipment supply service for the radio and electronics hobbyist has just been brought into operation by Standard Telephones and Cables Ltd. The new organisation trades under the name of Electroniques, the original firm of this name now being an entirely owned subsidiary of STC. The services previously offered to the amateur by Electroniques are now reinforced by the facilities of Electronic Services Division of STC.

The aim is to provide a rapid postal supply service covering a vast selection of equipments, components, tools and accessories. Most of the STC "professional" components will be available to individual amateurs as well as many other items produced by other electronic firms.

A "Hobbies Manual" containing full details of all items offered, plus constructional tips and useful circuits for the amateur, will be published shortly.

Enquiries regarding this service should be addressed to Electroniques (proprietors STC Ltd.), Edinburgh Way, Harlow, Essex.

Electronic Control of Zinc Smelting

THE largest automation project yet undertaken in the non-ferrous metals industry is to be carried out by Elliott-Automation and the Imperial Smelting Corporation.

The project involves the application of on-line computer control to the large new I.S.C. zinc-smelting plant which is under construction at Avonmouth near Bristol. In addition to the computer, the Elliott-Automation Group is providing plant instrumentation, control equipment and materials-handling systems worth almost £1M.

Thought for the Month!

How long will it be before bank services direct to the public are automated? We have already computers doing a large task in accounts ledgers, but what about the friendly bank manager to whom we look for an overdraft?

Well, this rather staggering thought occurred to us when we learned that a computer controlled money lending machine advances loans of £20 to Japanese civilians holding credit cards with the Japanese Credit Centre in Tokyo.

This could be the answer to those banks who wish to close on Saturday mornings, for two-thirds of the borrowers used the machine out of normal office hours. This machine also issues a note saying: "Thank you very much"—in Japanese, of course.

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.

LAST MINUTE GIFTS

Now that we are in the full swing of the festive season, most of us are surely joining the mad last minute rush to find a suitable present for members of the family. It seems appropriate to devote our first *Market Place* feature to a few suggestions that would make ideal gifts.

With the present day trend of technical achievements there are many good educational construction kits and these make excellent gifts to start the boys on their first steps into the science of electronics.



Antex Soldering Kit

CONSTRUCTION KITS

Typical of these construction kits are the Philips Young Engineer Kits. There are four basic kits, The Mechanical Engineer, The Radio Engineer, The Interphone Engineer, and The Electronic Engineer. The price ranges from £5 6s 0d to £10 0s 3d. The Electronic Engineer kit, basic version type EE8, enables eight electronic models to be made-up and with an "add-on" A20 or EE20 kit these can be extended to 21 different models. Circuits such as a direction finding two transistor radio, a gramophone amplifier and morse oscillator can be made and—with the additional kit—a one octave electronic organ.

Also available from Philips is the EL7500 Microphone assembly kit which is another construct-it-yourself item. This kit cost 7 guineas and contains everything needed to assemble and use the microphone, including a stand for table or desk use, and a cord and clip for wearing around the neck.

Another very good selection of construction systems are those from Radionic Products Ltd. Their kits range from a simple diode detector

receiver (today's equivalent of the old "crystal" set) to a digital computer. Each system is marketed in the form of construction sets and each set includes a handbook, comprehensive building instructions and a series of circuit sheets. The latter includes theoretical circuit diagram, explanatory notes for each circuit and an annotated diagram of the component layout and connections.

The advantages of the Radionic system is that the circuits are, where possible, laid out in close conformity with the theoretical circuit diagram on a transparent panel, and can be followed reasonably easily. Also, the circuit sheets are designed on a progressive basis from the simplest to the most difficult circuit, which is ideal for the beginners. A price list of complete sets are available from Radionic Products Ltd., Stephenson Way, Three Bridges, Crawley, Sussex.

Neither the Radionic nor Philips kits employ any soldering, eliminating precautions against damage to components from overheating.

SOLDERING

However, soldering is one of the many techniques that have to be mastered at one time or another by anyone involved in constructing electronic circuits. Two soldering kits which would make good presents are the "Marksman" from Weller Electric Corporation, price 38s 0d, and the "Precision Soldering Kit" from Antex Ltd., price 49s 6d.

AROUND THE HOUSE

After junior, we come to the ladies of the house; something reasonably different from the usual gift would be a cassette tape recorder. These recorders are very versatile, being battery powered, with mains units as an optional extra; they can be operated practically anywhere in the home or car. The ease of operation and the changing of cassettes is a simple process and should prove no problem to housewives, daughters or girl friends. Many large companies are now marketing cassettes of pre-recorded music by practically all the top artists. The "Musicassettes" are priced at 40s 0d each.

Now we come to the head(ache) of the house: finding something different each year is really a problem. But today we received the photograph of a collection of items which at first sight look completely unrelated to each other, but are in fact all transistor radios. Two that would make nice ornaments in the "den" are the "Old Parr Whisky Bottle" and the "Car Wheel and Tyre". A complete price list and address of the nearest stockist is available from Denham & Morley Ltd., 173-5, Cleveland Street, London, W.1.

As a last resort, but surely appreciated just as much, would be a year's subscription to PRACTICAL ELECTRONICS for the small sum of 36s 0d to any part of the world.



Philips Electronic Engineer Kit



Elizabethan LZ9102T Cassette Recorder



"Musicassettes" by Philips

Novelty Radios imported by Denham and Morley





MODEL CONTROL AMPLIFIERS

Last of a Short Series on Miniature R/C Designs

By D. Bollen

THE function of amplifiers in model radio control is to convert the low power signal from a receiver to a large d.c. current change, capable of energising a relatively insensitive relay or, in some cases, a motorised servo or escapement directly. This they must do without responding to spurious signals or background noise.

Although specifically intended for use with the receiver described in the November issue of PRACTICAL ELECTRONICS, the following units may be coupled with other receivers and with commercially manufactured equipment when additional controls are to be fitted.

AMPLIFIER "A"

Fig. 1 shows the circuit diagram of a dual purpose amplifier designed to feed either a low resistance relay or an escapement. A photograph of this design is shown in the heading picture. It will be seen that only seven components are used and no transformer is required. An input of 50mV will cause a current change of 30mA, and the current gain is approximately 35dB.

The maximum current change is 250–300mA with the transistor specified for TR2. If small motors are to be driven by the amplifier TR2 should be replaced by a transistor of greater power handling capacity, such as OC81 or a power transistor.

With no signal on its base, TR1 remains cut off and so, therefore, does TR2, which passes a fraction of a milliamp leakage current. When an audio frequency signal is passed to TR1 base both transistors conduct—TR2 heavily—assisted by the action of diodes D1 and D2. The diodes, incidentally, also serve to stabilise the amplifier against the effects of temperature.

Inevitably the receiver will produce some noise, picked up on the base of TR1. This causes a slight bias to be applied to the amplifier, raising the stand-by consumption to approximately 6mA, well below the figure likely to cause relay chatter. This drain has a negligible effect on the life of the battery employed.

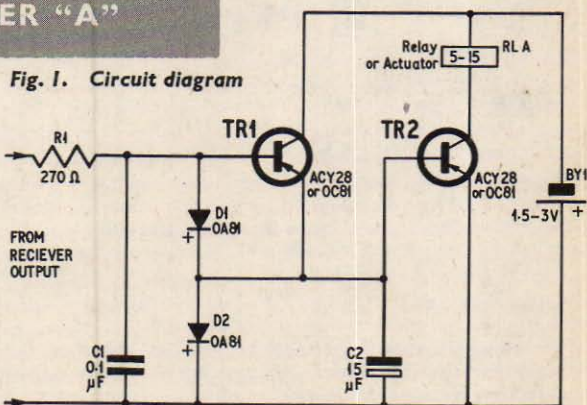


Fig. 1. Circuit diagram

BAND PASS FILTER

To reduce noise to a minimum, and to favour only the desired audio tone which activates the amplifier and relay, the overall response is tailored to give the curve shown in Fig. 2.

Capacitor C2, bypassing the emitter load of TR1, is of a small enough value to attenuate the lower audio frequencies, while still providing enough capacitance to smooth the raw d.c. pulsations resulting from a rectified a.c. signal. The input network, R1 and C1, filters out the high frequencies.

It will be seen that the peak response occurs in the region of 750 c/s and reasonable rejection of noise and interference may be expected. The low pass filter

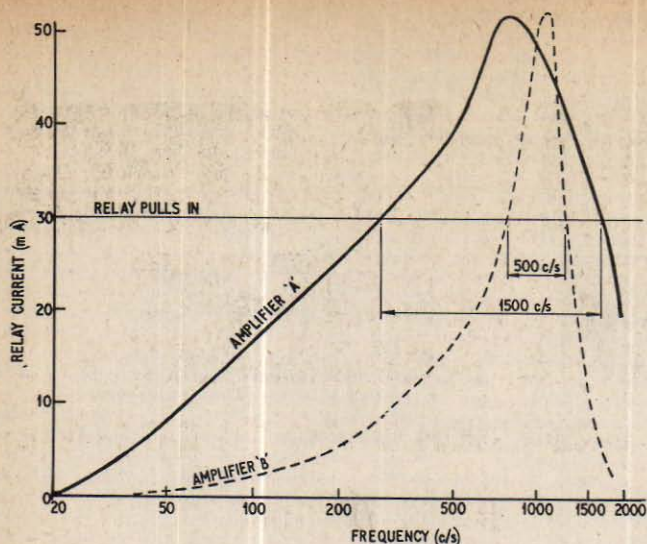


Fig. 2. Frequency response characteristic filtered to operate the relay over a narrow band

also effectively removes the quench component of the signal. In extreme cases of interference when, for example, an old electric motor is sited close to the receiver, R1 may be replaced by a variable resistor of up to 10 kilohms. This acts as a sensitivity control and should be preset to just below the point where interference triggers the relay.

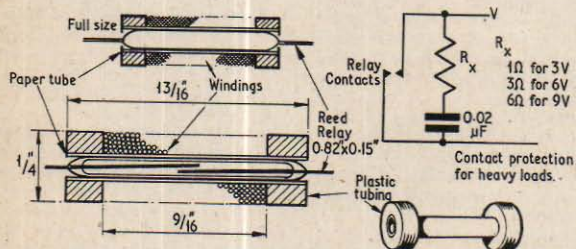


Fig. 3. Construction details of a suitable reed relay coil with suppression circuit for the contacts

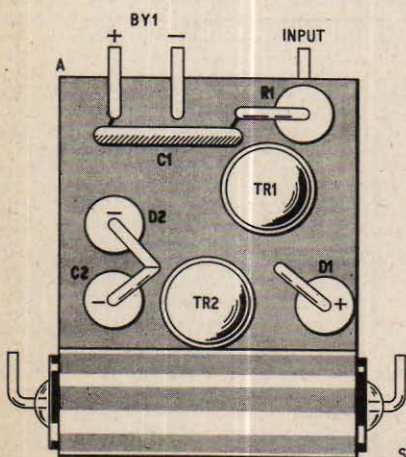


Fig. 4a. Component layout

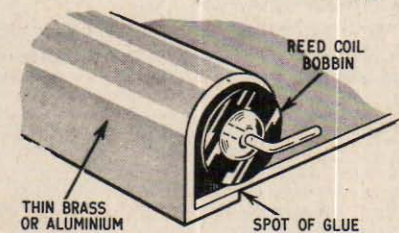


Fig. 4b. Mounting of the reed relay

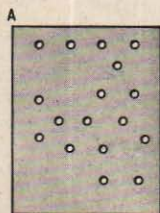


Fig. 4c. Full size drilling template

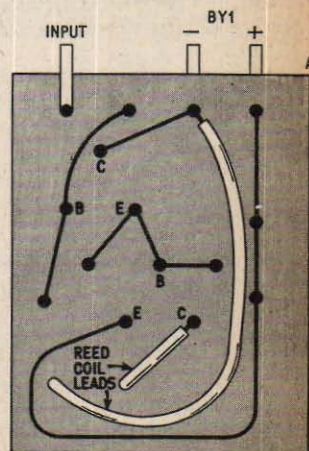


Fig. 4d. Underside wiring

COMPONENTS . . .

Resistor

R1 270 Ω 10%, $\frac{1}{10}$ watt carbon

Capacitors

C1 0.1 μ F ceramic 10V

C2 15 μ F elect. 15V

Transistors

TR1 and TR2 ACY28 or OC81 (Mullard) (2 off)

Diodes

D1 and D2 16P10 (Radiospares) (2 off)

Relay

RLA 5 to 15 Ω (see text)

Reed switch type RS/2 (Cockrobin Controls)

Battery

BY1 1.5V or 3V (one or two pen-light cells)

Miscellaneous

S.R.B.P. sheet lin $\times$ lin

P.V.C. wire

DRY REED RELAY

The dry reed relay used in the original model deserves an individual mention, mainly by virtue of its simplicity and small size. Details are shown in Fig. 3. A gummed paper cylinder, fitted with plastic cheeks, acts as the bobbin on which is wound 600 turns of 40 s.w.g. enamelled wire, giving a d.c. resistance of 15 ohms. The pull-in sensitivity of the relay alone is under 20 milliwatts and the speed of operation better than 1 millisecond.

In circuit, TR2 dissipates some power giving a total of 40 milliwatts including the relay. The speed of response is limited by the decay time of C2 which works out to around 0.01 second.

The recommended long-life contact current, for the particular dry reed used, is 100mA. However, the reed is quite capable of handling heavier loads, such as small electric motors with a switch-on surge of 1 amp, in normal circumstances where the relay does not operate continuously at high repetition rates and where contact arc suppression is incorporated.

AMPLIFIER "B"

COMPONENTS . . .

Resistors

R1	4.7k Ω	R4	1k Ω
R2	1k Ω	R5	200 Ω
R3	1k Ω		
All 10% $\frac{1}{10}$ watt carbon			

Capacitors

C1	0.1 μ F disc ceramic 20V	(Radiospares)
C2	0.1 μ F disc ceramic 20V	
C3	0.1 μ F disc ceramic 20V	
C4	15 μ F elect. 15V	

Transistors

TR1 and TR2 ACY28 or OC81 (Mullard)
(2 off)

Diodes

D1 and D2 16P10 (Radiospares) (2 off)

Relay

RLA 50 to 200 Ω (see text)

Battery

BY1 6 or 9V (type PP5 or PP3)

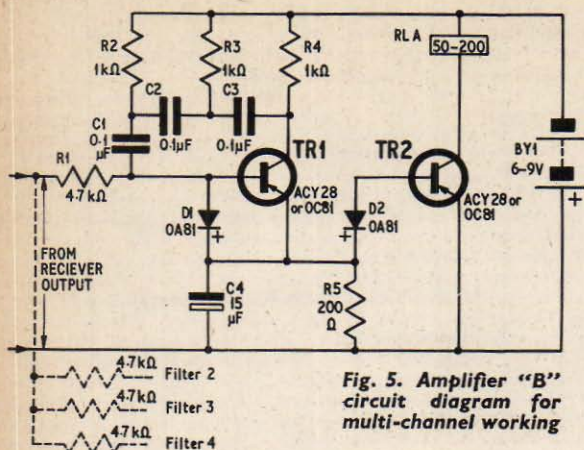


Fig. 5. Amplifier "B" circuit diagram for multi-channel working

For multi-channel working the amplifier must discriminate between different tones, responding only to the one to which it is tuned. Neglecting for the moment reed operation rather large ferrite pot-core inductances are normally employed to resonate at the selected frequency.

As a separate amplifier is needed for each channel, obviously its individual size and complexity will be multiplied by the number of channels required. It is preferable to plan for a simple, basic unit on which to build if a reasonably compact ultimate assembly is to be achieved.

The circuit of Fig. 5 provides a useful and compact alternative to the inductive filter and, with a sub-miniature relay, can be built on a panel less than 1in square.

PHASE SHIFT

The phase shift network composed of R2, R3, R4, C1, C2, and C3, connected between collector and base of TR1, feeds back an in-phase signal at the resonant frequency, thus increasing gain. At other frequencies the feedback is out of phase, tending to reduce gain.

The rest of the circuit is similar to that in Amplifier "A" although, in this case, D2 (Fig. 1) is replaced by

a resistor R5 (Fig. 5) and a diode D2 has been added in the base circuit of TR2.

The purpose of D2 may at first sight seem obscure, but it is, in fact, a useful one. At very low input voltages the d.c. resistance of this diode is high, around 10 kilohms in the forward direction, which reduces to about 200 ohms as the voltage increases.

When low level breakthrough occurs, as from an adjacent tone, the non-linearity of D2 assists in rejecting the unwanted signal and the overall effect is to sharpen the response of the circuit.

NARROW BANDWIDTH

Returning to Fig. 2, where the output of the amplifiers "A" and "B" are presented in similar low signal terms, with their relays set to operate at the same level as a datum for comparison, it shows that "B" has the much narrower bandwidth of 500c/s, resulting from selective feedback.

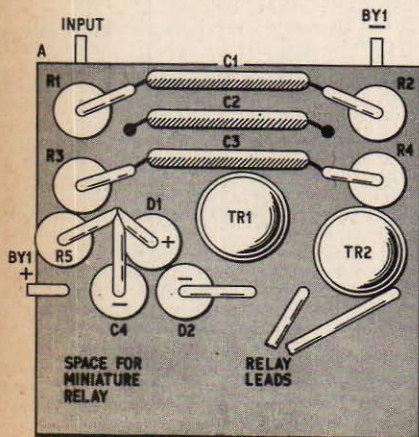
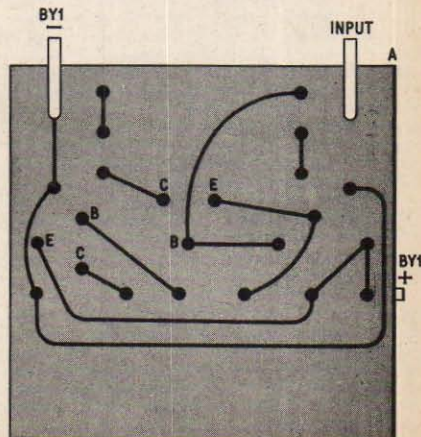
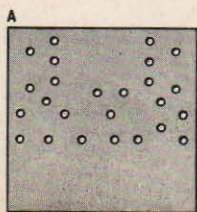


Fig. 6a (left). Component layout

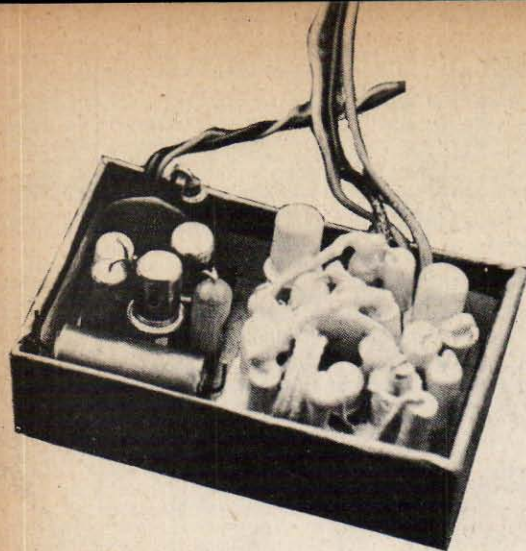
Fig. 6b (below). Full size drilling template

Fig. 6c (right). Underside wiring



The capacitance value should be chosen to give a good current change without breakthrough from lower tones. Smaller values for C4 will also assist and should

The circuit of Amplifier "B" is remarkably stable and free from any trace of self oscillation. The overall performance is largely determined by the current gain of TR1 and a minimum of 60 should be the aim. Stand-by consumption is only 0.5mA when connected to a working receiver and the total current change exceeds 50mA on signal.



Amplifier "A" housed in a matchbox alongside the receiver described in Part 2

model goes beyond the range of control, triggered by the absence of carrier.

Although very simple, using few components, amplifier "C" needs careful setting up initially. Different receivers have different noise levels; the amplifier standing current can be expected to vary over quite a wide range before the right value for C1 is found.

If carrier only reception is wanted, the quiescent current may be set to a low level and the current rise resulting from a signal used to operate a relay in the normal way.

An inexplicable tendency to oscillate at a very low frequency (about 10c/s) was exhibited by the original amplifier but this in no way interfered with the correct working of the amplifier as the self-oscillation ceased with a signal, and did not interfere with the level of the standing current.

Relay details are the same as described under amplifier "A" for a 15 ohm type.

OTHER AMPLIFIERS

Considerable scope for experiment exists with the design of model control amplifiers, and the wide range of control gear now available renders each application novel in its requirements. Variants, of the amplifiers given here, may be found to suit alternative systems so no hard and fast rules of design exist.

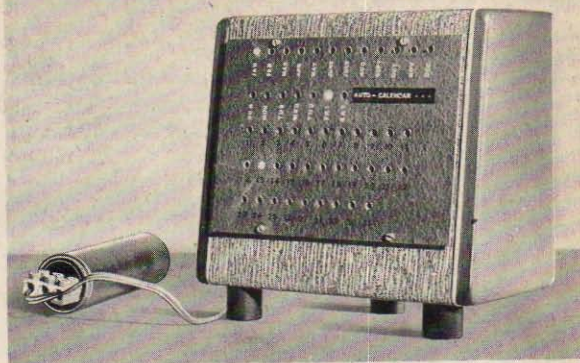
One very promising field of investigation lies in the adoption of computer principles, the use of binary switches cascaded to give fast, positive selection of controls in sequence on one channel, with an automatic coder in the transmitter.

This could challenge the present superiority of multi-channel systems as, theoretically, thousands of individual controls could be selected and set in operation within the space of a second.

Reed amplifiers have not been mentioned because they follow standard a.c. amplification principles. The reed occupies an intermediate stage in the chain of events following the receiver, needing either relays or additional amplifiers before the signal can be converted into mechanical motion. Amplifier "A" would make an ideal reed-follower if a slight bias of a fraction of a volt is switched on to the base of TR1 by the reed contacts.



NEXT MONTH in PRACTICAL ELECTRONICS



MAKE THIS UNIQUE AUTO CALENDAR

How to build an electronic perpetual calendar giving neon indication of the date—a fascinating device that will keep you always up-to-date day after day, year after year. Changes date at dawn each day, and takes care of leap year as well.

OTHER FEATURES INCLUDE:

DOORBELL REPEATER

Full instructions for constructing a simple sustaining visual and aural indicator. Ideal for the hard of hearing.

CAR BURGLAR ALARM

A simple and inexpensive system for protecting points of entry and immobilising the ignition.

FEBRUARY ISSUE ON SALE JAN. 13

MAKE SURE OF YOUR COPY-ORDER NOW!

TO _____ (Name of Newsagent)

Please deliver/reserve the February issue of PRACTICAL ELECTRONICS (2/6), on sale Jan. 13, and continue every month until further notice.

NAME _____

ADDRESS _____

Hand this form to your Newsagent

Book reviews

OUTLINE OF RADIO AND TELEVISION

By J. P. Hawker

Published by George Newnes Limited

399 pages, 8½ in x 5½ in. Price 30s

THE AUTHOR is a well-known authority on communications techniques and has a style of writing which I find to be very clear and absorbing. In this excellent book he exhibits an art which is not often found in technical books—that is, the ability to describe his subject concisely, yet in detail, and to hold the interest of the reader.

Having read this appraisal, it will come as no surprise to most people that he has compiled, in nearly 400 pages, a great deal of readable information: from the fundamentals of electricity and atomic particles, through radio wave propagation to practical domestic systems (including colour television). Furthermore, being of allied domestic interest, tape recording principles and stereophonic sound are included.

The important point in a book of this nature is to be topical, and this Pat Hawker has done within the limitations of printing time. Let me hasten to add that the most recent of semiconductors (for example, thyristor, f.e.t., and unijunction transistors) are not explained because their applications are not usually to be found in domestic systems at present.

To anyone embarking on radio or television (or even electronics) as a career or hobby, this book is to be thoroughly recommended, and will always be used in later years as a valuable reference. Good value for money; ideal as a Christmas gift.

M.A.C.

HANDBOOK OF RELAY SWITCHING TECHNIQUES

By Appels and Geels

Published by Philips Technical Library

321 pages, 9½ in x 6 in. Price 72s

THIS book sets out to review the relay both as an isolated individual and as an active circuit element. Taken overall it does this very well and there are numerous examples and diagrams showing relays in almost every conceivable application, usually with detailed descriptions of each circuit.

There are chapters devoted to coding, decoding and checking circuits which convert data from one form to another, counting and storage systems, and certain types of computing, translating and identification arrangements, all using relays. Another chapter deals with switching algebra. Semiconductors appear in some circuits, these are mainly diodes but transistors occasionally appear.

Each chapter contains worked problems as well as extra questions at the end, the answers being given elsewhere. Some aspects seem rather over-emphasised, for example there is a fair amount of information on the design of relays which is useful to a manufacturer rather than a user. The mathematics tends to be slightly overwhelming, for example in the coding chapter, but most circuits can be understood without difficulty.

A very wide range of relay switching applications is studied here although it must be remembered that the modern trend in automation uses solid-state, rather than mechanical, switches. At 72s this book is expensive but it does provide a very fair introduction to relay circuits in general.

G.D.H.

BUYING SECONDHAND

Ed. by E. Rudinger

Published by the Consumers' Association

144 pages, 8 in x 5 in. Price 8s

A LITTLE out of the ordinary to find a book of this sort to be mentioned on this page, but it is suggested that readers contemplating buying secondhand radios, television sets, tape recorders, or record players should have some idea of what snags to look for. This is only one section in a book devoted to numerous consumer (or domestic) products.

The Consumers' Association was set up in the interests of the general public. The service provided in the publication of this book goes a long way to helping potential buyers.

Meetings . . .

THE INSTITUTION OF ELECTRICAL ENGINEERS

LONDON

Date: December 16

Title: Colloquium on "Properties and the Possible Application of Hard Superconductors"

Time: 9.30 a.m.

Address: I.E.E. Savoy Place, London, W.C.2.
(Sponsored by the I.E.E. and the Institute of Metals)

Date: December 29 and 30

Title: Waves, Waveguides and Radar

Prof. P. J. B. Clarricoates and Dr. J. R. Richardson

Time: 2.30 p.m.

Address: I.E.E. Lecture Theatre, Savoy Place, London, W.C.2.

This lecture is intended for boys and girls of the fifth and sixth forms. Admission is free.

Applications for tickets should be made to the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2. Note: state which day is required.

SOCIETY OF ELECTRONIC AND RADIO TECHNICIANS

BRISTOL

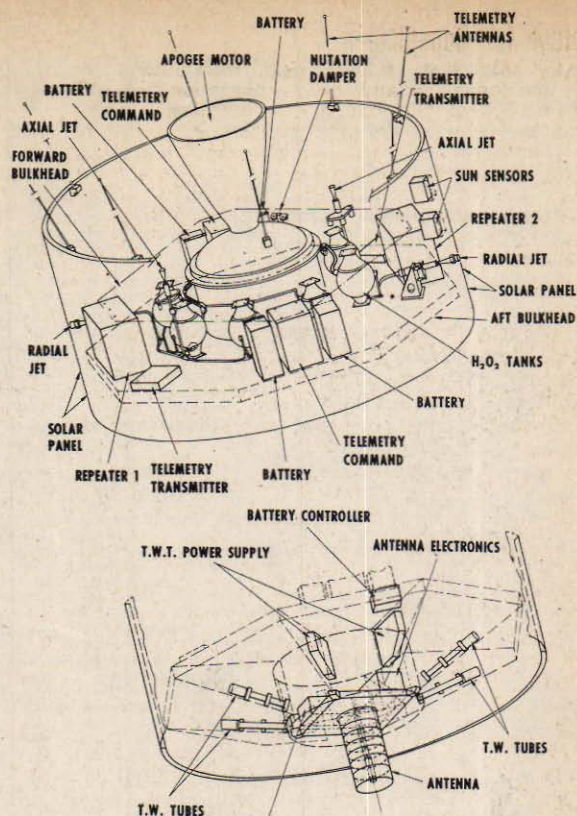
Date: December 20

Title: Oscilloscopes and Their Practical Applications

R. A. Watson (Telequipment)

Time: 7.15 p.m.

Address: Royal Hotel, Bristol.

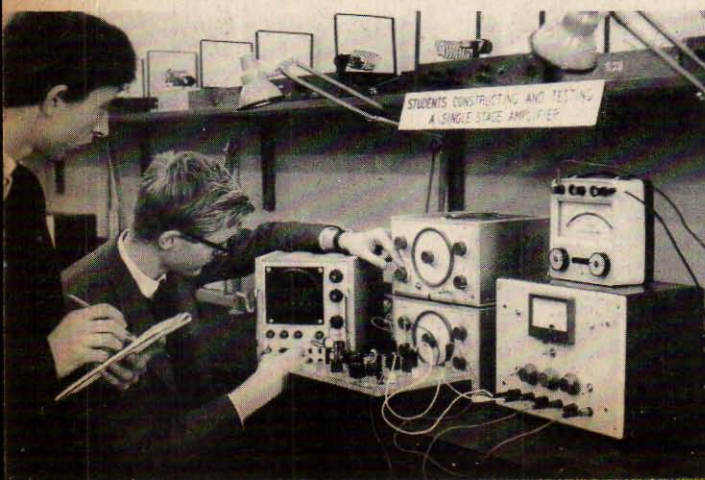


Later Birds are Up

Two new communications satellites, were launched recently with the aim of extending the range available for global communication links, and to support the Project Apollo. The first, *Lani Bird*, failed to kick into the correct orbit over the Pacific Ocean, but its equipment is functioning.

On the left we show the biconical horn antenna which picks up radio and television signals. Above is a diagram of the layout of equipment in the satellites. Notice the antenna on the underside. Both satellites were launched by N.A.S.A. for the Communications Satellite Corporation.

ELECTRONORAMA

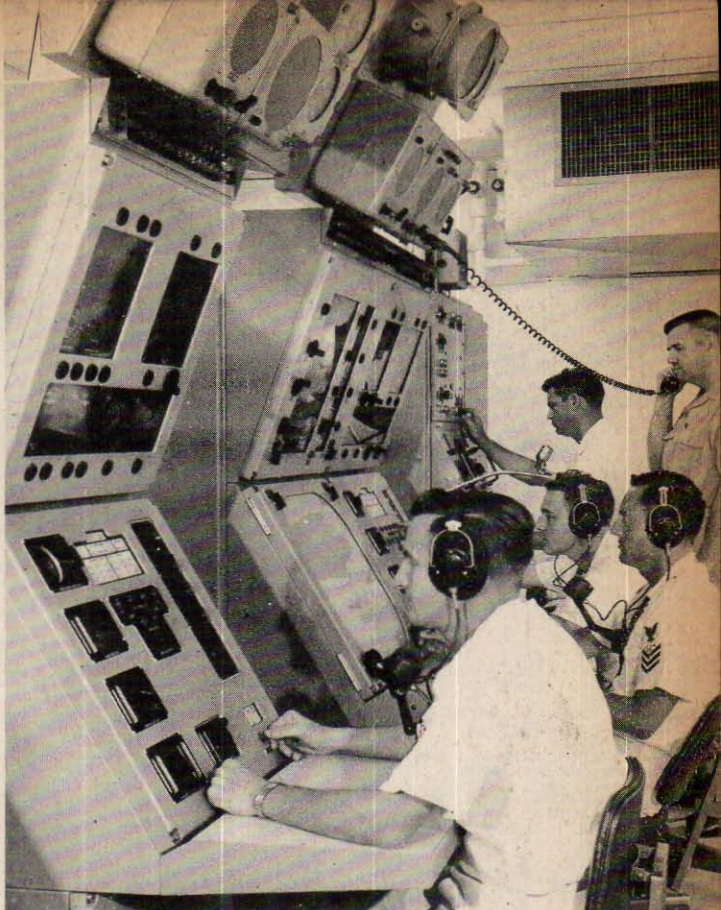


Trainees for New Radio Station

PART of the function of the new Leaffield P.G.O. Radio Station, in addition to being a central automated transmitter for overseas broadcasting, is to train technician apprentices in radio engineering. Two of them are seen (left) testing a single stage amplifier by feeding in a signal from a signal generator and examining the output on an oscilloscope. Both instruments are supplied by Advance Electronics.

Colour for Copenhagen

DENMARK's first u.h.f. television transmitter to be used for colour and u.h.f. propagation tests will be installed at Gladsaxe, near Copenhagen, where black and white technical test transmissions are due to begin early next year. In the foreground of the photograph below, work is shown in progress on the equipment section containing one of two 10 kilowatt klystron output tubes used in the transmitter. The equipment is being built and tested at Marconi's Chelmsford factory.



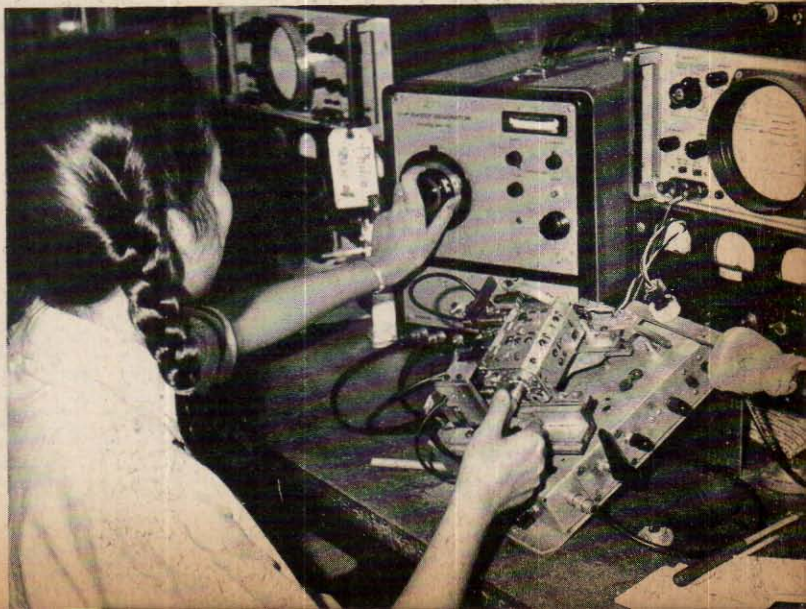
Mock Attack with Sonar

NAVY ship crewmen at the Fleet Antisubmarine Warfare School, San Diego, California, are practising a simulated, but realistic attack on an "enemy" submarine. The mock attack is being carried out in the Underwater Battery Plot Room of a new surface ship ASW attack trainer built by Honeywell's California Ordnance Center. Sailors at the two "attack" consoles (foreground), using information from sonar echo sounding equipment (background), are able to simulate the firing of an ASROC missile at their target with deadly accuracy.

Tuning in to Hong Kong

MUCH has been seen and heard about transistor radios from Hong Kong, but let us not forget that there is also a thriving potential in electronic components for computers and satellites there.

In the more "domestic" role high standards are maintained. This operator is making adjustments to an assembled tuner for television.



FREQUENCY DIVISION

The article *An Electric Clock with Digital Presentation* (March 1965 issue of **PRACTICAL ELECTRONICS**) mentioned several methods of producing a clock with all electronic working but these were not discussed in detail. Here we present a discussion of some of these methods, placing special emphasis on frequency division techniques.

THE problem of designing electronic clocks is, very briefly, one of frequency division. That is, you start with the mains frequency of 50c/s and divide this until you get one cycle per minute for operating the minutes display, one cycle per hour for operating the hours display and one or two cycles per day according to whether the 12-hour or 24-hour system is to be used. There are various ways of obtaining frequency division:

- (1) Binary circuits to give division by two for each circuit used;
- (2) Diode pump circuits to give division by up to 10;
- (3) Tunnel diode circuits to give division by up to 100;
- (4) Gas filled counting tubes (e.g. Dekatrons to give frequency division of up to 12.

Having mentioned the kinds of circuit elements which may be used, let us consider what we require exactly from the circuits. Firstly, the frequency division factor must be constant or the clock will run fast or slow. Secondly, the circuits must be capable of operating at very low frequencies—at least one cycle per hour. Thirdly, the circuit must use components of practical size.

The implications of these requirements are that frequency division must not vary with changes of voltage, temperature, humidity, or aging of components. At very low frequencies, circuits relying on capacitors retaining their charge cannot be used because capacitors always have a certain amount of leakage resistance. This leakage resistance may be hundreds of megohms but will nevertheless discharge the capacitor over a long period.

Low frequency circuits demand the use of high value capacitors; these would probably be electrolytic, but are the least ideal because of their very low leakage resistance. What is really required is a circuit with a "memory" of the condition it was in one hour previous and, in fact, of those listed, only the binary divider and Dekatron meet this requirement. However, a brief explanation of the other circuits will be discussed as a matter of interest.

BINARY DIVIDER

The circuit, often referred to as a "flip-flop", Eccles-Jordan, or bistable circuit, is shown in Fig. 1. In the present context it can be considered as a $\div 2$ circuit, that is the output will be half of the frequency of the input.

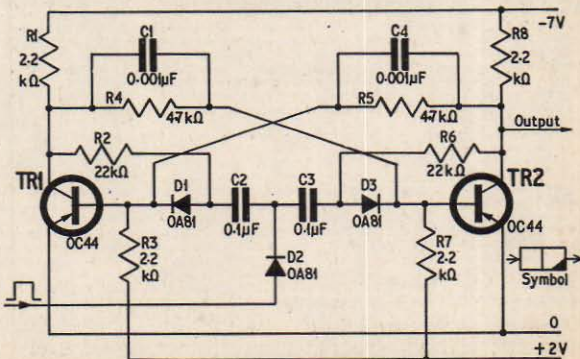


Fig. 1. Divide by 2 circuit or flip-flop

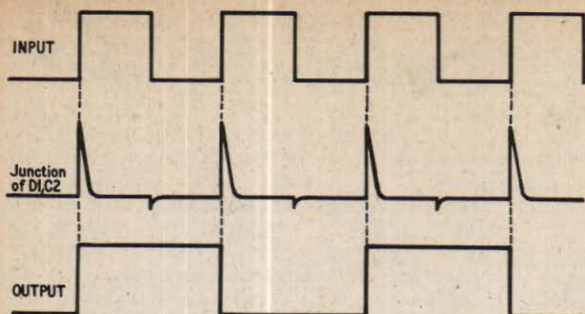


Fig. 2. Waveforms of the flip-flop circuit showing the input, the differentiated trigger pulse, and the output

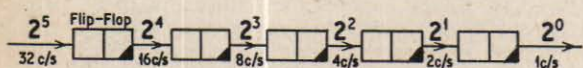
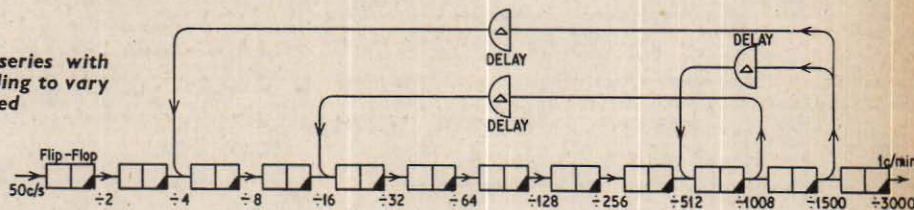


Fig. 3. Simple divide by 2 series from 32c/s to 1c/s

Fig. 4. More complex series with added delay networks including to vary the division factor as required



On first switching on the supply, one transistor will conduct fractionally more than the other due to slight unbalance in the voltages around the circuit (don't forget that component values are not spot on but often are within say ± 10 per cent tolerance).

If TR1 conducts more than TR2 then its collector voltage will be less negative than that of TR2. Therefore, the base of TR2 will be less negative than the base of TR1. As emitters are held at "earth" potential TR1 will conduct more heavily and TR2 will conduct even less. This effect is cumulative until TR1 is conducting heavily and TR2 reaches cut-off.

This action occurs very rapidly and is assisted by the capacitors C1 and C4. The transistors remain in this condition provided that no input pulses are applied to the bases. The steady state condition will be that the collector of the conducting transistor will be at about -0.5 volts and its base -0.2 volts. The non-conducting transistor will have a collector voltage around -5.5 V and a base voltage of $+1$ V.

When a square wave input is applied as shown it will be differentiated by C2 and R2, C3 and R6, and clipped by D2 giving the waveform at the junction of D1 and C2, and at D3 and C3, as shown in Fig. 2. The resulting positive pulses will not affect the "off" transistor but will reduce current through the "on" transistor.

This initiates a switching action so that the transistor formerly "on" will be switched "off" and that formerly "off" will be switched "on". The result of this is that one pulse will be obtained from the output for every two pulses at the input. The waveform at the output of the circuit will be as shown in Fig. 2.

By connecting several of these circuits in series, the input frequency can be divided by any power of 2; for example, if the input is 32c/s, the output after four series connected flip-flops will be 2c/s (as illustrated by Fig. 3) and after five will be 1c/s.

In order to count down from 50c/s to one cycle per minute, a frequency division factor of 3,000 is required. The nearest greater power of 2 is $2^{12} = 4,096$. This system will have to be modified to give division by 3,000. The modification involves feedback of pulses to reduce the count from 4,096 to 3,000. This is illustrated in block form in Fig. 4.

Delays are necessary in the feedback lines so that a feedback pulse does not coincide with an input pulse. Also shown are the dividing factors of the original frequency after each flip-flop, assuming that they all start from the zero condition simultaneously.

After dividing down to one cycle per minute the signal is fed into display circuits to drive a numerical indicator. These circuits will be dealt with later.

This particular method of frequency division fulfils all of the requirements but is expensive in components—at least 24 transistors, 100 resistors, 36 diodes and 36 capacitors.

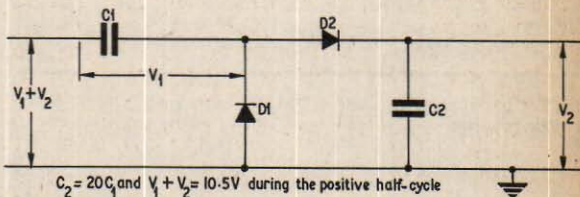


Fig. 5. Basic diode pump circuit

DIODE PUMP

The next method of frequency division to be considered is the diode pump circuit, shown in basic form in Fig. 5. In order to understand the operation of the circuit, let us assume that both capacitors are fully discharged. A square wave input is now fed to the circuit. On the arrival of the first positive half-cycle, D2 conducts and both capacitors are charged. The voltages to which they are charged are V_1 and V_2 ; the sum of these must add up to the total input (10.5 volts in this case). Let us assume that the capacitance of C2 is equal to 20 times that of C1. Since the reactance $X_c = 1/2\pi\sqrt{(fC)}$, the voltage across a capacitor is inversely proportional to the capacitance.

Therefore it can be said that

$$\frac{C_1}{C_2} = \frac{V_2}{V_1}$$

where the frequency f is the same for both capacitors.

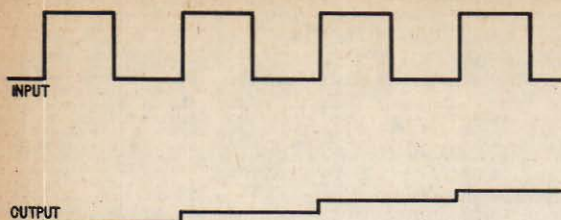


Fig. 6. Waveforms of the diode pump input and output

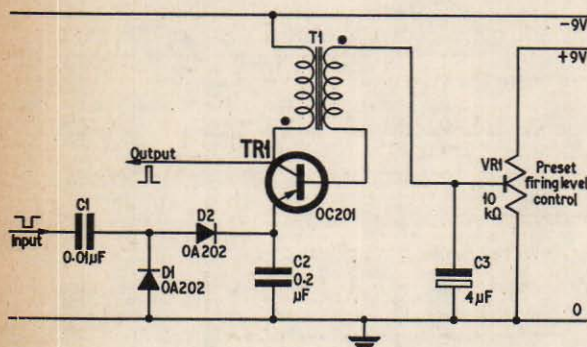


Fig. 7. Diode pump used with a blocking oscillator to govern the frequency division factor

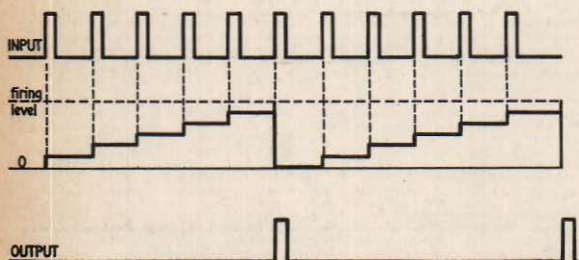


Fig. 8. Waveforms showing the staircase and output pulse in synchronism

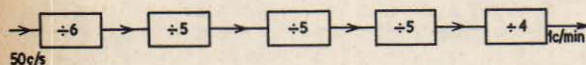


Fig. 9. Complex series of dividers for ÷ 3000

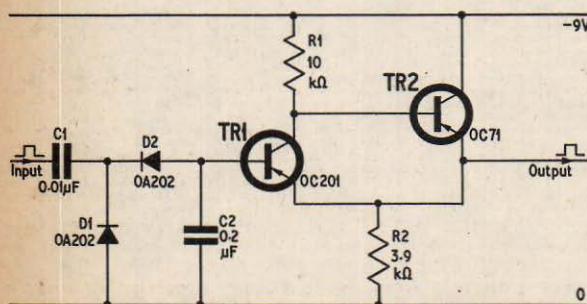


Fig. 10. Diode pump used with a Schmitt trigger circuit for firing after the required count

If the ratio of the capacitors is 20 : 1 then the ratio of their voltages is 1 : 20, or 0.5V across C2 for 10V across C1. During the following negative half-cycle, D1 conducts and discharges C1. On the following positive half-cycle, C2 once more gets 0.5V charge. The resultant input and output waveforms are shown in Fig. 6. This output is called a "staircase" waveform, for obvious reasons.

When the voltage across C2 reaches a certain level, it should be arranged to trigger another circuit to discharge C2 and produce an output pulse at the same time. This voltage will determine how many pulses are to be let through before resetting the circuit to "zero". Hence the division factor is determined. One way of doing this is to use a blocking oscillator, see Fig. 7.

In this circuit, the positive bias on the base, set by VR1, keeps the transistor cut off until the "staircase" level on the emitter rises above this bias. The transistor then conducts and is rapidly driven to saturation by positive feedback from collector to base via T1. When this occurs, C2 is very rapidly discharged and would charge in the opposite direction were it not for diodes D1 and D2 conducting and clamping the voltage on C2 to zero.

When the transistor saturates it ceases to amplify so that positive feedback ceases. The current then drops and the transistor rapidly cuts off (feedback through T1 again). It remains cut off until the staircase voltage once again becomes more positive than the bias. This is shown in graph form in Fig. 8.

ACCURACY

This circuit has the disadvantage that C2 slowly discharges through transistor leakage current. This necessitates the use of a silicon transistor such as OC201. Needless to say the capacitors used must have a very high leakage resistance and polystyrene dielectric capacitors are recommended for C1 and C2. D1 and D2 are silicon diodes to reduce leakage current effects.

Another disadvantage of this circuit is that its frequency division depends so much on supply voltage, temperature and stability of component values. Thus it cannot always be relied upon to give the correct count. It is quite good for a count of up to 6. If it drifts and counts 5 instead of 6, your clock will probably gain 4 hours a day overall. The rate can of course be set by VR1, which is thus the fast/slow control.

To divide by 3,000, several of the circuits will be required in succession with division ratios set as shown in Fig. 9. For those who wish to experiment, an

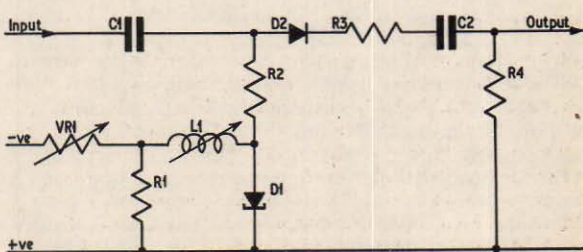


Fig. 11. The tunnel diode D1 can be used for frequency division but can be an expensive way of achieving the required result

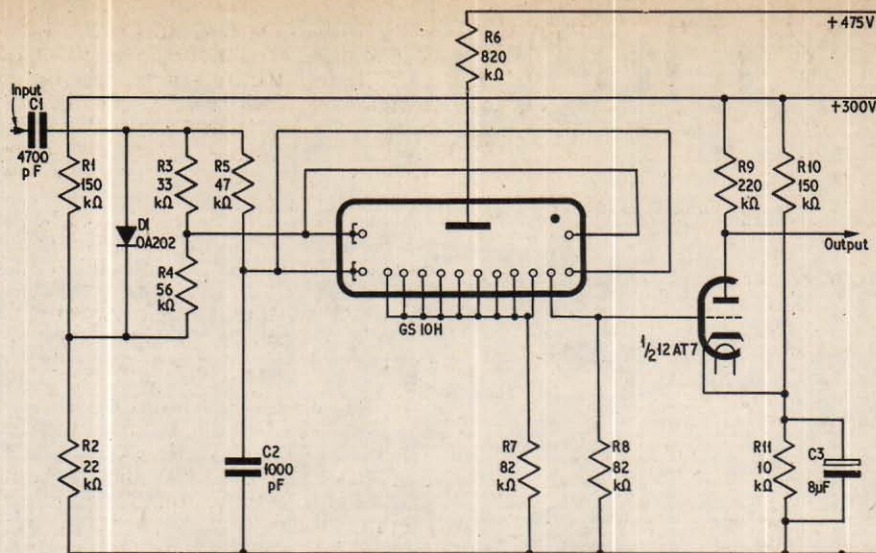


Fig. 12. A Dekatron counter tube containing up to ten or twelve cathodes can be very efficient for frequency division in clocks

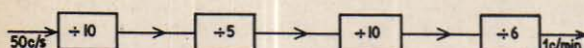


Fig. 13. Complex series of Dekatron counters can be used to divide by 3,000

alternative circuit arrangement of the diode pump is shown using a Schmitt trigger circuit for firing after the required count. With the suggested values shown in Fig. 10, the circuit will fire when the base of the OC201 goes more negative than about $-7.8V$, and when fired discharges C2 to about $-2.5V$. This means that the range of voltage across C2 is $5.3V$. If the voltage on this capacitor builds up in $1V$ steps then the circuit will divide by 6. To divide by 6 the input voltage should be about $20V$ peak-to-peak. Above $21.2V$ p-p the circuit will first divide by 5, and below $15.5V$ p-p, it will first divide by 7.

Only brief mention will be made of tunnel diode countdown circuits. The basic circuit is shown in Fig. 11.

To get the circuit to work at low frequencies, the inductance L1 has to be very large—perhaps hundreds of henrys and of high Q. This factor alone would put it out of the running from a practical point of view. Tunnel diodes are also very expensive.

GAS-FILLED DEKATRONS

The last method of frequency division to be dealt with (and the most attractive from the cost point of view) uses Dekatron tubes. These tubes will give a count of 10 or 12 depending on the number of electrodes in the tube. Intermediate counts of 2 and 5 for the 10 counter and 2, 3, 4, and 6 for the 12 counter may be obtained with some tubes. To couple one stage to the next, coupling amplifiers are required.

The Dekatron requires two negative pulses is succession to step the glow from one cathode to the next (see Fig. 12). The first negative pulse is applied to the first "guide" and transfers the glow from one cathode to the first guide. The second pulse is applied to the

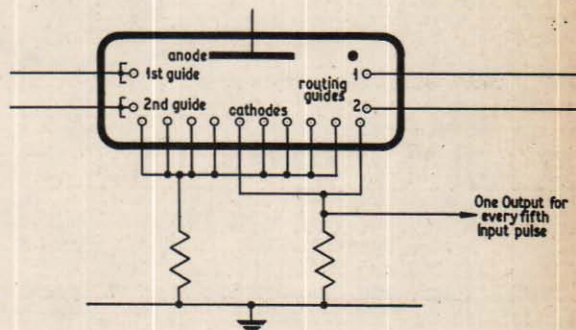


Fig. 14. Key to Dekatron electrodes and wiring for division by five

second guide and transfers the glow from first guide to second guide. On completion of the second pulse, the glow transfers from the second guide to the next cathode.

The guides and cathodes are pins arranged in succession around the tube. At the end of a count of 10, the glow is on the last cathode and about 25 volts appears at the cathode end of R8. This is amplified by the triode to drive the next stage. The input circuit forms this drive into two pulses which are required as described above. The routing guides, which are not in all tubes, determine the direction of glow transfer.

In order to get a countdown of 3,000, four tubes are required, three of them decade counters and one a duo-decal counter (count to 12).

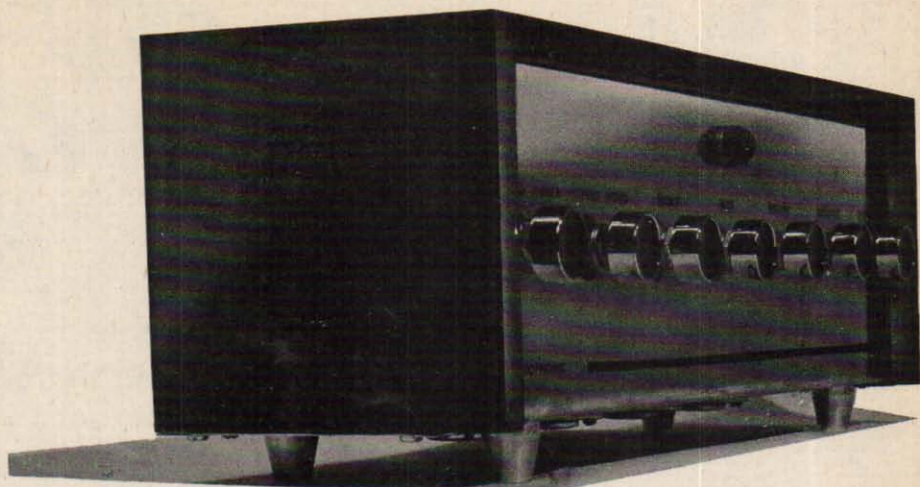
One possible arrangement of Dekatrons is shown in Fig. 13. The intermediate counts of 5 or 6 are obtained by strapping the fifth and tenth cathodes together or the sixth and twelfth cathodes together respectively; for example, to divide by 5 the connections would be as shown in Fig. 14.

Next month: The second and final part will describe methods of display and give some basic circuits incorporating the design principles outlined here for experimental electronic clocks

Integrated Stereo Amplifier

PART TWO

By. R. Hirst



IN last month's issue, the first part of this article described the features of the circuit that provide a high performance compatible with the neat and clean appearance, both externally and internally. Component assembly and wiring of the two main channel amplifiers (except the output transistors) were shown on perforated board.

In Fig. 2 (last month) the wiper leads of VR3a and VR3b should be screened, and screens connected to C'11 and C11 on the board. The junctions of C19a and VR3a, and C19b and VR3b, should be connected to these screens. This is shown in Fig. 9. Also in Fig. 2, C29b (between VR1b and VR2b) should read R29b. Diodes D1 and D2 (a and b) should be OA95.

It is intended in this part to show how the two channels are combined with the tone controls, inter-channel circuitry, and power supply unit.

One particularly important point to remember is that "earth return" wiring is carried out in thick wire, 12 s.w.g., to avoid mismatching impedances (see last month's article). Good mechanical joints are essential prior to soldering. The constructor should follow all the diagrams given to ensure the best results.

MECHANICAL CONSTRUCTION

As previously indicated the mechanical structure has been fabricated from two main component parts, in order to ease the problem of having to make difficult bends that would stem from the use of one piece of material (Figs. 6 and 7).

Prior to the assembly of sections 1 and 2 (Figs. 6 to 9) it would be advisable to mount upon Section 1 the mains transformer T1, the output transistors TR8a, TR8b, TR9a and TR9b, the controls, the rectifier and the electrolytic capacitors, as shown in Fig. 9. These should then be wired up as far as possible.

Tackled in this manner it will prove a comparatively easy assembly. However should the two sections be married together before any wiring procedure takes

place then it will be difficult to delve into the interior of the U-shaped chassis.

Once this initial operation has been completed then all the components should be mounted on Section 2 (Fig. 9) including the completed amplifier board (Fig. 5). Sections 1 and 2 should now be bolted together and the final wiring operations completed as shown.

When mounting the output transistors it will be necessary to smear both sides of the mica insulating washers with silicon grease before fitting them between the transistors and the metal chassis. This will ensure that the best possible heat transference will be effected between transistor and heatsink.

It is also essential to fit the isolating bushes or nylon screws so that the transistors are electrically insulated from the heatsink otherwise all the transistors in the output configuration could be irreparably damaged because their collectors are connected to the case. At best the amplifier will just refuse to function.

You will notice from the final assembly photograph that small feet have been fitted on the underside of the chassis. This is necessary to allow a free passage of air over the output transistors, thus helping to maintain the temperature stability of the amplifier as well as to obviate the damage that might occur if stood on a polished surface.

The small pillars that hold the component board away from the chassis of Section 2 were made from a length of tubing cut to the required size. When finally wiring the board to the output transistors care must be taken to ensure that the bottom of the board is clear of the main chassis so that no short circuit can take place.

The fixing holes for the smoothing capacitors have been deliberately omitted so that the constructor can use capacitors of his own choice, but the voltage and capacitance values must be adhered to.

Although it was not necessary on the prototype to screen the input circuitry, it may be advisable in

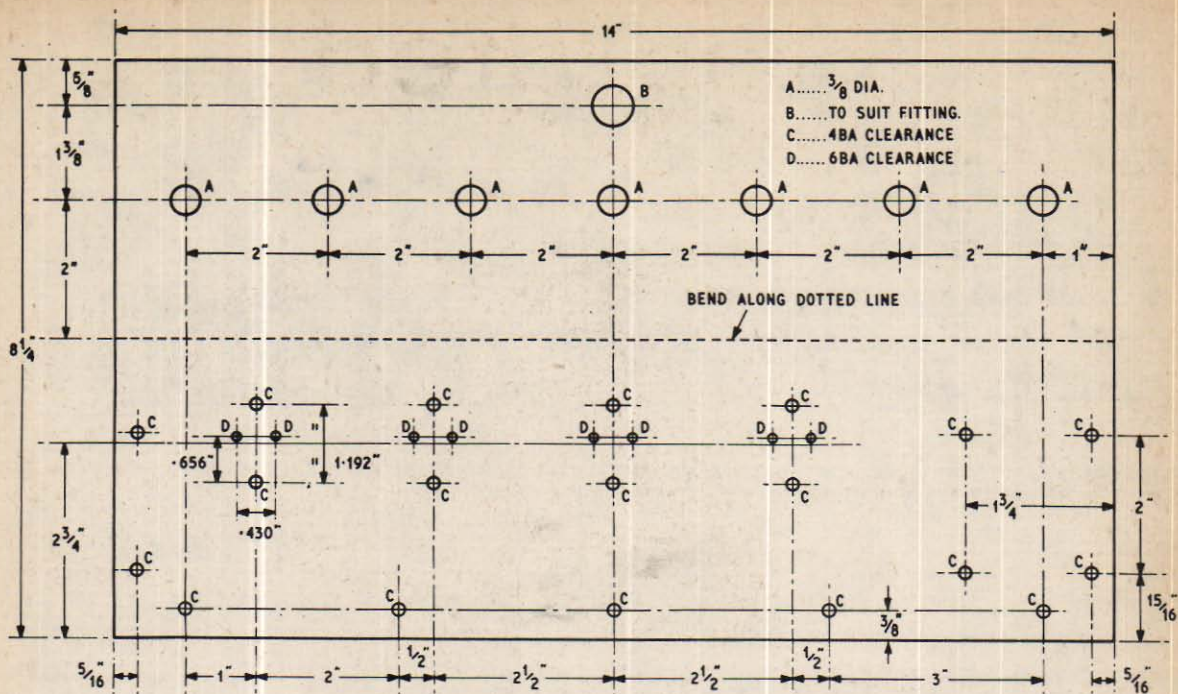


Fig. 6. Drilling details of Section I, the base and front panel. Bend away on the dotted line to look like the model shown in photograph below. Material 18 s.w.g. aluminium

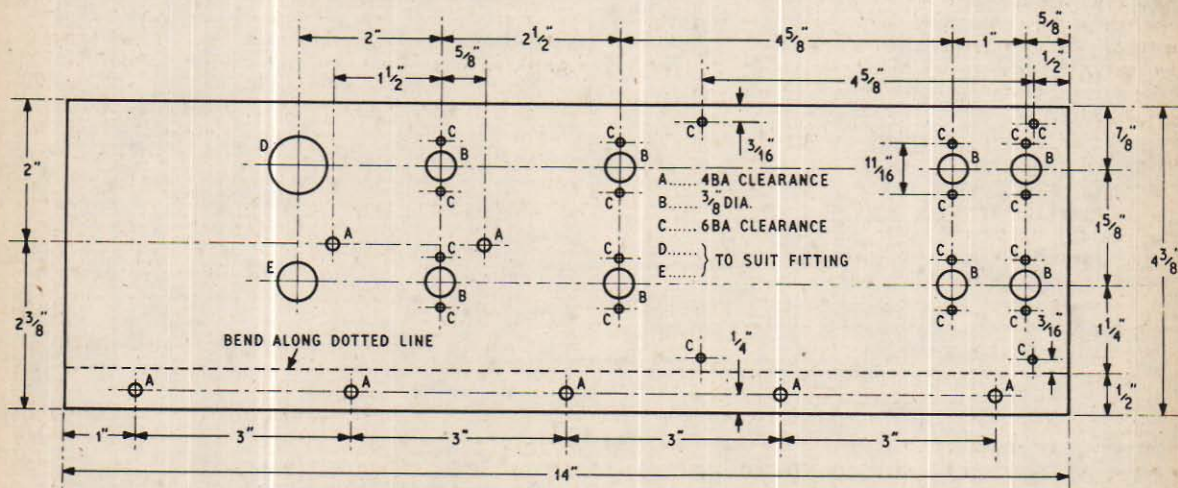


Fig. 7. Rear panel drilling details. Bend away on the dotted line (see photograph on next page). Material 18 s.w.g. aluminium

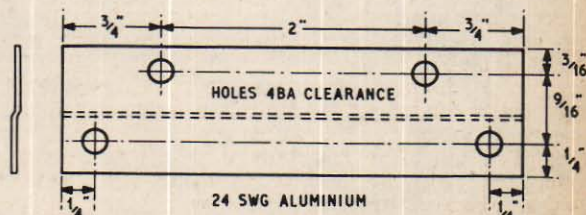
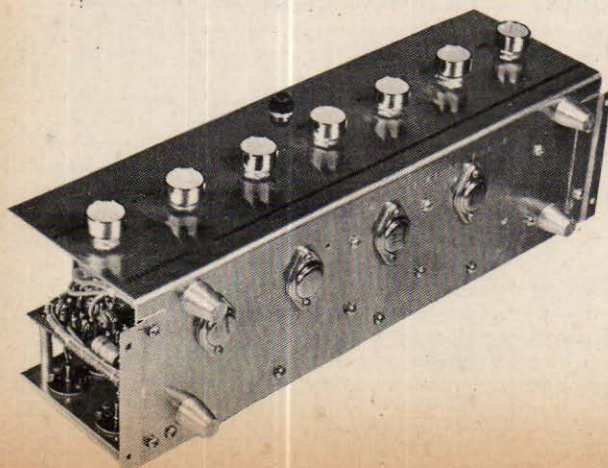
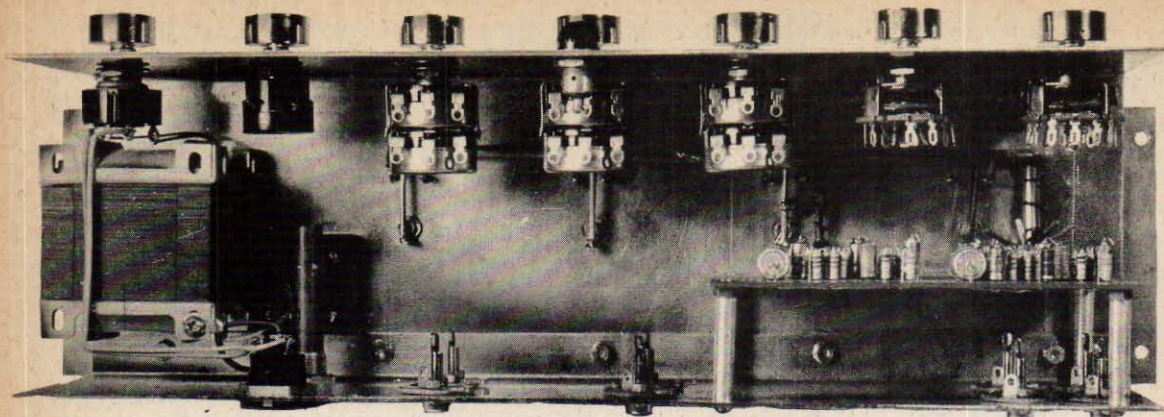


Fig. 8. The fixing brackets to hold the wooden case (see photograph on left)



The half-way stage. Most of the chassis mounted components are assembled. Before adding the capacitors wire up the output transistors in a cable form as shown, ready for connection to the board

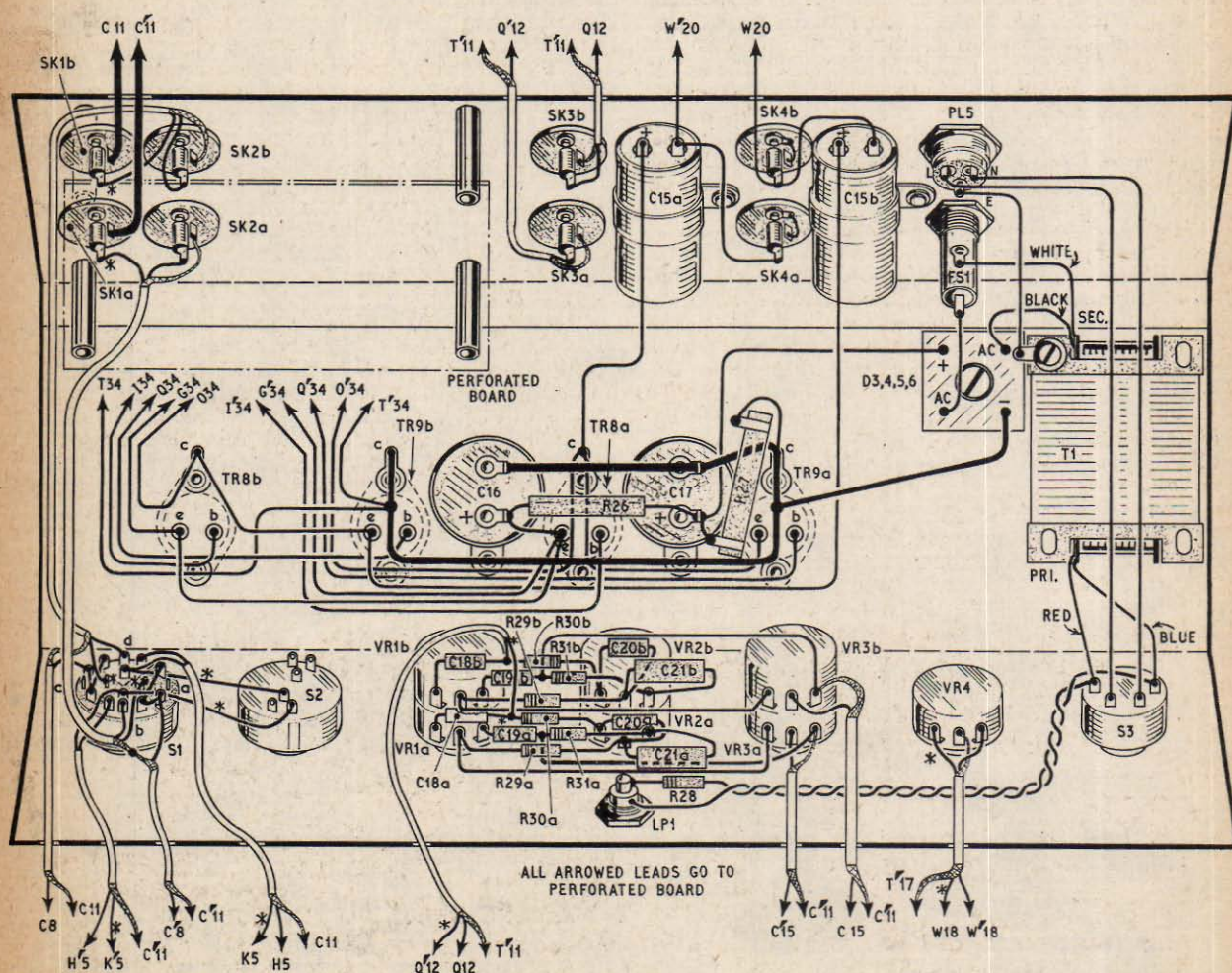


Fig. 9. The wiring of the base and front panel piece (Section 1) and that of the rear panel (Section 2), and assembled into one unit. Asterisks are shown to identify twin leads. Arrowed code numbers relate to perforated board locations (see Fig. 5 last month). For exact position of board see photographs. Observe thick 12 s.w.g. wires

certain instances to provide a simple screen to cover the appropriate part of the component board and the input sockets.

The cabinet was made from ordinary softwood and then finally finished with veneer. The cabinet just rests on the fixing brackets (Fig. 8) and then screwed in position from the underside. The front panel was satin finished by rubbing the surface of the material with steel wool coated with a silicon furniture polish.

Afterwards the surface was polished quite vigorously with a soft duster until all the polish was completely removed and the surface was reasonably shiny. The lettering was taken from a Letraset pack of electronic data and then sprayed or brushed with a clear varnish.

SETTING UP PROCEDURE

Having thoroughly checked out the wiring of the amplifier and set VR6a and VR6b at zero resistance, then VR5a and VR5b should be adjusted to about the mid-way point. **IT IS IMPERATIVE THAT THESE LATTER TWO INSTRUCTIONS BE CARRIED OUT PRIOR TO SWITCHING ON.**

The unit may now be switched on at the mains. At this stage it may be better not to connect in the speakers or any input while the d.c. conditions are set up. In the quiescent condition, that is to say when no input signal is being applied to the amplifier, the centre voltage measured at the emitter of TR9a or TR9b will not be half the rail voltage as expected. This is due to the reduction in the main rail voltage when the amplifier is functioning at full power output. When this happens then the centre voltage is indeed half of the rail voltage.

The voltage at this point should be set in the quiescent state by varying VR5a and VR5b until it reads exactly 35 volts on a 20 kilohm-per-volt meter. This should ensure that the amplifier should clip evenly when under full drive conditions.

Once this voltage has been set up it will be necessary to disconnect one of the amplifiers by breaking the positive supply to each amplifier in turn. It is essential to make sure that the whole of the amplifier section has been disconnected otherwise the current reading that follows from the setting of VR6a and VR6b will not be a true reading.

Having disconnected one of the positive supplies the volume control should be reduced to zero and an

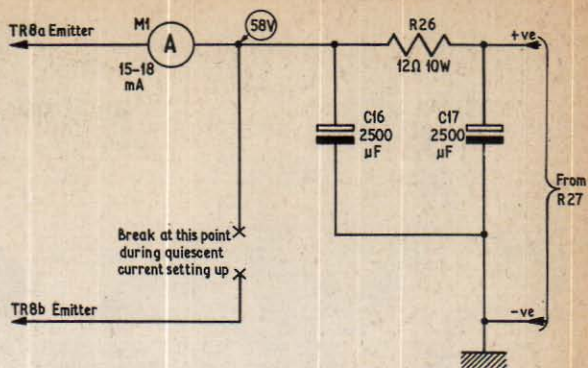


Fig. 10. Measure the supply quiescent current while adjusting VR6a and b. Break each channel h.t. line in turn while the other is being set up

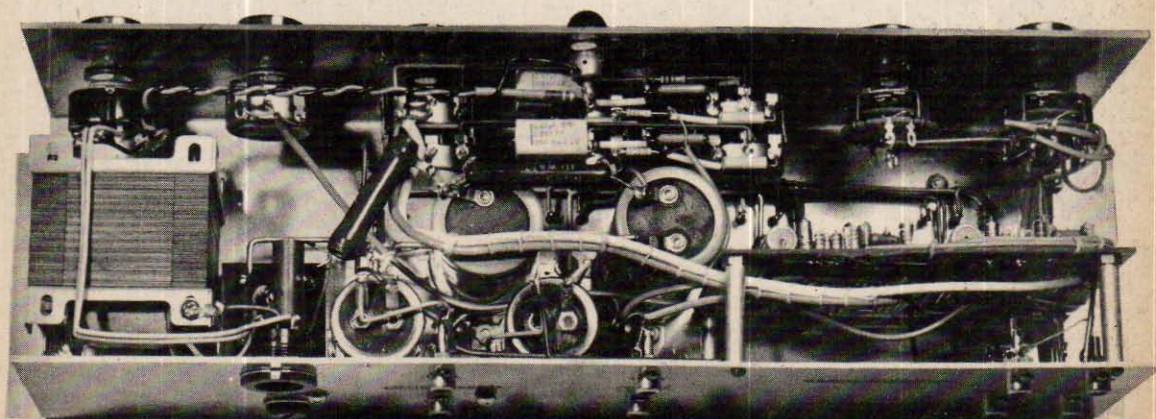
ammeter introduced into the positive rail between the junction of R26 and C16 and the amplifier positive rail as shown in Fig. 10. VR6a should now be advanced very slowly until the current measured lies between 15 and 18mA. Reversing the operation VR6b should be set up in the same manner.

If an oscilloscope is available then the setting up of VR5a and VR5b is much more of a simple matter. The oscilloscope should be connected across the terminals of the output socket and a 15 ohm resistor should be inserted in place of the loudspeaker.

The volume control should then be advanced to about a half-way position and a signal of 1kc/s introduced into any one of the input sockets of the same channel. The signal should be increased until one side of the waveform shown on the oscilloscope starts to flatten off.

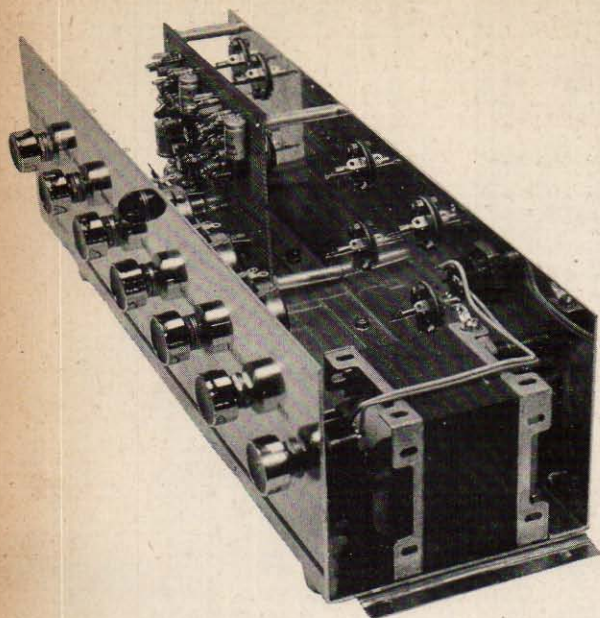
VR5a should now be varied until both halves of the waveform start to clip at the same time. The peak-to-peak voltage measured should be somewhere in the order of 43 volts. The voltage representing an output power of 10 watts is 35 volts peak-to-peak.

After the setting up of these four potentiometers there is no further setting up procedure required but it is advisable to check the input sensitivity and balancing operation to ensure that there is no great discrepancy between the channels.



The finished amplifier wired up and ready for testing and setting up

NEWS BRIEFS



Half-way stage in construction of the amplifier

A.C. TEST PROCEDURE

The volume controls should be advanced to their maximum output condition and the tone and balance controls set to the mid-position. The stereo/mono switch should be set to MONO and the input selector set to TUNER. A 1kc/s signal should be introduced into the appropriate input socket and should not exceed 250mV r.m.s. (measured on an a.c. millivoltmeter) for an output of 35 volts peak-to-peak as indicated by an oscilloscope or 12.5 volts r.m.s. measured on an a.c. millivoltmeter.

Now the input signal should be reduced to zero and the "function" switch set to the MIC position. The input level may now be advanced once more until the output across the load reads 35 volts peak-to-peak; the input signal required to promote this output should not be more than 5mV r.m.s. After transferring the input to the "phono" socket the input signal should not exceed 250mV r.m.s.

By checking the performance of the amplifier in the MONO condition it is possible to transfer the output measuring instrument from one output socket to the other so that a quick comparison can be made between the opposite channels.

Having ascertained the input characteristics the balance control may then be checked by reducing the volume control until the output is below 4 volts peak-to-peak, then turning the balance control in the appropriate direction. The output signal should now increase by approximately two and a half times, in other words the output voltage should now read about 10 volts peak-to-peak.

The tone control characteristics may be easily confirmed by referring to the curves shown in Fig. 4 (last month). There is also an output provided to feed a tape recorder giving 300mV r.m.s.

Note: The mains transformer T1 delivers 58V at a load of 50mA. At full load the secondary winding is rated 43V at 2.5A. ★

Baird Travelling Scholarship

As the outstanding scholar involved in the study of the science of television, Mr J. D. Penney, B.Sc.(Eng.) has been awarded the 1966 Baird Travelling Scholarship awarded through the Royal Television Society. Mr Penney is using his scholarship to further his investigation into tunnel diode amplifiers and superconducting tunnel diode amplifiers (tunneltrons). He visited several companies in the U.S.A. during November and has also been doing research work in this field with the aid of a Science Research Council grant.

Telemetry Monitoring of Waterways

A NETWORK of newly-developed electronic "sentinels" soon will be monitoring and recording quality data of many key waterways throughout the U.S.A. By the end of 1967, over 100 of these water quality data collection systems will be providing basic information for the United States Geological Survey on the behaviour of water resources, yielding data useful to agencies concerned with pollution control and other water management problems. The telemetry and computer systems are developed by Honeywell.

The Engineers' Day

BRITAIN's urgent need for professional engineers prompted the Government to stage The Engineers' Day Exhibition at the Science Museum, London.

Opened by The Queen on November, 18, 1966, this exhibition will run until January 14, 1967. Girls and boys between the ages of 13 and 18 are the target. Large parties from schools in southern England have already visited this exhibition; it is also open to individual visitors and is likely to be a major attraction during the Christmas holiday period.

All young people who are trying to formulate ideas for a career would be well advised to seize this opportunity of learning about the exciting and rewarding future that is assured for the qualified engineer. Fathers should make a point of attending too, for much bias against engineering and technology as a career stems from out-moded ideas and prejudices about the subject held by parents.

The great variety of paths open to the practicing engineer is vividly demonstrated by the individual exhibits of national industries and Government departments—all manned by qualified engineers ready and eager to talk about the work of "their day."

PRACTICAL NEW YEAR THOUGHT . . .

If you've forgotten to send a fellow electronics enthusiast a Christmas present, why not send him the perfect New Year gift—a year's subscription to PRACTICAL ELECTRONICS?

Simply send your friend's name and address together with your own and remittance to cover each subscription to The Subscription Manager (Z2), PRACTICAL ELECTRONICS, Tower House, Southampton Street, London, W.C.2. An attractive greetings card will be sent in your name to announce each gift.

RATES (INCLUDING POSTAGE) FOR ONE YEAR (12 ISSUES): U.K. AND OVERSEAS £1 16s. 0d. U.S.A. \$5.00.

To make sure of your own copy why not place a regular order with your newsagent.

Charge Storage in TRANSISTORS

Two unusual circuits using this effect

By K. T. Wilson

WHILE a transistor is conducting, charge is flowing between emitter and collector through the base region. The sign and direction of this charge will, of course, depend on whether the transistor is a *pnp* or a *npn* type. Some of this charge will flow to the base circuit, and the ratio of the amounts of charge flowing in the two circuits is the current gain or amplification factor, commonly represented by the symbol h_{fe} .

When forward bias is removed from the transistor, a certain amount of charge will still exist in the base region, and consequently the transistor will continue to conduct until this charge has been dissipated. If the base is sharply reverse-biased, base current will flow in the opposite direction to normal and will help to dissipate some of this excess charge.

This characteristic is used in several high-quality audio amplifiers to obtain an extended frequency response from power transistors. In such a case, using power transistors which would normally show a response 3dB down at 4kc/s, reverse base currents of 20 to 30mA may be flowing into the base of each power transistor in order to sustain a level response at 10kc/s.

STORAGE TIME

If the base is not reverse biased, however, the stored charge supports an undiminished collector current for some time until the charge is exhausted. This delay time is called the *storage time* of the transistor, and depends mainly on the current which the transistor was passing before base cut-off. Conversely, when forward bias is applied, current does not flow in the

collector circuit immediately. In this case the odd phenomenon of *base-following* can occur—the collector voltage moves in phase with the base voltage until normal transistor action comes into effect.

Normally, both these effects cause considerable trouble in transistor switching circuits, and combined efforts had to be made by transistor designers and by circuit designers to give us the very fast switching arrangements which exist today.

It is possible, however, to design circuits which make deliberate use of these two charge storage effects.

A PULSE SHARPENER

Fig. 1a shows a pulse-sharpener which makes use of the switch-on time. With no input, the transistor is held cut-off by the positive bias developed by the current flow through the diode, D1 via R2 and R3. If a negative pulse is now applied to the input, the output will follow the input potential until the transistor switches on. When this happens, the output potential goes very sharply positive, cutting off the diode. In this way, a sharp spike very suitable for triggering purposes can be produced from a rather poor square wave or any other waveform with a reasonable rise time over a limited voltage. The waveforms are shown in Fig. 1b.

A DELAY CIRCUIT

The second circuit shown in Fig. 2a depends on the switch-off time and the *base-following* effect. The bias on TR1 is adjusted until roughly half the battery volts are dropped across R1. In this condition, both diodes are back-biased by about 4½ volts each and if the input pulses are less than this, they will not change the state of the transistor. If a negative pulse of greater amplitude is applied, it will appear unchanged at the output of the transistor without causing any switching action, as the diode D2 is back-biased.

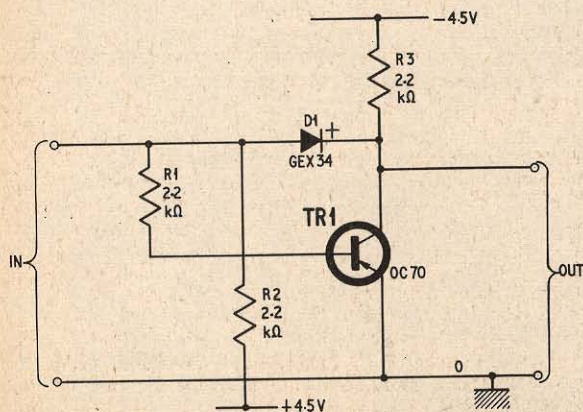


Fig. 1a. Basic circuit for a pulse-sharpener utilizing the "switch-on time" effect. The transistor and diode specified are suitable for pulses not narrower than $1\mu s$

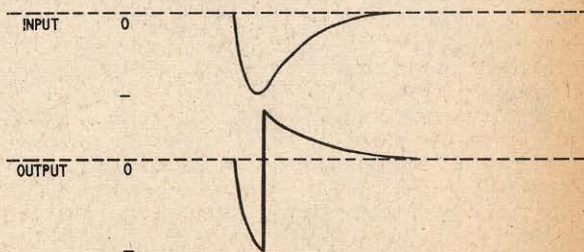


Fig. 1b. These waveforms show how the output initially follows the input, but swings very sharply positive when the transistor switches on

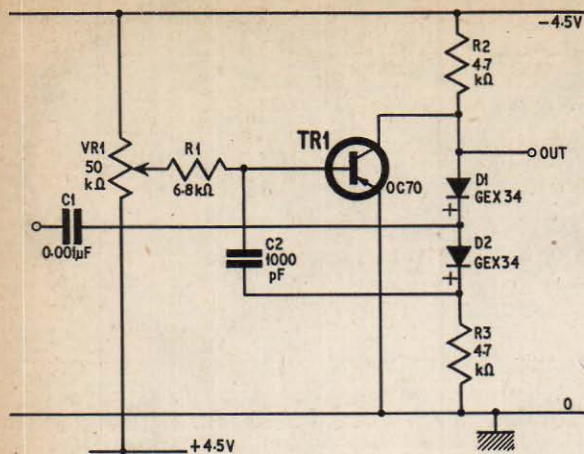


Fig. 2a. Basic circuit using the base-following effect

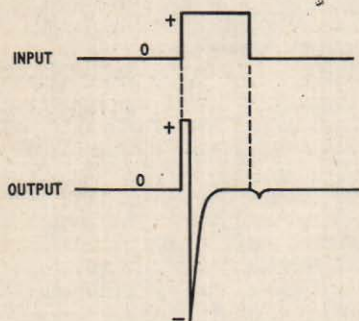


Fig. 2b. These waveforms show how sharp positive and negative pulses are obtained from a positive input pulse

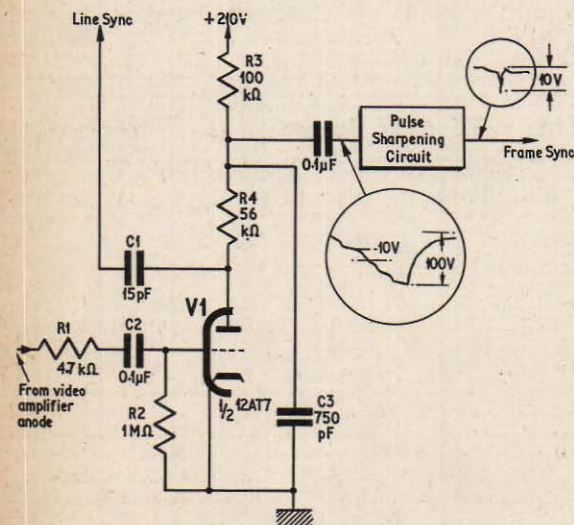


Fig. 3. A practical application of the pulse-sharpener is this arrangement to produce a sharp pulse for frame sync in a TV receiver

If a positive pulse is applied, however, D2 conducts, the pulse appears at the base of TR1 and, since the transistor does not switch off instantly, the positive pulse also appears at the collector. Both diodes D1 and D2 are now in a conducting state and the pulse at the collector serves to sharpen that at the base in bootstrap fashion until the transistor switches on.

This circuit can be used to discriminate between positive and negative pulses, to obtain sharp positive and negative pulses from a single positive pulse or from the leading edge of a square wave, or to obtain a pulse delay of a fixed amount. It should be noted that the values of the coupling capacitors have very little effect on the waveforms.

Some examples will now be given of practical applications of the two effects illustrated in Fig. 1 and Fig. 2.

FRAME SYNC PULSE

One use of the pulse sharpening circuit is shown in Fig. 3. On most television receivers, the frame sync pulse is obtained by integration, and the resulting waveform consists of a series of steps superimposed on a slowly rising waveform. The frame time base requires a sharp pulse for really good synchronisation, however, and the usual circuit does not provide it, so faulty interlace and even frame jitter are common faults. The use of the pulse sharpening circuit greatly improves this. Only one of the steps is sharpened, the others occurring either while the transistor is too far beyond cutoff to respond, or when the transistor is fully on. Thus one, and only one, sharp pulse is delivered to the frame time base, and perfect synchronisation is the result.

IMPROVING A SQUARE WAVE

Another use for the pulse sharpening circuit is shown in Fig. 4. In this case, the problem is a square wave generator whose output has an insufficiently sharp edge. With older type valve operated square wave generators, this usually occurred with the positive going leading edge of a positive square pulse.

This problem is tackled in a slightly different way, as the output pulse must be very considerably sharpened. The leading edge of the pulse is picked off at an earlier stage of the generator, where it is negative-going and still fairly sharp. This is differentiated and applied to the sharpening circuit which produces a negative pulse followed at once by a very sharp positive pulse. This positive pulse is picked off by a diode and added to the square wave whose positive leading edge is defective. The excess is then clipped off by a Zener diode, and the result is an excellent square wave.

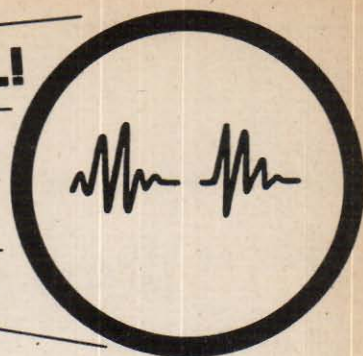
OSCILLOSCOPE TRIGGERING

Fig. 5 shows how the circuit of Fig. 2 can be used to provide the facility for oscilloscope triggering in a pulse generator.

Unless the oscilloscope is triggered before the arrival of the pulse being observed, the front edge of the pulse will not be seen due to the time needed to start the time base. If the trigger for the pulse generator (whether internal or external) is sent through a delay circuit so that the original trigger is used for the oscilloscope and the delayed trigger is used for the pulse generator, then the whole of the pulse will be visible on the c.r.t. This is a useful facility which is often missing on home-made pulse generators.

LOOK!

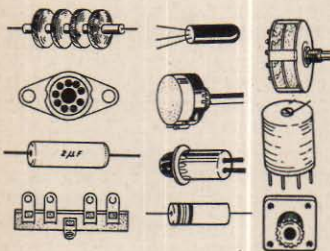
PRACTICAL!
VISUAL!
EXCITING!



a new 4-way method of mastering
ELECTRONICS
by *doing* — and — *seeing* . . .

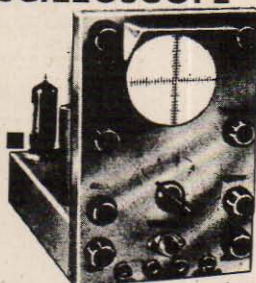
1 ▶ OWN and HANDLE a

complete range of present-day **ELECTRONIC PARTS** and **COMPONENTS**

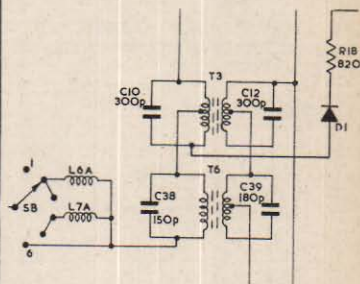


2 ▶ BUILD and USE

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 | ● PHOTO ELECTRIC CIRCUIT | ● A.C. EXPERIMENTS |
| ● TRANSISTOR EXPERIMENTS | ● COMPUTER CIRCUIT | ● D.C. EXPERIMENTS |
| ● AMPLIFIERS | ● BASIC RADIO RECEIVER | ● SIMPLE COUNTER |
| ● OSCILLATORS | ● ELECTRONIC SWITCH | ● TIME DELAY CIRCUIT |
| ● SIGNAL TRACER | ● SIMPLE TRANSMITTER | ● 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 PEI

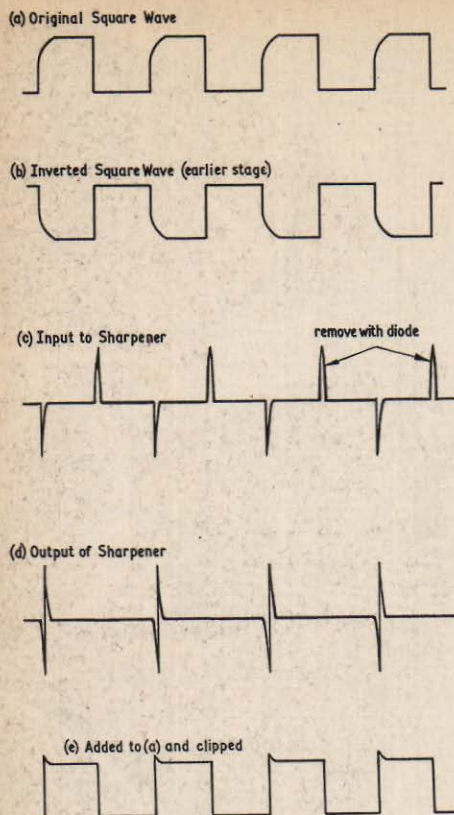


Fig. 4. Deficiency in the leading edge of a square wave can be restored by the process depicted in the waveforms (a), (b), (c), (d) and (e).

Finally, as shown in Fig. 6, the circuit of Fig. 2 can be used to generate square waves of variable width. The output of the circuit is applied to a Schmitt trigger so that a pulse applied at the input of the circuit produces a square wave whose width can be altered within limits by varying the bias on the base of the transistor TR1.

PRACTICAL NOTES

Since, in each of these circuits, the properties of the transistor rather than the external components determine the action of the circuit, almost any transistor will work.

Small a.f. transistors, with a cut-off (common-base) of a few hundred kilocycles, will give output pulses of one microsecond or better; r.f. transistors can produce pulses with extremely rapid rise and fall times and widths of down to 50 nanoseconds. The author's prototype circuits were built on "Veroboard", but any construction is suitable as long as it is remembered that stray capacitance must be kept to a minimum round the collector circuit. A rather straggly layout is often better for the purpose of reducing strays than a very neat "everything-close-to-the-baseboard" form of construction.

Some variation in performance may be noted using different diodes. The same type of switch-off problems exist for diodes as for transistors. The point contact diodes specified are suitable for use with the transistors specified, but those who aspire to very fast-rising waveforms will have to use faster diodes such as those used in computing. For most purposes, however, it is not necessary to use the ultra-fast gold-bonded type of diode; in fact the virtue of these circuits is that they enable sharp pulses to be produced with the minimum of expenditure in components. ★

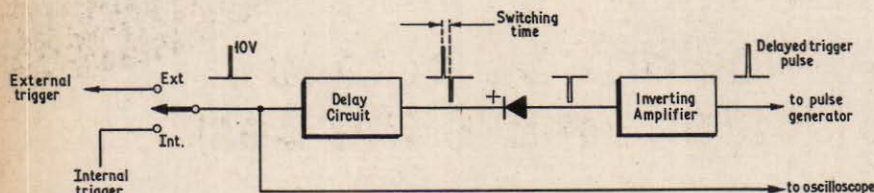


Fig. 5. An arrangement for using the base-following effect to provide a delayed triggering facility for an oscilloscope

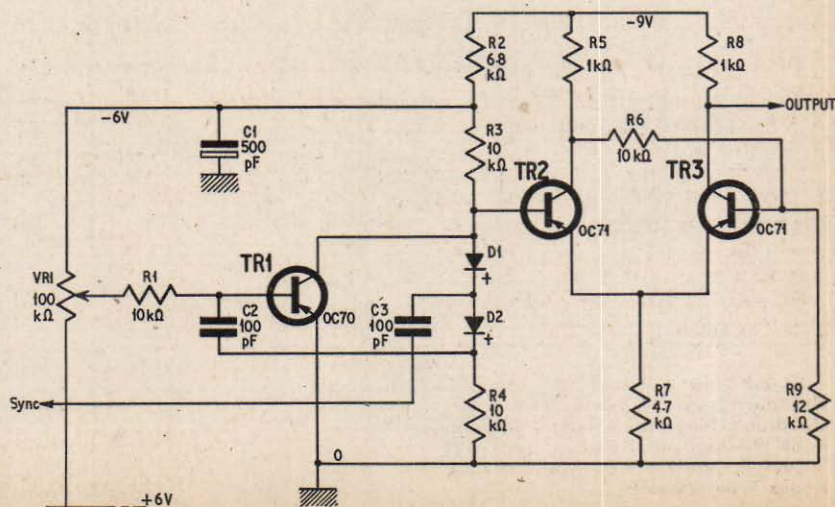
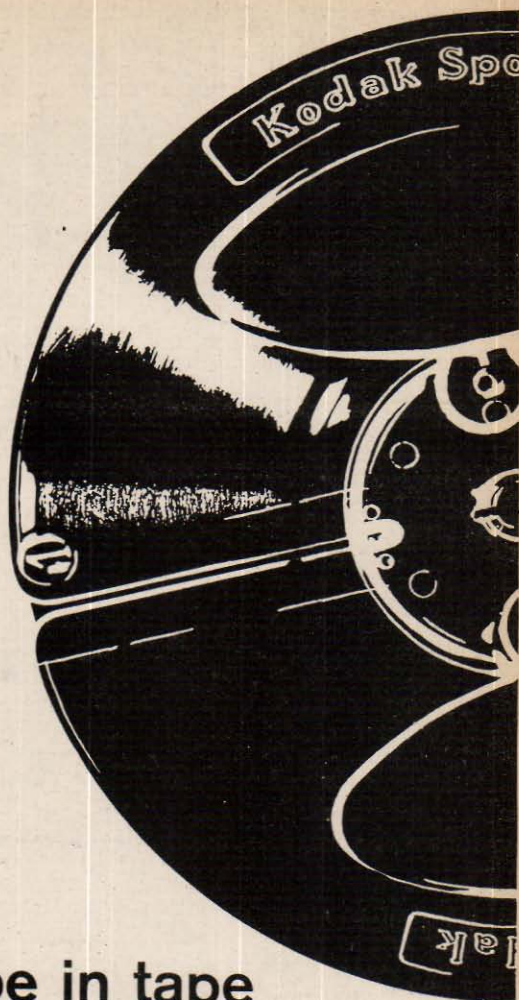
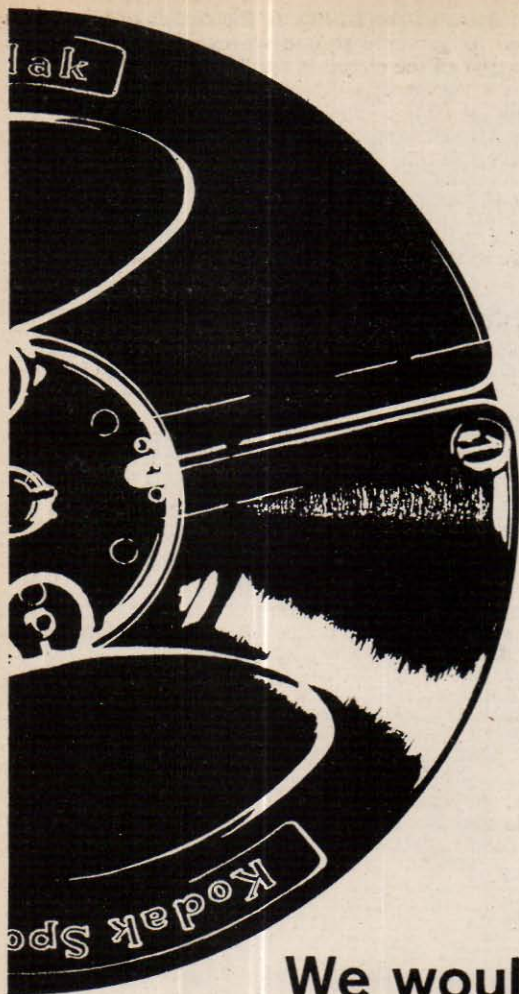


Fig. 6. This circuit provides square waves of variable width and is derived from Fig. 2



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.....

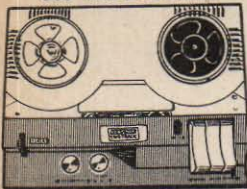
Address.....

P.E.

'Kodak' is a registered trade mark

THE ELECTRONICS & SCIENTIFIC CENTRE

MAGNAVOX-COLLARO 363 TAPE DECKS



The very latest 3-speed model—1 $\frac{1}{2}$, 3 $\frac{1}{2}$, 7 $\frac{1}{2}$ i.p.s. available with either $\frac{1}{2}$ track or $\frac{1}{4}$ 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 $\frac{1}{2}$ x 11 x 5 $\frac{1}{2}$ in. deep below unit plate. For 200/250v. A.C. mains 50 c.p.s. operation. New unused and fully guaranteed.

LIND-AIR PRICE

$\frac{1}{2}$ track model £10.10
 $\frac{1}{4}$ track model £13.95
Carriage and Packing 7/6 extra.

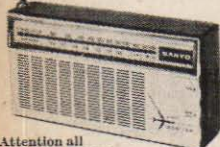
SINCLAIR SUPER MINIATURES

Micro 6 miniature radio £2/19/6.
Micro-FM (tuner/receiver) £5/19/6.
P23 M.P.S. unit £3/19/6. Z-12
12 watt amp and pre-amp,
fully built £4/19/6. Stereo 25
pre-amp control unit, fully
built £5/19/6. P & P.
3/6 each.



BREAKTHROUGH! AT LAST!!

9 TRANSISTOR RADIO WITH AIRCRAFT BAND



Attention all enthusiasts, this is history! Lind-Air first in the field once again with this wonderful SANYO Portable transistor radio with medium and Aircraft wave bands. Transmitting from 107 to 135 Mc/s. Limited quantity available, so send at once.

Price only £17/10/0

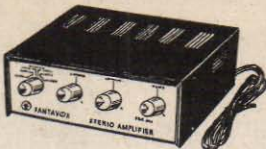
(Complete with telescopic aerial, leather carrying case and earpiece). P. & P. 5/6.



SELECTOR DRIVE

A very interesting item with numerous applications consisting of an electro-magnet and brass tooth wheel. A switch wiper and contacts are coupled to this and are arranged to be on for 10 pulses and off for the next 15. An auxiliary contact is normally on, but off for one in every 25 pulses; complete with suppressor resistors and a series contact to facilitate continuous operation. Absolutely ideal for window displays, switching lamps or models, 12 or 24 v. D.C. Brand New and Boxed. 12/6, inc. P. & P.

FANTAVOX STEREO AMPLIFIER MODEL MG-333



The Stereo MG-333 is a compact and handsomely designed dual channel amplifier for use with stereo record players and AM or FM tuners. The amplifier operates from a power source of 105-125 (or 200-240) volts, 50/60 cycle AC, and is equipped with individual volume controls for each channel, a continuously variable tone control, and a stereo-monophonic mode switch. Price £28/19/6. P. & P. 6/6.

BRAND NEW GRAM DECKS FROM STOCK

(With Cartridge unless stated)

B8R UA 14 £4.9.6. UA 16 £5.9.6.
GARRARD 8pins.
1000 (Mono or Stereo) 8pins.
3000 (Stereo) £9.19.6.
SP25 £9.19.6.
AT 60 £28.19.6.
401 (Less Cartridge and Arm) £24.19.6.
LAB 80 (Less Cartridge) £24.19.6.
WB1 Base £5.18.0.
WB2 Base £5.10.3.
Postage & Packing 5/- on each.

MULTIMETERS

C.1001. (as illus.)
20,000 Ω /volt £3/12/6.
P. & P. 3/6. D.14.1,000
 Ω /volt. £2/12/6. P. & P.
3/6. C.A.B.Y. N.H. 200.
20,000 Ω /volt £2/12/6.
P. & P. 3/6. C.A.B.Y.
B.40. 10,000 Ω /volt.
£2/12/6. P. & P. 3/6.
TAYLOR T.M.K. 500.
30,000 Ω /volt. £5/19/6.
P. & P. 6/6. New AVO Meters from stock.
MINILAB
71 Tester. £6/19/6. P. & P. 6/6.



PROFESSIONAL ELECTRIC INSTANT HEAT SOLDER GUN

Ideal for model makers, home repairs, electronics, radio, TV, etc. Unique features include interchangeable tip, extension barrels, comfortable grip with trigger control. "U" shaped 3 $\frac{1}{2}$ in. bit to minimise wear. Light beam is automatically directed onto end of bit when ON/OFF trigger is in use. 85 watt element with special ventilation. Complete with 2-pin, 5 amp. plug. 230-250 volts. Spares 49/6 P. & P. 2/6 available.



SYNCHRONOUS CLOCK MOTORS

Geared for 40 revolutions per hour. 230v. 50 cycles. With mounting flanges. 29/6. P. & P. 1/6.

MODEL MAKER'S

Miniature D.C. Motor. Ideal for driving a gear system or can be used as a Tachometer. Speed 10,900 r.p.m. at 230 m.A. 6.3 v. D.C. Housed in black ebonite case, size 1 $\frac{1}{2}$ in. x 1 in. dia. Spindle $\frac{1}{16}$ in. long x $\frac{1}{16}$ in. dia.
Two for 12/6. P. & P. 2/6.



L.S.T. COMPONENTS

23 NEW ROAD, BRENTWOOD, ESSEX

OUR FAMOUS BARGAIN PACKS:

5 Mullard OC81 brand new first grade.....	10/-
5 Mullard OC73 (high voltage OC71's).....	10/-
4 Mullard OC83 will switch 500 MA.....	10/-
2 Mullard OC81 and driver OC81D.....	7/-
2 Mullard OC45 I OC44 RF Kit.....	8/6
3 2N2926 Planars beta 150-300.....	11/-
8 100 PIV $\frac{1}{2}$ amp. Silicon Rectifiers.....	10/-
6 NPN Silicon transistors RF and AF.....	10/-

SPECIAL XMAS BARGAIN PARCEL: 30/- post paid.
Comprising: 25 RF transistors, 25 Audio transistors, 25 Switching transistors, 1 OC16 equivalent power transistor and 25 50 volt 200 MA Silicon diodes.—All tested—Normally 42/-.

WE ALSO STOCK:

Unijunctions	Transistors/Examples
2N2160..... 15/-	2N1304..... 6/9
2N2646..... 14/6	BFY51..... 9/6
Thermistors	Power Rectifiers
A25..... 12/6	IS413..... 6/9
KS31W..... 2/-	SCR's/Thyristors
Mains Neons	CR74..... 27/6
We stock an attractive panel neon @ 3/3 incl. built-in resistor.	

Send 1/- stamps for our 16-page catalogue, which includes 5-page JEDEC reference section and lists many hundreds of transistors, diodes and other special devices.
POSTAGE: Please add 9d. postage and packing.

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. 10 $\frac{1}{2}$ x 5 $\frac{1}{2}$ x 7 $\frac{1}{4}$ £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 1/67

GOODMANS INDUSTRIES

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

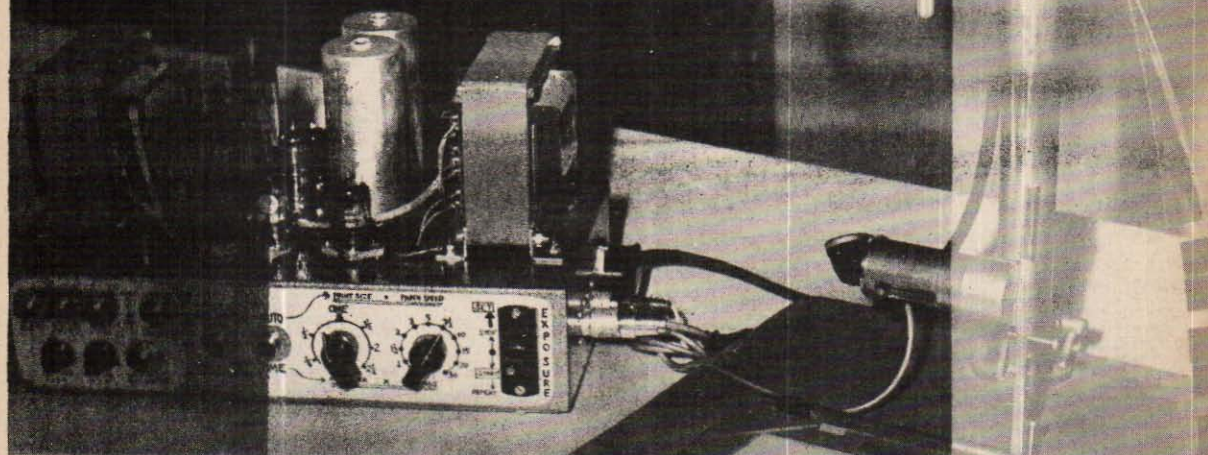
**LIND-AIR
Electronics
Ltd.** DEPT. P.E.4

53 TOTTENHAM COURT ROAD, LONDON W.1

LANGHAM 3653

MANY MORE INTERESTING BARGAINS AVAILABLE AT THE SHOP

THE LUMOSTAT



PART THREE

by M.L. MICHAELIS M.A.

IN this final article, the automatic function is discussed in some detail and the general operating procedure explained. Constructional details of the photocell sensing unit are also included.

AUTOMATIC EXPOSURE FUNCTION

The range of capacitor values to be wired to the contacts of S9b in relation to the range of photographic speeds we desire to work with is determined by the following expression.

$$C = \frac{1}{500 S} \mu F \text{ (S in ASA units).}$$

Let us now look at the range of photographic speeds which come into question in the average darkroom. We will do this in the form of a small table, listing major groups of photographic materials in the first column, approximate ASA speed ratings in the next column, resulting values of C in the third column and the corresponding settings of S9 with specified component values in the final column. Note that the settings of S9 in "seconds" are given merely as time-function scale positions. These times have no direct meaning here for the automatic function, since there the exposure time is computed and varied automatically.

The camera film speeds are quoted just for comparison and orientation in the above tabulation. If such films were to be used under the enlarger instead of in the camera, the integrating capacitor values would need to be unmanageably small in order to obtain fast enough shut-down of the exposure. In such cases it is essential to weaken the lamp intensity of the enlarger (insertion of high-density reduction filters) and then to switch over to the time-function of

the Lumostat. As far as the automatic function is concerned, it is evident that there are no immediate problems in exposing materials of low sensitivity in this manner, whilst high-sensitivity materials become increasingly problematic on account of the very small values of C then required.

Let us now look at this problem more closely, in order to determine the smallest value of C which is usable in practice, and thus the maximum permissible speed of a photographic material for automatic exposure. If on occasion materials of *greater speed* than this determined limit are used in the darkroom, they will have to be exposed on the *time* setting of the Lumostat, set to exposure times as determined by a conventional exposure meter, estimated, or found out by trial exposures. The so-called *dark current* of the photocell and the question of insulation impose a lower limit on C before stray capacitances would set an ultimate limit.

THE DARK CURRENT

Every photocell passes a minute current even in total darkness, due to thermal emission at room temperatures, cosmic radiation, etc. Thus V7 will fire after a certain elapse of time even in total darkness, because the capacitor selected by S9b will gradually charge up on the minute dark current. The smaller C, the sooner will this process be completed.

It is quite essential to use only the very best materials in the entire integrating grid circuit of V7. Thus use a ceramic switch for S9, a ceramic base for V7 and best quality capacitors for the integrator banks on S9.

Also pay particular attention to the insulation of switches, relay contacts, plugs and sockets, photocell

cable and photocell mounting. The weakest point of the whole chain is V7 itself, since the guaranteed leakage resistance between grid and other electrodes of most small ECC-range double triodes is only in the region of 100 to 500 megohms. This is not sufficient here. The ECC82 is an exception, being specially specified for unusually high grid insulation among valves of its class. Make sure to use a new and guaranteed ECC82.

Check the entire insulation of the circuit as follows. Set S9 to "½ sec." and VR2 to minimum ($\times \frac{1}{4}$), i.e. to the fastest available timing setting. Switch to "AUTO" and have the photocell plug, cable, socket and housing connected, but the photocell removed from its socket. Start an exposure.

If there is an elapse of at least one minute before the exposure is terminated automatically through insulation leakage, the latter is satisfactory as far as leakage between positive voltages and V7 pin 2 is concerned. However, if the exposure does not terminate within 5 minutes, insulation leakage between V7 pin 2 and chassis points is excessive. The offending component (switches, relays, etc.) can be determined by disconnecting these one by one and taking the wiring direct. If none of these components are at fault, then the capacitor itself may be poor. Note that we here require insulation efficiencies of thousands of megohms, since the photocell operates with usable photoelectric currents down to as low as one hundredth of a microamp at nearly 90V anode voltage, i.e. with a photoelectrically controllable impedance of up to nine thousand megohms.

Assuming that the insulation is satisfactory, we are left solely with the inevitable dark current of the photocell as limiting factor. This behaves as an insulation leakage to a positive voltage, thus making all computed exposures too short. We may consider the tolerable limit to lie at 25 per cent error introduced due to this cause, since otherwise correctly exposed black-and-white photographic materials have this exposure tolerance under virtually all circumstances and slight correction with VR2 is possible anyway and valid over long sequences of exposures.

Tests with the prototype showed operation being stable and as ideally predicted up to very much longer times of exposure covering normally required values. This must mean that the actual dark current of the photocell is very much smaller indeed than the makers guaranteed maximum of $0.05\mu\text{A}$. It was found that V7 fires on dark current after about 120 seconds, not 1.5 seconds, under the above-mentioned conditions.

TABLE I

Type of Photographic Material	Approximate Speed Factor	Value of C	Setting of S9 ("seconds")
FOR THE CAMERA			
Special high-speed films	up to 20 thousand ASA commonly marketed	—	—
Normal films	20 to 80 ASA	—	—
DARKROOM MATERIALS			
Diapositive plates	2 ASA	0.001 μF	1/2
Diapositive copy film (e.g. Perutz Positive)			
Documentation enlarging paper (e.g. Agfa AGEPE)			
Ordinary bromide enlarging papers	0.3 to 1.0 ASA	0.002 μF to 0.0068 μF	1, 1.5, 2, 3, 5
Direct-reversal copy films (e.g. Ferrania CONTRA-TIPPO DIRETTO ORTO)	about 0.05 ASA	about 0.04 μF	10 or 15
Reserve in hand on Lumostat for still more insensitive special materials	down to 0.015 ASA	up to 0.1 μF	20 or 30

This permits automatically computed exposures of up to 30 seconds in the settings for bromide enlarging papers before the tolerable limit of 25 per cent dark current error is approached.

Practical tests with several hundred enlargements of the most varying densities have shown that if VR2 is judiciously adjusted, automatic exposures up to 60 seconds duration are adequately accurate on normal bromide paper. Most exposure times with a 75W lamp in an enlarger with a lens opening up to about f/4, with f/5.6 or f/8 as working setting, and enlargement up to half or full postcard size from 35mm negatives, come out at 1.5 to 10 seconds on bromide paper. This is a full order of magnitude below the dark-run time, so that dark current errors are normally negligible in practice.

The dark current is thus some 80 times smaller than the maximum value which the makers guarantee as never being exceeded. The maximum value applies when the photocell is run near the maximum permissible ambient temperature, which is 70°C.

The dark current is strongly temperature dependent, as is any thermal electron emission process, so that it is very much less at room temperatures. However, in order not to aggravate other factors which might cause the dark current to rise, the photocell should not be subjected to intense illumination with anode voltage applied. Thus switch back to the time function and preferably cover the photocell up before switching on the main white ceiling light after the conclusion of a working session.

In principle, R23 gives adequate protection even if intense illumination should inadvertently reach the photocell, since at the maximum safe photo-current of $5\mu\text{A}$ it gives a voltage drop making the anode voltage collapse down to a small residual value. Under normal working conditions, R23 has no effect since its value, although high as far as carbon resistors go, is quite negligible in comparison with the photocell impedance. R23 thus need not be of high accuracy, but it should be of good stability since it is an appreciable part of the time-determining resistor chain on the time function.

In view of small dark current errors, it would be pedantic to specify close tolerance capacitors for the automatic function bank on S9b, yet these capacitors must possess meticulous insulation, calling for types such as Siemens "Styroflex" which happen to have tolerances of 1 or 2 per cent. For the time function bank on S9a, modern metallised plastic film capacitors of any make, especially if selected from the ranges marketed for "slow time-bases", are most suitable.

BEHAVIOUR AROUND 2 ASA SETTING

Referring back to the table of speed ratings of dark-room materials and corresponding capacitance settings of S9 (derived from theoretical considerations well confirmed by practical tests with the prototype) we see that C must be about 1,000pF for exposing diapositive plates and sheet films as well as high-speed documentation enlarging papers, all of which are some two to six times faster than ordinary bromide papers. In the mid-way setting of VR2, dark current will shut down the exposure after some 40 seconds with this value of capacitance, dropping to some 10 seconds when VR2 approaches minimum setting on various picture size corrections described below. This brings the maximum usable automatic exposure down to somewhere between 2.5 and 10 seconds, which is beginning to cut things rather fine.



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 inter-changeable 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



To: **GOLDRING MANUFACTURING CO. (G.B.) LTD.**, 486-488 High Road, Leytonstone, London, E.11.

Please send me descriptive leaflets on

Name

Address

☐ TURNTABLE UNITS ☐ TRANSCRIPTION ARMS

☐ MONO & STEREO CARTRIDGES

☐ HI-FI ACCESSORIES

To: Goldring Manufacturing Co. (G.B.) Ltd., 486 High Road, Leytonstone, London, E.11. Telephone: Leytonstone 8343

KIT AND EQUIPMENT OPPORTUNITIES FROM T.R.S.

DE-LUXE RECORD PLAYER KIT

An elegantly designed quality instrument that builds into a superb reproducer. With 4 Sp. Garrard Auto-Slim unit and special Mullard high quality 3 watt printed circuit valve amplifier, vol. bass and treble controls, 8" x 5" 10,000 line speaker. Contemporary styled 2-tone cabinet, charcoal-grey and off-white with matching blue-velvet. Size 17 1/2" x 16" x 8". A stylish unit capable of quality reproduction. Circuit and const. details 2/6 (free with kit).

COMPLETE KIT £13.19.6
Carr. and ins. 12/6
Ready wired 30/- extra. Illuminated perspex control panel escutcheon, 7/6 extra. Four contemporary mounting legs, 6in. 6in. 6in. 11/6; 12in. 12/6 extra.



Now for STEREO RADIO with a T.R.S. Stereo F.M. Decoder

Developed out of a proven Mullard design and produced specially by T.R.S. Six transistor unit with built-in stereo indicator, readily adaptable for use with valve or transistor equipment. For 9-15 v. operation. Complete kit with circuit and instructions £4.19.6 (plus p/p 2/6). With pre-aligned inductors £5.5.0 (p/p 2/6).

TAPE OPPORTUNITIES

1500' 7" REEL American professional quality tape. Gives 1 1/2 hrs. playing per track at 3 1/2 r.p.s. With leader and stop folds. In attractively presented sealed boxes. Ideal for 2 and 4 track machines, mono or stereo. Outstanding value at 17/6 per reel (p/p 1/- for first reel, 6d. each after first when ordered at same time).

UNIQUE DOUBLE SIDED TAPE on 5 1/2" reels. Superb quality used in normal way. Ideal for experimenters too. 650' 9/-; 600' 8/6 (p/p 1/- per single reel, 6d. for each additional).

EMPTY TAPE REELS (Plastic)
3 in. 1/3, 4 in. 2/-, 5 in. 2/-, 5 1/2 in. 2/-, 7 in. 2/3.
PLASTIC REEL CONTAINERS (Cassettes)
3 in. 1/3, 5 in. 1/9, 5 1/2 in. 2/-, 7 in. 2/3.

MISCELLANEOUS

ENAMELLED COPPER WIRE—2 oz. reels
14 g.-20 g. 3/4; 22 g.-28 g. 3/8; 30 g.-34 g. 4/8;
36 g.-38 g. 4/8; 30 g.-40 g. 5/- etc.
VEROBORD—All sizes including 3 1/2 x 5in.,
5/2; 3 1/2 x 3 1/2 in., 3/8; 3 1/2 x 1 1/2 in., 12/6. All
accessories and tools in stock.

VOLUME CONTROLS, LOG and LINEAR—
5K-2, 10 3in. Spindles Morganite Midget Type
1 1/2 in. diam. Guar. 1 year. LOG or LIN ratios
less 5s. 3/8. D.F. 8v. 5/-, Twin Stereo less
5s. 7/8. D.F. 8v. 9/6 (100k to 2 Meg only).

RESISTORS—Modern ratings full range 10
ohms to 10 megohms, 20% 1/-; 5% 3d. ea.,
ditto 1 w. 6d. ea., 2 w. 9d. ea., 10% 1/-; 4d.
ea., 5% Hi-Stab., 1/-; 5d. ea. (below 100
ohms and over 1 meg. 9d. ea.) 1% Hi-Stab.,
1 w. 1/6 ea. (below 100 ohms. 2/- ea.).

A GOOD WAY TO SPEND 3d.

Send 3d. stamp to T.R.S. and you will receive our latest Bargain-packed lists by return. A great way to buy and save!

6 VALVE AM/FM TUNER UNIT

Med. 190 m. 550 m.
V.H.F. — 88 Mc/s-103
Mc/s., 6 valves and
metal rectifier. Self-
contained power unit.
Magic-eye, 3 push-
button controls, on/off,
Med., V.H.F. Diodes
and high output sockets
with gain control. Illuminated
2-colour perspex dial 11 1/2 x 4in. x 4in. x 5 1/2 in. Strongly recommended for use with Mullard amplifiers below. For A.C. mains 200/250v. Unbeatable value. Complete kit, inc. Power Pack as illustrated, 11 gns. Carr. 7/6. Ditto less Power Pack 10 gns. Carr. 7/6. Circuit and Const. details 4/8. Free with kit.



WE ARE SINCLAIR SPECIALISTS

We carry full stocks of these world-famous all-British designs as advertised and give prompt delivery.

MICRO-6 Six stage vest-pocket revr. (Kit) ... 59/6
MICRO-FM 7 transistor FM tuner-revr. (Kit) ... 25.19.6
Z.12 combined 12 w. amp and pre-amp. built ... 89/6
STEREO 25 de luxe pre-amp/control unit built ... 29.19.6

"CIR-KIT" FOR INSTANT CIRCUIT MAKING

Invaluable for constructors. Enables you to produce "printed circuits" quickly and cleanly. Kit No. 3 inc. baseboard, processed copper and strip sheet as advertised.

15/-

PEAK SOUND STEREO AMPLIFIER

inc. pre-amp. Uses Cir-Kit for easy building. Model SA-8-8 uses 14 matched transistors; 20-20,000 c/s to 3dB. Specially for use with high quality ceramic P.U.s. For 3-8 ohm speakers. Output 8.5 watts per channel. A high-quality instrument for easy building and reliability. Complete with instructions £12.19.6 (p/p 4/-).

PEAK SOUND POWER PACK—75/- (p/p 6/6).

CONDENSERS, 150v. working: .01 mfd., .02 mfd., .03 mfd., .04 mfd. 9d.; .05 mfd., .1 mfd. 1/-; .25 mfd. 1/3; .5 mfd. 1/6 etc. Midget elect. 1 mfd.-50 mfd. ea. 1/9; 100 mfd. 2/-.

MIDGET TUNING CONDENSERS, COILS, VOLUME CONTROLS, SPEAKERS, TRANSFORMERS, ETC.

POSTAL AND PACKING CHARGES

Terms: C.W.O. or C.O.D., post and packing 1/10. 1/- 1lb. 1/9, 3lb. 3/-, 5lb. 5/9, 8lb. 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.

TWO-YEAR GUARANTEE EX-RENTAL TELEVISIONS

17 in. £11.10.0

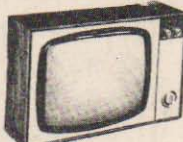
3 star Guarantee

- ★ Tube
 - ★ Valves
 - ★ Components
- Channels for all areas
Insured Carriage 30/-

Free illustrated list
a wide range of models,
sizes and prices

17" — 19" — 21" — 23"

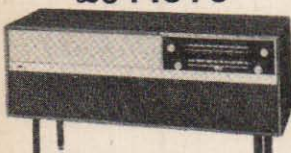
Demonstrations daily



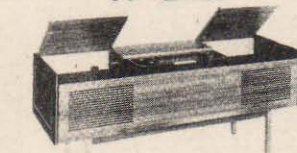
RADIOGRAM CABINETS

£9.10.0

19 Gns.



Superbly made and styled in Veneered English Walnut
LIFT UP LID TO CHANGER AND RECORD STORAGE COMPARTMENT
Position 8" x 5" Twin Speakers
Dimensions: 40 x 16 1/2 x 15 1/2
Legs 1 gn. Carr. 30/-
Other Models — Send for List



An elegant Stereogram Cabinet in modern Veneered Teak

BLACK LEATHERETTE SIDE PANELS
Dimensions: 52 x 17 1/2 x 12
Speaker positions for Twin 10" x 5" Speakers

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

VALVES £1 per 100. Assorted TV and Radio. Surplus ex-rental dismantled receivers. Post 4/6. Send for list.

TRANSISTORS 3/- each. OCB1, OCB1D, AF117.



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.

DUKE & CO. (LONDON) LTD. 621/3 ROMFORD ROAD
MANOR PARK, E.12

Phone: ILFord 600-1-2-3. Liverpool Street—Manor Park—10 mins. Stamp for Free List.

HI-FI YEAR BOOK

1966-1967

by M. Henslow

15/- Postage 1/6

TRANSISTOR BIAS TABLES (GERMANIUM), by E. Wolfendale. 21/- Postage 1/-.

RADIO VALVE DATA. Compiled by "W.W.", 8th ed. 9/6. Postage 1/-.

QUESTIONS & ANSWERS ELECTRONICS, by C. Brown. 8/6. Postage 6d.

ABC'S OF ANTENNAS, by A. Lytel. 16/- Postage 1/-.

TRANSISTOR SPECIFICATIONS & SUBSTITUTION HANDBOOK, 1967 ed. Tech. P. 21/- Postage 1/-.

ABC'S OF RADAR, by A. Andrews. 18/- Postage 1/-.

OUTLINE OF RADIO AND TELEVISION, by J. P. Hawker. 30/- Postage 2/-.

TRANSISTOR POCKET BOOK, by R. G. Hibberd. 25/- Postage 1/-.

BASIC OSCILLATOR HANDBOOK, by N. H. Crowhurst. 21/- Postage 1/-.

1966 WORLD RADIO TV HANDBOOK. 28/- Postage 1/-.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKISTS
British and American Technical Books

19-21 PRAED STREET
LONDON, W.2

Phone: PADdington 4185

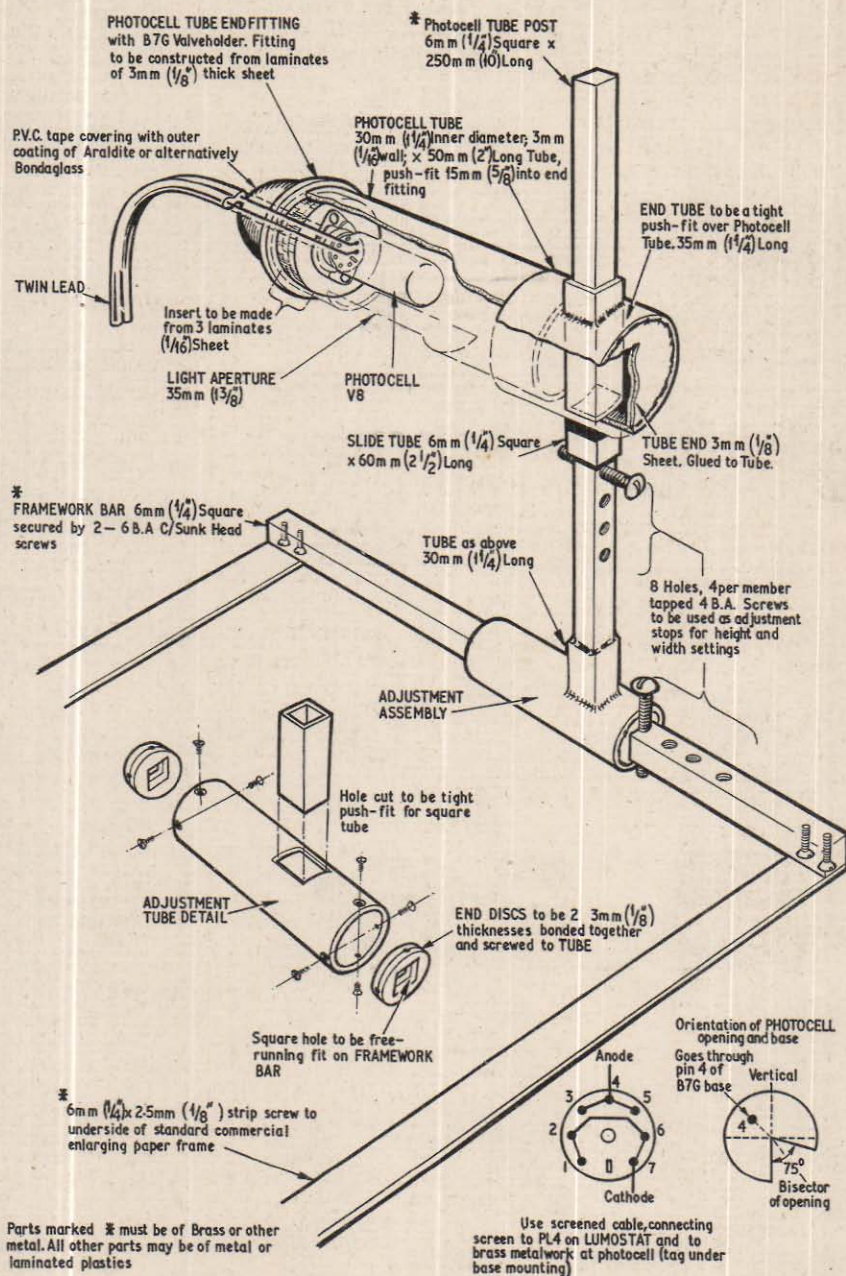
Closed Saturday 1 p.m.

However, under proper conditions the required exposures of the documentation paper do not exceed 2.5 seconds, so that automatic exposure would work *in principle*, but it is here undesirable for another reason. It exposes the papers such that the mean of highlights and shade, weighted according to area, is a medium grey, as it should be for normal pictures. But this may not be true for documentation copies! Suppose

the last page of a manuscript has just one line of text and the rest blank. The copy must come out virtually blank white. The automatic would try to make it run grey, if full pages are adjusted to come right!

The time function of the Lumostat is thus normally more appropriate for all documentation purposes; *fortunately* so, since the scope of automatic exposure is beginning to be severely limited at 2 ASA with a 90AV

Fig. 7. Constructional details of the photocell sensing unit



Drill and tap the holes for the vertical and horizontal stop bolts so that the line from the centre of the photo-cell opening to the centre of the picture is square to the picture edge and at 45 degrees to vertical

Drill corresponding pairs of holes for common picture sizes: 6 x 9cm; 7 x 10cm (half postcard); 9 x 12cm; 10 x 14cm (postcard); 13 x 18cm

photocell in the published arrangement, which is clearly really comfortable only for ordinary bromide papers or anything slower.

OTHER TYPES OF PHOTOCELLS

Professional automatic exposure systems for the darkroom have combated this limitation by resorting to secondary emission photomultiplier tubes, e.g. to the RCA 931 A tube which has already appeared in amateur CCTV designs for flying spot scanners. Cadmium sulphide photoresistors are of the same order of sensitivity, but of much lower impedance and different spectral response as well as lack of inherent constant current operation, thus less suitable. In principle, a photomultiplier probe using the RCA 931 A could be devised for connection to the Lumostat as it stands. It would have to be provided with its own high voltage power supply. The expense and complications were, however, not considered worthwhile in the present case, since the simple 90AV vacuum photocell adequately covers copy films and bromide papers, whilst the 2 ASA group of documentation materials is best exposed to time for other reasons.

However, these considerations considerably influenced the decision to provide optional time and automatic functions, instead of either alone as more common in electronic exposure control equipment for the darkroom.

Colour enlarging papers are of roughly the same speed as bromide papers, or effectively slower due to colour balance filter effects in relation to the spectral response of the 90AV photocell. Thus there is no difficulty in obtaining accurate automatic colour exposures.

PROVISION FOR PHOTO-DOCUMENTATION

It will be seen upon perusal of Fig. 1 (full circuit diagram of the Lumostat), that circuit provisions have been made for operating a photocopy film unit. To the left of the Auto/Time switch S8 on the front panel is situated the selector switch S6 with the settings "Photocopy Unit" and "Enlarger". In the former setting, a.c. is switched straight through to the output socket SK1 for the photocopy unit. The loading of 400 watts

of the photocopy lamps would not be possible to obtain from the stabilised supply, and lamp stabilisation is quite unnecessary when taking microfilms with the photocopy unit. However, the 400 watts a.c. supply goes via RLA and is controlled in the same manner as for enlarger operation, via the exposure control circuit of V7. The stabilised d.c. supply is hereby idling, apart from supplying V7 with the necessary stabilised supplies. The function of S7 is identical to that for the enlarger.

The shortest exposure times on the time function, reaching down to $\frac{1}{8}$ of a second, have been provided mainly with the requirements of the photocopy unit in mind. If on occasion special fast films are used, such short exposures are here required, although practically never with the enlarger. An exposure of $\frac{1}{8}$ second is the shortest practicable while still allowing the lamps to reach operating brilliance in a time short.

COPYING FROM FILM TO FILM

With the commonly used arrangement for copying from film to film with an enlarger, it is clear that the time function of the Lumostat must be used, since there is no logical position for applying the photocell for an automatic exposure.

Since the optical system is fully enclosed on the film-to-film operation, subdued white light may be used for convenient working. The switch S5 is provided on the Lumostat for this purpose.

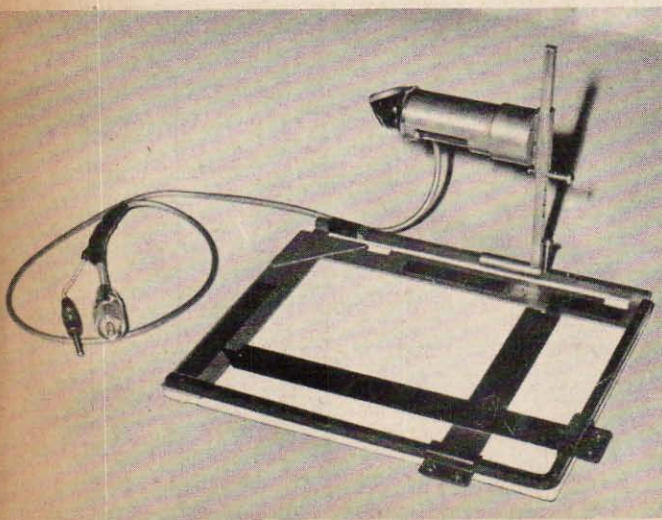
THE OPERATION OF VR2

The control VR2 should be set largely empirically, to correct all manner of subsidiary effects and influences affecting the automatic exposure. On the time function, it is a straightforward multiplication factor control for the time settings of S9 and may be set unambiguously as required.

If the details for the photocell mount given in Fig. 7 are followed exactly, there will be only small variations necessary in relation to picture size, which must be determined by experiment.

Special picture compositions, where the average tone is deliberately not to be a medium grey, can also be corrected by adjusting VR2. For example, consider a shot of uncle George coming in at the garden gate late at night, taken by flash. This picture is required to be almost entirely black, with just uncle George lit up. The automatic exposure, without appropriate special instructions, would under expose this shot because of the large clear areas of the negative. Thus VR2 must be temporarily advanced. The converse would be true of high-key compositions such as a group of eggs in a white dish on a white tablecloth. However, such subjective corrections with VR2 are virtually never critical, and one soon gets the knack of knowing how far to move VR2 for that odd non-standard picture within a film strip of otherwise average pictures.

Of course, VR2 may also be turned up or down to change the basic speed setting in interpolation of the step settings of S9. However, it is quite pointless to attempt to improve the signal-to-noise ratio in this manner, i.e. to reduce the dark current error when operating near the upper speed limit, for any change of setting of VR2 changes the voltage swing through which the integrating capacitor has to charge and thus changes the dark run time in direct proportion. The maximum usable exposure for a given setting of S9 in relation to a given photographic speed is thus not changed. ★



DE LUXE PLAYERS.

4-Speed Players 2-tone Cabinets 17" x 16" x 8". High flux loudspeaker and High Quality Amplifiers ready built. Quality output. Volume and Base controls. Special instructions enable assembly in 30 minutes, only 50 pence to join. 12 months' guarantee.



TO BUILD YOURSELF

PORTABLE CABINET As illustrated. To fit standard player 69/6

3 WATT. Ready made and tested with UCL82 triode pentode valve 59/6

SINGLE PLUG UNITS BSR 44.18.8 Garrard SP12 24.18.8

Garrard SP25 24.18.8

Philips AG1016 212. 9.6

Garrard A70 219.18.6

Garrard LAB80 224.18.6

Garrard 401 229.18.6

GARRARD TEAKWOOD BASE WB.1 Ready 72/6

cut for mounting 1000, 2000, 3000. SP25, AT60.

INTEGRATED STEREO AMPLIFIER 4 watt per channel.

A splendid example of functional design and value. Gold enamel cabinet, size 7 x 3 x 8 in. 200-250V. A.C. Separate Gram and Tuner inputs. Self contained.

pre-amp. and all controls. £9.19/6

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key in. 14/6 2in. 15/9 1 1/2in. 18/1 1 1/2in. 20/6 2 1/2in. 37/9 1 1/2in. 14/9 1in. 18/1 1 1/2in. 18/6 1 1/2in. 22/6 2 1/2in. 44/3 1 1/2in. 15/6 1 1/2in. 18/1 1 1/2in. 20/2 2in. 34/3 1 1/2in. sq. 31/3

BARGAIN XTAL PICK-UP ARM Complete with ACOS LP78 Turnover Head and Stylus 20/- Stereo 30/- SPEAKER PRET Tylan various colours. 55in. wide, from 10/- H.T. 28in. wide from 5/- H.T. SAMPLES S.A.E.

EXPANDED METAL GRID or Silver 12 x 12 in. 8/-

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. output, 1 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., 15/6; 2 amps., 17/6; 4 amps., 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. 47/6

MOVING COIL MULTIMETER EP10K. 0-1,000V. A.C./D.C., ohms 0 to 3 meg. 79/6

MOVING COIL MULTIMETER EP20K. 0-2,500V. D.C. 20,000 ohms per volt. 0-1,000V. A.C. Ohms 0 to 6 meg. 50 Microamps full scale. 99/6

NEW MULLARD TRANSISTORS

OC71 6/-; OC72 7/8; OC81D 6/-; OC81E/-; AF115 8/-; AF114 8/8; OC44 8/-; OC45 8/-; OC171 9/-; OC170 8/8; AF117 7/-; OC2812/6; AD140 15/-; OC35 15/-; Holders 1/3.

VALVE HOLDERS. Int. Oct. 6d. Mazda Oct. 6d. B7A, B8A, B8G, B9A, Moulded 9d. Canister 1/-; B7G, B9A Cans 1/-; Valve base plugs B7A, B9A, Int. Oct., 2/3.

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

WEYRAD P50 - Transistor Coils

RA2W 6 in. Ferrite Aerial with car aerial coil. 12/6

Osc. P50/LAC. 12/6

I.F. P50/300 470 12/6

3rd I.F. P50/300 6/-

Weyrad Booklet 2/-

Spare Cores. 25/-

Driver Trans. LFDT4 9/6

Printed Circuit, PCA1. 9/6

V.B. Tuning Gang 10/6

Weyrad Booklet 2/-

Volume Controls

Long spindles. Midset Size 5 K. ohms to 2 Meg. 1/06 or 1/1N. 1/8 3/4. D.P. 5/-

STEREO 18/10/6, D.P. 14/6.

COAXIAL PLUG 1/-; PANEL SOCKETS 1/-; LINE SOCKETS 2/-; OUTLET BOXES, SURFACE OR FLUSH 4/6.

BALANCED TWIN FEEDERS 6d. 4y, 80 or 300 ohms.

TELESCOPIC CHROME AERIALS. 12in. extends to 33in. 6/6 each. CAR AERIAL PLUGS 1/6. Sockets 1/3.

TV REMOTE CONTROL

For Philips 197G11A, 121A, 125A, 129A, 237G11A, 113A, 1213A, 131A, Stella ST1033A, 330A, 43A, 53A, Corsor CT1910A, 21A, CT202A, 21A, 31A, Philips Price 3 gns.

Our Price 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/-. CALLERS WELCOME

RADIO COMPONENT SPECIALISTS

337 WHITEHOUSE ROAD, WEST CROYDON

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 1685

35/-

Leaflet S.A.E. 200/250 v. A.C.

35/-

35/-

35/-

35/-

35/-

35/-

35/-

35/-

MERRY CHRISTMAS

NEW TUBULAR ELECTROLYTICS				CAN TYPES			
2/350 v.	2/3	100/25 v.	2/-	8/600 v.	6/6	16/800 v.	12/6
4/350 v.	2/3	250/25 v.	2/6	16/1600 v.	7/6	32/3240 v.	7/6
8/450 v.	2/3	500/15 v.	3/-	32/3240 v.	7/6	64/50350 v.	11/6
16/450 v.	3/-	8+8/450 v.	3/6	64/50350 v.	11/6	100/100350 v.	11/6
32/450 v.	3/9	8+8/450 v.	3/9	100/100350 v.	11/6	200/200350 v.	11/6
25/25 v.	1/9	16+16/450 v.	4/3	200/200350 v.	11/6	400/400350 v.	11/6
50/50 v.	2/-	32+32/450 v.	4/6	400/400350 v.	11/6	800/800350 v.	11/6

PAPER TUBULARS			
350v.-0.1 9d.	0.5 1/9.	1 mfd. 3/.	2 mfd. 150v. 3/.
500v.-0.001 to 0.05 9d.	0.1 1/.	0.25 1/6.	0.5 3/.
1,000v.-0.001, 0.002, 0.0047, 0.01, 0.02, 0.1, 0.047, 0.1 2/6.			
E.H.T. CONDENSERS. 0.001mfd., 7kV, 6/6; 20kV, 10/6.			

SUB-MIN. ELECTROLYTICS			
250 mfd. 15v. 2/8; 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 10/-; 50 to 800 pF. 1/-; 1,000 to 5,000 pF. 2/-.			
TWIN GANG. "0-0" 208 pF. +178 pF. 10/6; 365 pF. miniaturized. 10/-; 500 pF. standard with trimmers. 9/-; 500pF. midrange less trimmers. 7/6; 500 pF. slow motion. standard 9/-; small 3-rang 500 pF. 18/6. Single "0" 365 pF. 7/6. Twin 10/-.			
SHORT WAVE. Single 10 pF. 25 pF. 50 pF. 75 pF. 100 pF. 160 pF. 5/8 each. Can be gauged. Couplers 9d. each. TUNING. Solid dielectric. 100 pF. 300 pF. 500 pF. 3/6 each. TRIMMERS. Compression ceramic 50, 50, 70 pF. 9d.; 100 pF. 150 pF. 1/3; 250 pF. 1/6; 600 pF. 750 pF. 1/6.			

BEST BRITISH PVC RECORDING TAPES			
L.P. 7in. 1800ft. 19/6	D.P. 7in. 2400ft. 29/6		
L.P. 5 1/2in. 1200ft. 14/6	D.P. 5 1/2in. 1800ft. 24/6		
L.P. 5in. 900ft. 11/6	D.P. 5in. 1200ft. 18/6		
Spare Spools 2/6. Tape Splitter 5/-.	Leader Tape 4/6.		
Tape Boxes: Collaro 2 tape 28/6 pair, B.S.R. 4 tape 70/-.			

MAINS TRANSFORMERS

E.M.I. 200-250. 100 mA. 6.3 v. 4 a. 6.3 v. 2 a. 19/6		Post	
250-0-250, 80 mA. 6.3 v. 3.5 a. Rectifier 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. 1 a. 7/6; 6.3 v. 4 a. 10/6			
Ditto tapped sec. 1.4 v. 2, 3, 4, 5, 6.3 v. 1 amp. 10/6			
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 25 mA. 25/-			
Ditto, 1 amp. 5, 10, 15, 20, 25, 30, 35, 40, 55, 60. 29/6			
Sub-Min. Mains to 9 v. 80 mA. 1 1/4 x 1 1/4 in. 7/6			
AUTO TRANSFORMERS 0-115-200 v. Input/Output, 60w. 18/6; 150w. 25/-; 500w. 82/6			

CRYSTAL MIKE INSERTS

1 1/2 x 2in. 6/-; RM3 1 x 1in. 7/6; ACOS 1 1/2 x 2in. 8/6			
TANNOY CARBON MIKE with Switch 5/6			
MOVING COIL HEADPHONES 100 ohms (ex. Govt.) 12/6			
H.R. HEADPHONES 2000 ohms. 12/6; 4000 ohms 15/6			
H.R. HEADPHONES 2000 ohms Super Quality 25/-			

1967 GRAM CHASSIS £10.10



Three Wavebands:		Five Valves: ECH81, EF89.	
Long, Med., Short. Gram.		EBCH1, EL84, EZ80.	
12-month guarantee. A.C. 200-250 v. Ferrite Aerial 5 watts 3 ohm. Chassis 13in. x 7in. x 5in. dial size 13in. x 4in. Two pilot Lamps. Four Knobs.			
Alined calibrated. Chassis isolated from mains			
"IMPERIAL" AM-FM Radiogram Chassis			£17.10
"CONTINENTAL" AM-FM Stereo Chassis			£24.10
(Leaflets available for these and other models)			

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 35/- 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. 9/6. Chassis 4/6.

B.B.C. 2 SUPER BOOSTER transistor model. Ready built 75/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2 1/2in. sides. 7 x 4in. 5/6; 8 x 7in. 6/8; 11 x 3in. 6/8; 11 x 7in. 7/6; 13 x 9in. 9/6; 14 x 11in. 12/6; 15 x 14in. 15/-.

ALUMINIUM PANELS 18 s.w.g. 12 x 12in. 5/6; 14 x 9in. 4/6; 12 x 8in. 3/6; 10 x 7in. 2/6; 8 x 6in. 2/6; 6 x 4in. 1/6.

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 1/2 x 4in. high.

Gold/Walnut knobs. Volume and Tone controls on separate

Polished Wood Panel 6 x 2in. Brand new with makers' guarantee. BARGAIN PRICE P. & P. 1/6.

78/6

ALL PURPOSE TRANSISTOR PRE-AMPLIFIER

14 db gain. 250v. or 9v. input. Ready built with Mu Metal

matching 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/-

35/-

35/-

35/-

35/-

35/-

35/-

35/-

35/-

35/-

BAKER 12 in. STALWART

The only High Fidelity Loudspeaker with a choice of 3 ohm or 15 ohm models

Max. Power	15 watts
Base Res.	40/50 cps.
Flux	12,000 gauss.
Voice Coil	1 1/2 in.
Response	45-13,000 cps.
Chassis	Solid Aluminium
Overall dia.	12 in.
Overall depth	6 in.
PRICE 5 GNS. POST FREE	
(State 3 or 15 ohm)	

CATALOGUE S.A.E.

GROUP MODELS FOR VOCALS BASS, LEAD AND RHYTHM GUITARS 80-10,000 cps. Voice Coils 15 ohms. Heavy duty

'Group 25'	'Group 35'	'Group 50'
12in. 5gns.	12in. 8gns.	15in. 18gns.
25w.	35w.	50w.

LOUDSPEAKERS P.M. 3 OHMS. 2 1/2in., 3in., 4in., 5in., 7in., 8in., 10in., 12in., 15in., 18in., 20in., 22in., 24in., 26in., 28in., 30in., 32in., 34in., 36in., 38in., 40in., 42in., 44in., 46in., 48in., 50in., 52in., 54in., 56in., 58in., 60in., 62in., 64in., 66in., 68in., 70in., 72in., 74in., 76in., 78in., 80in., 82in., 84in., 86in., 88in., 90in., 92in., 94in., 96in., 98in., 100in., 102in., 104in., 106in., 108in., 110in., 112in., 114in., 116in., 118in., 120in., 122in., 124in., 126in., 128in., 130in., 132in., 134in., 136in., 138in., 140in., 142in., 144in., 146in., 148in., 150in., 152in., 154in., 156in., 158in., 160in., 162in., 164in., 166in., 168in., 170in., 172in., 174in., 176in., 178in., 180in., 182in., 184in., 186in., 188in., 190in., 192in., 194in., 196in., 198in., 200in., 202in., 204in., 206in., 208in., 210in., 212in., 214in., 216in., 218in., 220in., 222in., 224in., 226in., 228in., 230in., 232in., 234in., 236in., 238in., 240in., 242in., 244in., 246in., 248in., 250in., 252in., 254in., 256in., 258in., 260in., 262in., 264in., 266in., 268in., 270in., 272in., 274in., 276in., 278in., 280in., 282in., 284in., 286in., 288in., 290in., 292in., 294in., 296in., 298in., 300in., 302in., 304in., 306in., 308in., 310in., 312in., 314in., 316in., 318in., 320in., 322in., 324in., 326in., 328in., 330in., 332in., 334in., 336in., 338in., 340in., 342in., 344in., 346in., 348in., 350in., 352in., 354in., 356in., 358in., 360in., 362in., 364in., 366in., 368in., 370in., 372in., 374in., 376in., 378in., 380in., 382in., 384in., 386in., 388in., 390in., 392in., 394in., 396in., 398in., 400in., 402in., 404in., 406in., 408in., 410in., 412in., 414in., 416in., 418in., 420in., 422in., 424in., 426in., 428in., 430in., 432in., 434in., 436in., 438in., 440in., 442in., 444in., 446in., 448in., 450in., 452in., 454in., 456in., 458in., 460in., 462in., 464in., 466in., 468in., 470in., 472in., 474in., 476in., 478in., 480in., 482in., 484in., 486in., 488in., 490in., 492in., 494in., 496in., 498in., 500in., 502in., 504in., 506in., 508in., 510in., 512in., 514in., 516in., 518in., 520in., 522in., 524in., 526in., 528in., 530in., 532in., 534in., 536in., 538in., 540in., 542in., 544in., 546in., 548in., 550in., 552in., 554in., 556in., 558in., 560in., 562in., 564in., 566in., 568in., 570in., 572in., 574in., 576in., 578in., 580in., 582in., 584in., 586in., 588in., 590in., 592in., 594in., 596in., 598in., 600in., 602in., 604in., 606in., 608in., 610in., 612in., 614in., 616in., 618in., 620in., 622in., 62

DAVIS & WHITWORTH LTD.

222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX
PHONE: SOUTHEND (0802) 46344

FREE Packs of your own choice to the value of 10/- with all orders over £4 in value

THE LARGEST RANGE OF LOW PRICED SILICON CONTROLLED RECTIFIERS (THYRISTORS) IN GT. BRITAIN.

1 amp (TO 5 can)	7 amp (stud)	16 amp (stud)
PIV each	PIV each	PIV each
100 9/6	100 10/6	100 16/6
400 25/-	200 15/-	200 25/-
	300 25/-	300 30/-
	400 30/-	400 40/-
	500 40/-	500 50/-
	600 45/-	600 55/-

FREE SCR literature including circuit diagrams for light dimmers, speed controllers, AC power switch, etc., with all SCR orders or on request

FREE

Clearance line ... 25 PIV—50 amp, 30/- 25 PIV—10 amp, 12/-

PACK No.	VALUE	PRICE	PACK No.	VALUE	PRICE	PACK No.	VALUE	PRICE
B1. 50—Trans. unmarked and untested ..	10/-		C1. 15—50v. germ. trans., new ..	15/-		D1. 25—W hi-stab. resistors mixed ..	5/-	
B2. 4—Solar cells, inc. book of ins. ..	10/-		C2. 1—Unijunction 2N2160 or 2N2646 ..	15/-		D2. 3—BA115 G.B. diodes, TV, video. ..	5/-	
B3. 4—OA5 gold bonded diodes, Mullard ..	10/-		C3. 5—Audio kit, NKT278/275/271/773 ..	15/-		D3. 3—G.P. diodes, OA70, OA79, OA81 ..	5/-	
B4. 16—Germ. diodes, 50PIV, 40Mc/s ..	10/-		C4. 2—RF power trans., OC22 and BUY11 ..	15/-		D4. 2—Sil. recs., 400/600PIV 400mA ..	5/-	
B5. 6—Matched set OC 44/45/81D/81 ..	10/-		C5. 2—Sil. recs., BYZ13, 200PIV, 6 amp. ..	15/-		D5. 5—Gold bonded diodes, assorted ..	5/-	
B6. 15—AF red spot, RF white spot. ..	10/-		C6. 5—Sil. recs., 750mA, 100/200PIV ..	15/-		D6. 1—Power trans., OC16, Mullard ..	5/-	
B7. 1—60 watt sil. power trans., 5Mc/s ..	10/-		C7. 3—High v. AF trans., pnp, ACY17 ..	15/-		D7. 2—Zener diodes, 5 v., 250mW ..	5/-	
B8. 2—Power trans., OC26/35 type ..	10/-		C8. 1—80v. npn, epitaxial planar BFY50 ..	15/-		D8. 3—Sil. recs., 60-120PIV, 0.1A ..	5/-	
B9. 1—Light sensitive cell, ORP12 type ..	9/-		C9. 2—60v. sil. trans., 200Mc/s ZT83/84 ..	15/-		D9. 10—Assorted capacitors ..	5/-	
B10. 8—50v. trans., germ., pnp., latest type ..	10/-		C10. 2—BC108 trans., npn, epitaxial planar ..	15/-		D10. 20—Transistor heat sinks ..	5/-	
B11. 2—Trans. comp. pair, AC128, AC176 ..	10/-		C11. 3—Sil. trans., Mullard OC200-205 ..	15/-		D11. 2—OA182 G.B. diodes, 100PIV, 500mA ..	5/-	
B12. 4—OA182 G.B. diodes, 100PIV, 500mA ..	10/-		C12. 3—AC128, high gain output trans. ..	15/-		D12. 3—Sil. recs., 60-120PIV, 100mA ..	5/-	
B13. 7—BA115 G.B. diodes, TV, video ..	10/-		C13. 1—2 watt HF, ep/plan, trans. BSY25 ..	15/-		D13. 3—Metal-alloy trans., mat. type ..	5/-	
B14. 3—Popular trans., OC71/72/73 ..	10/-		C14. 2—3 watt planar, 2N1613, 2N1893 ..	15/-		D14. 3—Low imp. earphones, less plugs ..	5/-	
B15. 8—Bi-directional trans. ..	10/-		C15. 4—Sil. pnp. trans., in the 25300 series ..	15/-		D15. 1—2N706 pep trans., 300Mc/s, sil. ..	5/-	
B16. 10—Assorted computer diodes ..	10/-		C16. 1—Sil. power 85 watts, 25721 series ..	15/-		A1. 6—Silicon rectifiers, BY100 type ..	20/-	
B17. 5—OA47 gold bonded diodes ..	10/-		C17. 2—60v. 150Mc/s TO-18, 2S103/4 ..	15/-		A2. 10—Relays, mixed types and voltages ..	20/-	
B18. 4—OA202 sil. diodes, sub. min. ..	10/-		C18. 1—2N132 sil. planar, pnp trans. ..	15/-		A3. 20—Mixed, marked and tested trans. ..	20/-	
B19. 5—2G417 trans., eqvt. AF116/7 TO-18 ..	10/-		C19. 3—2N706 epitaxial planar TO-18 ..	15/-		A4. 2—2N601 trans., germ., 30v, 10Mc/s ..	20/-	
B20. 4—Assorted npn trans., TO-5, TO-18 ..	10/-		C20. 3—Germ. npn trans., 2N1302/4/8 ..	15/-		A5. 8—sil. recs., 100-400PIV, 0.5-1A ..	20/-	
B21. 2—Sil. recs., 10 amp., 50-100PIV ..	10/-		C21. 3—Germ. pnp trans., 2N1303/5/7/9 ..	15/-		A7. 1—500Mc/s epitaxial mesa, pnp, 2N700 ..	20/-	
B22. 4—OC139 transistors, NPN. ..	10/-		C22. 1—300Mc/s germ. Mullard, ASZ21 ..	15/-		A8. 6—Sub. min. zeners, 3.3-13.5v. ..	20/-	
B23. 3—OC140 trans., npn, Mullard ..	10/-		C23. 2—35A sil. rec., 100PIV, stud. ..	15/-		A9. 1—2N174 real power 80v., 150W ..	20/-	
B24. 3—OC77 trans., Mullard ..	10/-		C24. 4—Germ. pnp trans., AF114/5/6/7 ..	15/-		A11. 2—Power trans., OC20's, 100v. ..	20/-	
B25. 3—OC83 trans., lamp, high gain ..	10/-		C25. 2—Power trans., germ., OC28/29 ..	15/-		A12. 1—High power, high volts. 25024 ..	20/-	
B26. 3—AC127 trans., npn, high gain ..	10/-		C26. 2—2SO12A 5Mc/s 60W, Texas ..	15/-		100v, 100W ..	20/-	
B27. 2—HF germ. trans., OC170, OC171 ..	10/-		C27. 4—800PIV, 550mA, STC, FST3/8, sil. ..	15/-		A13. 25—Assorted trans. and diodes, all new, ..	20/-	
B28. 4—High current trans., OC41, OC42 ..	10/-		C28. 5—Sil. Recs., BY114, BY101, 400PIV ..	15/-		E1. 2—2N458 matched power trans. ..	20/-	
B29. 4—OC44 or OC45, Mullard ..	10/-		C29. 1—200Mc/s low noise trans., AFZ12 ..	15/-		150W, 80v. ..	20/-	
B30. 2—Low noise trans., npn, 2N929/30 ..	10/-		C30. 2—Sil. trans., narrow gain spread, ..	15/-		E2. 1—25026 power trans., 200v, 100W ..	30/-	
			BCZ11 ..	15/-		L1. Logic kit handbook ..	12/6	
						L2. Logic kit handbook ..	15/-	

FIRST EVER LOGIC KITS. Learn for yourself how computers work, even make one for yourself. Full instructions for a noughts and crosses machine, binary counters, timers, etc. L.1. 5 gns. L.2. 10 gns. No need to purchase both kits, you can start with L.2. which incorporates L.1. DETAILS FREE.

MAKE A REV. COUNTER FOR YOUR CAR. THE 'TACHO BLOCK'. This encapsulated block will turn any O Ima meter into a perfectly linear and accurate rev. counter for any car. State 4 or 6 cylinder. Cost 20/-.

NO CONNECTION WITH ANY OTHER FIRM. MINIMUM ORDER 10/- CASH WITH ORDER PLEASE. For complete lists and substitution charts send 1/- in stamps, add 1/- post and packing per order. OVERSEAS ADD EXTRA FOR AIRMAIL.

Harmony in the home RECORD HOUSING



Lowline Two Equipment Cabinet 23 gns.
Scan Speaker Enclosure 8 gns. Scan Storage Unit £6.17.6

Housing Hi-Fi is our business . . . turntables, tape recorders, loudspeakers, tuners, amplifiers, records, tapes . . . there's a RECORD HOUSING cabinet to suit your equipment. Send for illustrated catalogue giving full details of over 20 different cabinets, plus stockists' list (U.K. only) to:

RECORD HOUSING (Dept. P.E.1)

Brook Road, London, N.22. Tel.: BOWes Park 7487

VIKING STEREO 4 + 4 HIGH QUALITY AMPLIFIER



A high quality stereo amplifier, built to meet the requirements of budget Hi-Fi. Elegant styled cabinet in black rexine and woodgrained ends. Brushed aluminium panel, black and silver knobs. Quality components throughout. Ganged Bass and Treble controls, separate volume controls for each channel. Valves (Standard Model) 2 x ECL86 (De-Luxe Model) 1 x EOC83 (2) x ECL86. Output 8 ohms matching, suitable A.C. mains 230-240 volt. Cabinet size, 16 1/2 in. wide, 8 1/2 in. high, 8 1/2 in. depth. Full instructions and guarantee. Send for leaflet.

STANDARD MODEL (amplifier only) . . . £11.11.0 plus 12/6 P. & P. and Ins.
DE-LUXE MODEL (amplifier only) . . . £12.12.0 plus 12/6 P. & P. and Ins.
CABINET extra if required . . . £1.5.0
CABINET separately . . . £1.15.0 plus 7/6 P. & P. and Ins.

VIKING 10-12. A twelve watt amplifier for use on 230-240 volt A.C. mains. Inputs suitable Microphone, Record Player, Tuner, Tape Recorder, etc. Printed circuitry. Five Mullard valves, reliable components. Front panel contains 2 Input Jacks, 2 Volume Controls, 1 Tone, Neon and On/Off switch. Designed to fit into same type and size cabinet as Stereo. Fully guaranteed. Send for leaflet.

Price (amplifier less case) £7.19.6 plus 12/6 P. & P. and Ins.

VIKING X.P.15. A frustrated order offered at a fraction of cost (original price 39 gns.). 15 watts output. Suitable for 210-240 Volt A.C. mains. Attractive Black chassis with slotted Chromed steel top cover, size 15 x 7 1/2 x 7 in. 4 Input Jacks, 2 volume controls, 2 tone, 5 Mullard valves. Fully guaranteed. Send for leaflet.

Price Complete £12.19.6 plus 12/6 P. & P. and Ins.

Famous **VIKING P.A. BASS AMPLIFIERS**, 15, 30, 40, 60 and 100 watts. Send for leaflet.

SPEAKER ENCLOSURES — SPEAKERS — MICROPHONES — RECORD PLAYERS AND TAPE DECKS. Send for leaflets.

Terms: C.W.O., C.O.D. Money back guarantee.

VIKING (ELECTRONICS) LTD. STONEBRIDGE

Telephone: ELG 3644

37 HILLSIDE
LONDON, N.W.10

detached particles

JOHN VALENCE

BEST BUY

Few of our readers will need convincing that you can't get a good stereo effect from a one-piece stereogram. The set manufacturers produce large quantities of these lowboy type cabinets with loudspeakers placed rarely more than 3ft apart—and they sell quite well. One can only assume that these instruments are not bought primarily for their reproduction qualities, but rather as items of furniture that will fit into the domestic scene without any major upheaval to existing arrangements.

The Consumers' Association has been having a look at these stereograms, and their findings are reported in the November issue of *Which?*

In this report the closeness of the loudspeakers is commented upon, with the statement that the best stereo effect is obtained in one rather small area immediately in front of the instrument. (The idea of sharing one chair may of course have its attraction to some couples. . . . I would suggest to the Consumers' Association that they investigate how many of these stereograms are bought by newlyweds. All in the interests of sociology, of course.)

The *Which?* report concludes with an emphatic note that if you want good quality sound, separate (hi fi) units are essential. Hi fi equipment makers and dealers are delighted and are, I expect, already stocking up in anticipation of the rush of new converts to the cult.

MODERN TIMES

According to the latest reports, Bevercotes will soon start working.

Good news certainly, but it is only a partial victory for the National Coal Board, since the miners have agreed to work the automated pit for only five days a week. The NCB wanted the mine worked for the full seven days in order to reap the maximum advantage of automation.

One of the major difficulties to be overcome is the miners' objection to the disruption of normal social life.

Perhaps this all seems remote to most of us—but is this not a problem

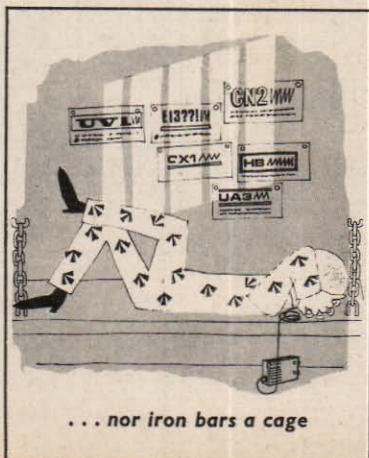
that countless workers in diverse fields will have to face in the future? The introduction of costly automation systems in industry will be a viable proposition only if the plant is operated continuously. Thus greater, and more economic, production with (we hope) improved standards of living can only be obtained by accepting some revolutionary changes affecting our social lives.

Some bank computer centres are operated 24 hours per day. Did they have difficulty in getting clerks to work these shifts I once asked a bank official, "Oh no," he said, "in fact many volunteered." There are obviously some compensatory advantages for those working "unconventional" hours.

BREACH OF SECURITY

It would seem a shrewd choice to select Lord Mountbatten to lead the investigation into prison security. A past President of the I.E.R.E. and chairman of the National Electronics Research Council, Lord Mountbatten is well at home in the field of electronics. We can be sure that the lamentable absence of electronic surveillance systems will not go unheeded in the report which is expected very soon now.

But there remains the said spectacle of bolting the stable door. . . .



Why, oh why, one can only ask, has this security been allowed to deteriorate while there is an abundance of electronic devices on the market capable of reinforcing the sorely pressed prison staff?

With installations of closed circuit television, proximity detectors (infrared, radio or ultrasonic), and a comprehensive communications system it should be possible to achieve almost 100 per cent inviolability of an outer perimeter wall, while allowing the limited amount of freedom of movement to the inmates that modern ideas on this subject require.

COLD COMFORT

The Electricity Council are making ambitious plans for the "all electric" new town of the future, as was indicated during a recent conference.

The heating of homes by cheap off-peak current is becoming increasingly popular. With a little more attention to heat insulation in house design heating costs can be reduced by as much as 50 per cent it is claimed. But this is not all. The "waste" heat from lamps and the multitude of electrical equipment which will be used even more extensively in future will contribute significantly towards heating up the cocooned homestead, it was suggested.

But just a moment: is not the Electricity Council's peep into the future somewhat unimaginative, and does it not indicate a lack of appreciation of the potentialities of that closely related and up and coming younger branch of technology?

When electronics really comes into its own there will be no waste heat. Cold cathode fluorescent tubes and electroluminescent wall and ceiling panels will oust the incandescent filament lamp, while transistors will drive out the last remaining thermionic valves from receivers and amplifiers thus denying the household those few additional watts of thermal energy "on the side."

Sorry, but in this respect it would appear that the electrical people can expect only cold comfort from the advance of electronics.

Readout—

A SELECTION FROM OUR POSTBAG

Anchors aweigh!

Sir—I was most interested to read the descriptive article by S. Simpson, entitled *Ship to Shore Radio*, which appeared in the November 1966 issue. Having heard these stations operating in contact with coastal shipping on many occasions, it was pleasant to have information concerning the equipment installed at the GPO Radio Stations and also to learn of the very full coverage of services provided by these stations.

Perhaps at some later date, it would be possible to include a similar article, dealing with the radio communication, radar and direction-finding equipment installed on the larger type of merchant ship. I feel this would be an equally interesting subject and a fitting sequel to the feature on coastal radio stations.

A. G. Coker,
Guildford,
Surrey.

Foiled

Sir—Having received some excellent information from your magazine I am hoping you can help with my present problem.

I am a keen fencer. Our club is at the moment trying very hard to obtain electrical equipment for fencing, and in order to reduce costs, I offered to try and obtain a circuit diagram for an electronic counter. This is, as you probably know, a piece of equipment that counts the number of hits.

I was wondering if your magazine had any such circuit, or if not, whether any of your readers have access to a circuit diagram.

A. C. Farrow,
Cardiff,
S. Wales.

Sir—Being a member of the Worcester Fencing Club, I am interested in foil fencing with the electric foil and wondered if you have any information on the equipment and circuitry concerned.

R. Kenrick,
Worcester.

Sound definition?

Sir—In re-reading the article by M. Scibor-Rylski describing how to make a *Fuzz Box* (July 1966), I noticed in the introduction a mistake which I hope he will not mind me correcting. It said "Vibrato, sometimes mistakenly called tremolo—is produced by mixing a fixed low frequency oscillation with the guitar signal."

The first point to be corrected is that the low frequency, usually 2 to 4c/s, is used to modulate the guitar signal and is not merely mixed with it. If it was, no change in the sound would be produced, as all such low frequencies are inaudible.

The second, more debatable point, is that of the name given to this effect. Both the Oxford and Nuttall's dictionaries suggest that the names tremolo and vibrato are interchangeable, whereas others are vague enough to be of no help.

The answer seems to be that vibrato is a regular variation in the frequency of a note, whereas tremolo is a regular variation in the volume of a note.

Tremolo is, therefore, the name correctly given by amplifier manufacturers to the effect described above, and vibrato is the effect produced by what is commonly called the tremolo arm on a guitar, but should, as the guitar manufacturers name it, be called a vibrato arm, or vibro-arm for short.

Malcolm P. Hamer,
Bath.

There is much confusion over the loose use of the words tremolo and vibrato. Strictly speaking, Mr. Hamer is correct. The word vibrato is of recent origin and is thus not well defined. Some organ makers use this for amplitude modulation, some for frequency modulation. If the pitch changes, it is vibrato, but in an organ it should be called tremulant since this is the expression used for pipe organs. It is derived from the French word "tremblant"; they were the originators of the effect and no pipe organ has ever had the name vibrato on a stop.

Tremolo is an Italian word first associated with the singing voice and is quite definitely an amplitude modulation.

Incidentally, the frequency of 2 to 4c/s seems suspect to me although it might be used for a special effect; the normal organ vibrato or tremulant runs at 6 to 7c/s.—A.D.

CAN YOU HELP?

Letters for inclusion under this heading should be as brief as possible. Replies should be made direct to the readers concerned.

Sir—I wish to acquire copies from November 1964 to August 1965 inclusive, complete with blueprints. C. Farrall, 34, Wellfield Road, Stockport, Cheshire.

Sir—I wish to obtain copies of Volume 1, November 1964 to September 1965 inclusive, and Volume 2, February 1966, complete with blueprints. H. A. Newell, 41, Old Palace Road, Guildford, Surrey.

Sir—I am anxious to obtain the August 1966 issue and wondered if any of your readers could help? D. S. Gradziuk, 41, Hawthorne Avenue, Gillway Estate, Tamworth, Staffs.

Sir—I wish to obtain the July and August 1965 back numbers, if possible complete with blueprints. E. J. Darby, Jr., Nettleslack Farm, Broughton Beck, nr. Ulverston, N. Lancs.

Sir—I wish to obtain the blueprint or circuit diagram with details of parts of the guitar amplifier which was described in the February and March 1965 issues.

I. M. Edward, Manuel Industries, Ernakulam-6, Kerala, India.

Sir—Can any reader supply me with the March and April 1965 issues, complete with blueprints, if any? A. M. Riddle, Glendore, Church Road, Wembury, Plymouth, Devon.

Sir—I wish to purchase from any reader the October 1965 issue, without blueprints.

L. C. Galitz, 103, Sheaveshill Avenue, Colindale, N.W.9.

Sir—I require a handbook or any other data for the R109 Reception Set, and the January and February 1966 issues of PRACTICAL ELECTRONICS. H. Delia, 37, Avon Road, Burnage, Manchester, 19.

Sir—I would be most grateful if any reader could supply me with the February and May 1966 issues of PRACTICAL ELECTRONICS. G. H. A. Hardwick, 24, Westwood, RAF Bawtry, Doncaster, Yorks.

Back numbers are usually very quickly exhausted. We strongly advise all our readers that a standing order be placed with their newsagent to avoid any future disappointment.

A New Martin Recordakit

designed specially for the MAGNAVOX 363

3 WATTS OUTPUT

OUTLET FOR HI-FI AMP

SOLDERING NOT
NECESSARY

SEPARATE RECORDING
LEVEL AND VOLUME
CONTROLS

Get the best out of your MAGNAVOX STUDIOMATIC TAPE DECK with a Martin Recordakit assembly. This comprises everything you want to make a superb two or four track 3-speed recorder (taking 7 in. reels) at a price that will save you pounds. The basic Martin units are assembled and tested, making it necessary for you simply to fit and connect them together in accordance with the detailed instructions book supplied. When built, your Martin Recorder appears as shown here. The lid is detachable. Case with speaker, and deck also available. Details on request. MARTIN RECORDAKITS have long been famous for their high performance standards, quality of materials, simplicity and dependability. The latest is the best yet.



KIT M4 less case and deck (four track) but incl. valves, screws, wire, track switching, etc. £15.19.6

KIT M2 less case and deck (two track) but incl. valves, wire, screws, etc. £14.19.6

Martin Audiokits for Hi-Fi

The uniquely reliable kits with "Add-on-ability"

No other system allows you to enlarge your installation stage by stage as Audiokits do. They comprise a wide range of very well made prefabricated transistorised units in which connections are standardised throughout and from which anything from a simple straight amplifier to an elaborate hi-fi stereo amplifier with FM tuner can be built. The Recordakit described above can be combined with your Audiokit assembly if you wish.

- 5-stage input Selector £2.7.6
- Pre-amp/vol. control £1.17.6
- Pre-amp/tone controls £3.2.6
- 10 watt amp. (3 ohms) £5.12.6
- 10 watt amp. (15 ohms) £6.12.6
- Mains power supply £2.15.0

FROM PRE-AMP TO A HI-FI STEREO/FM ASSEMBLY

Martin Recordakits and Audiokits are obtainable from good stockists everywhere. In cases of difficulty please write direct. Trade enquiries invited.

MARTIN ELECTRONICS LTD 154/155 HIGH ST., BRENTFORD
M'SEX Phone: 1SLeworth 1161/2

MARTIN ELECTRONICS LTD.

154 High St., Brentford, Middlesex

Full details of ☐ Recordakits ☐ Audiokits please

NAME.....

ADDRESS.....

(Block letters)

P.E.671



RADIONIC

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.)

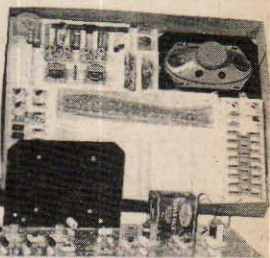
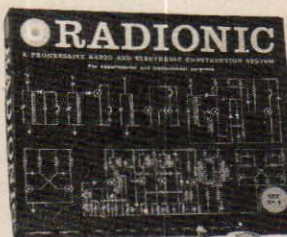
Full details from:

RADIONIC PRODUCTS LIMITED
STEPHENSON WAY, THREE BRIDGES
CRAWLEY, SUSSEX

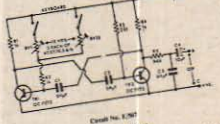
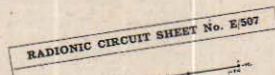
Tel.: CRAWLEY 27028

Trade Enquiries Invited

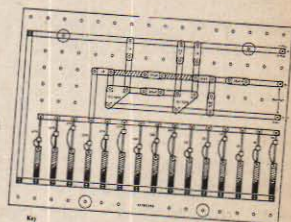
RADIO & ELECTRONIC CONSTRUCTION SYSTEM



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.

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.

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. R. WHISTON (Dept. CPE), New Mills, Stockport

CRACKLE PAINT. Black or Grey, 1 pint tins 4/6, 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.

2 1/2 oz. tins 3/6 1 gallon 35/-
1 pint 15/- 1 gallon 58/-

Carriage: Orders up to 5/-, 9d; up to 10/-, 1/9; over 10/-, 3/6. 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)
Mickley Square, Stocksfield, Northumberland
Tel. Stocksfield 2280

RELAYS. 8 assorted 12-24 volt Ex-Equipment, 20/-, p. & p. 4/6. We can supply most relays as recommended in this journal.

GOVERNMENT SURPLUS. Electrical and Radio Equipment. Our new catalogue No. 16 now ready. 2/6 Post Free, cost refunded on purchase of goods over £2. **ARTHUR GALLIS**, Radio Control Ltd., 93, North Road, Brighton.

FIVE-TON FACTORY CLEARANCE: Radio, TV Electrical Components in mixed parcels. Example: 22lb. mixed parcel £1, p.p. 7/6. Speakers, grilles, valves, bases, i.f.s. covers, condensers, etc. Hundred other items. S.A.E. list and postal orders to P. NEWTON, 16 Shalcross Crescent, Hatfield, Herts.

TRANSFORMERS, etc. S.A.E. for list. APPS, 58 Chertsey Drive, North Cheam, Surrey.

ELECTRIC SOLDERING IRON



FANTASTIC BARGAIN OFFER ONLY

10/-

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.

C. H. SERVICE (Dept. PE)
Lusted Hall Lane, Tatsfield, Kent.

FOR SALE

(continued)

TIME SWITCHES reconditioned 14 day clock once on once off every 24 hours, fully guaranteed, Venner, 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.

C. Core Transformers

Mains Prim; Tapped 200/240V. Sec.; 80, 140, or Ser.220 volts. 100 Milliamps, 6.3V, 1.8A, 6.3V, 1A Terminal Tags, Mu-Metal Screened.

Size: 3 x 3 x 3 1/4 ins.

14/6 post paid.

A.E.I. Semi-Conductor Rectifiers

Type GJ5M, PVI 300 volts, 500 m.a. at 2/6 each, post paid.

Cash with order (no C.O.D.)
(SEND S.A.E. FOR LISTS)

JACK PORTER LTD.

(Established 1928)

30/31 College Street, Worcester

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.

RADAR TEST GEAR

COVERING 900 TO 1,230 Mc/s

3 - CY-1165/UPM - 4B } OFFERS?
2 - CY-1154/UPM - 4A }

ALSO: PULSE GENERATORS, SIGNAL GENERATORS, WAVEMETERS, STABILISED POWER SUPPLY UNITS

S.A.E. FOR DETAILS

112 GROBY ROAD, GLENFIELD, LEICESTER

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, Avo model 7. 2/6 plus S.A.E. TELRAY, Maudland Bank, Preston.

SERVICE SHEETS

(continued)

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

30 Baker 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 1966 list of Service Sheets at 1/6 plus postage. (please delete items not applicable)

I enclose remittance of which includes postage

MAIL ORDERS ONLY Jan. PE

MISCELLANEOUS

CONVERT ANY TV SET into an Oscilloscope. Diagrams and Instructions, 12/6. REDMOND, 42 Dean Close, Portslade, Sussex.

"PRACTICAL ELECTRONICS" Integrated Stereo Amplifier. Model Train Controller. Lumostat, and all constructional 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.

PRINTED CIRCUIT SERVICE

Prototypes, Layouts, Photo Work, Production Runs, or One Offs
Express Service on all Orders

MECELEX & CO.

Whycliffe Mills, High Church Street
Basford, Nottingham
Tel.: Nottingham 77357

MISCELLANEOUS

(continued)

ELECTRONIC ASSEMBLY, Wiring and Repair work undertaken. Kits made up. Prompt service. Nothing too small. All enquiries welcomed. E. J. ANDREWS, Merryweather House, Kettlestone, Fakenham, Norfolk. Tel.: Thursford 330.

TRANSFORMERS

TELEVISION:!

From your OWN Car Battery

Famous **DELCO TRANSFORMER** transforms 12 or 24v. supply to mains Power for TV, 4" drills, etc.

NOW ONLY

£6-10-0



C.O.D. 3/6 extra.
SMALLER MODEL 12/24v. input, 20/-
110/250v. output

MAGNETIC RELAY SWITCHES.

12v., 40 amp. Contacts for remote switching. Each 13/6

INDOOR TELEVISION AERIAL. 17/6

Extending Single dipole. Each 17/6

VIBRATOR POWER-PAK. Step 12v. up to MAINS output. For Universal AC/DC

razors, small fluorescent fittings, radios, etc. Only 37/6

HOOVER ROTARY TRANSFORMERS. 30/-

6v. input, 250v. output, 12v. input, 490v. output. 32 watts.

GENERATING SETS. Brand New. **TINY**

TIM. 12v. 300 watts. In packing case.

SELF STARTING. Normal List Price £76.

Price Delivered **£37-10-0**

Send NOW—Delivery by return
JAMES WALKER, ELECTRONICS DIVISION
School House, Wood Walton, Huntingdon
Phone Abbots Ripton 368. 9 am. to 10 pm.

EDUCATIONAL

A.M.I.Mech.E., A.M.I.E.R.E., City & Guilds, G.C.E., etc. Become a Technician or Technologist for high pay and security. Thousands of passes. For details of Exams and Courses in all branches of Engineering, Building, Electronics, etc., write for 132-page handbook—FREE. B.I.E.T. (Dept. 125k), 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.

SEMICONDUCTOR EXPERIMENTS; the practical way of learning electronics at home. With each experiment you receive all components, full instructions, test circuits, tabulation and graph sheets with sample results. Also low cost test equipment kits. Details free.

ELECTRONIC EXPERIMENTS

49 HEATH LANE, BRINKLOW, RUGBY

STUDY RADIO, TELEVISION AND 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. (Dept. 577), Intertext House, Parkgate Road, London, S.W.11.

HOME STUDY COURSES in Practical Electronics. Free Brochure without obligation from: **BRITISH NATIONAL RADIO SCHOOL**, Reading, Berks.

EDUCATIONAL

(continued)

B.Sc.(ENG.), A.M.I.Mech.E., A.M.I.E.R.E., City & Guilds, etc., on "Satisfaction or Refund of Fee" terms. Wide range of expert 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.

TELEVISION SERVICING RADIOTELEGRAPHY RADAR MAINTENANCE

Full and Part-time Training Courses

Apply:—Director, British School of Telephony,
20 Penywern Road, Earls Court, London, S.W.5

SITUATIONS VACANT

TEST AND INSTALLATION ENGINEER for Language Laboratories, interesting and growing field of advanced electronics. **ELECTRONIC CLASSROOMS LTD.**, 197 Lower Richmond Road, Surrey. Telephone: G. E. SPARK, Prospect 4463, for appointment.

ELECTRONICS TECHNICIAN required with ability to turn research worker's ideas into reality. Would suit practical man with some theoretical knowledge. Salary up to £1,290 according to qualifications and experience. Four weeks' holiday annually. Application forms from Establishment Officer, University College, London, Gower Street, W.C.1, quoting EL/2.

SITUATIONS VACANT (continued)

RADIO TECHNICIANS

A number of suitably qualified candidates are required for permanent and pensionable employment in various parts of the U.K. including London, but primarily Cheltenham. There are also opportunities for service abroad.

Applicants must be 19 or over and be familiar with the use of Test Gear. They must have had Radio/Electronic workshop experience and offer at least "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/54)
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-test 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

1.67

NOTICES

INCORPORATED PRACTITIONERS in Radio and Electronics, (I.P.R.E.) LTD. Conditions of Membership and Examination Syllabus, 1/-; 1966 Examination Question Papers, 2/-; Sample Copy of I.P.R.E. "Review", 2/-; Dept. F, 32 Kidmore Road, Caversham, Reading, Berkshire.

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
62 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 (all models) BC.342, BC.312,
BC.348J.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

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, Carnforth, Lancs.

RECEIVERS AND COMPONENTS

BI-PAK SEMICONDUCTORS

8 RADNOR HOUSE
93/97 REGENT STREET
LONDON, W.1

LOW COST SILICON CONTROLLED RECTIFIERS (THYRISTORS) FACTORY TESTED
1 AMP (TO-5) EACH 8/6
7 AMP (STUD) PIV EACH 10/6
100 9/6
200 12/6
400 22/6
25 PIV Power SCR 50 Amp, Special Price 35/-
Free SCR Literature including
Circuit Diagrams for Light
Dimmers, Speed Controllers,
AC Power Switch, etc., with
SCR orders or on request.

FREE One 10/- Pack of your own choice free with orders valued £4 or over
FREE LOGIC MODULES and/or, Gates, Memory Units, Timer Units, etc., details free
FREE

VALUE	PAK 50	TRANSISTORS MIXED UNTESTED	10/-	10 SCR's UNMARKED, UNTESTED VOLTAGE RANGE 1 amp 50-400 PIV	20/-
3	OC139 Trans. NPN Mullard	10/-	3	High vlt. AF Trans. PNP ACY17	15/-
2	Drift Trans. 2N1225 100 M/Cs	10/-	8	Sil. Rect. 750mA 100 PIV TEXAS	15/-
6	Matched Trans. OC44/45/81/81D	10/-	3	BSY95A Sil. Trans. STC	15/-
4	OA10 Diodes Mullard	10/-	3	Sil. Trans. OC200 Mullard	15/-
15	Red Spot AF Trans. PNP	10/-	2	Sil. Power Rect. 2 Amp 200 PIV BYZ13	15/-
15	White Spot RF Trans. PNP	10/-	1	AF139 GERM. Trans. 1500 M/Cs	15/-
4	Sil. Rects. 3A 100/400 PIV	10/-	1	Sil. Power Trans. 100 M/Cs STC BUY11	15/-
4	NPN Trans. OC139 2N1308, ETC.	10/-	6	Zener Diodes 3-15vts. Mixed 400mW	15/-
10	10 Amp Sil. Rect. 50/100 PIV	10/-	5	OAS Gold Bonded Diodes Mullard	15/-
8	Diodes 4 OA70, 4 OA79	10/-	1	2N1132 PNP PLANAR Trans. Sil.	15/-
1	3 AMP SCR 100 PIV	10/-	2	2N697 NPN PLANAR Trans. Sil.	15/-
3	Sil. Trans. 25303 PNP	10/-	4	GERM. Power Trans. eqvt. OC16 Mullard	15/-
5	2G344A Trans. Eqvt. OC44	10/-	1	UNIUNJUNCTION Trans. TO-5 can	15/-
10	Assorted Computer Diodes	10/-	2	Sil. Trans. 60VCB 200 M/Cs, ZT83/84	15/-
4	Zeners 5, 6-8, 10, 12 Vts	10/-	1	Sil. PLANAR Trans. BSY25 NPN 100M/Cs	15/-
4	2G417 Trans. Eqvt. AF1116/7	10/-	1	Sil. Trans. IS104 150 M/Cs HFE 200 NPN	15/-
2	200 M/Cs Sil. Trans. BSY26/7	10/-	2	SCR's 50 PIV 1 Amp TO-5 can	15/-
2	Bi-directional Trans. ASY66	10/-	1	Tunnel Diode IN3720 (TD-5) G.E.	15/-
4	High Current Trans. OC42	10/-	1	2N2160 UNIUNJUNCTION Trans. TO-5 can	15/-
2	Power Trans. OC36/35	10/-	2	Sil. Rect. 5 Amp 400 PIV Stud	15/-
5	Sil. Rects. 400 PIV 250mA	10/-	1	Tunnel Diode JK19B STC, 1200 M/Cs	15/-
3	OC71 Trans. Mullard	10/-	2	GERM. Power Trans. OC28/29	15/-
3	OC75 Trans. Mullard	10/-	1	2N174 Power Trans. 150W PNP Ic 15A	15/-
3	NPN Sil. Trans. 70 M/Cs	10/-	6	Sil. Rect. Type BY100 800 PIV 550mA	20/-
1	Power Trans. OC20 100 Vits	10/-	8	Sil. Rect. 400 PIV 200/500mA	20/-
5	OA47 Gold Bonded Diodes	10/-	1	Transistor Manual by G.E. 648 pages	30/-
4	OA202 Sil. Diodes Sub-Min	10/-	1	Silicon Controlled Rect. Mullard G.E.	30/-
3	OC77 Trans. Mullard	10/-	25	Mixed Sil. & GERM. Trans. New Marked	30/-
8	OA81 Diodes Sub-min	10/-	40	Mixed Semiconductors New Marked	40/-
3	Sil. Rects. 400 PIV 500 mA	10/-	1	Logic Module Handbook & Catalogue	17/6

Our vast stocks covered 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.

RECEIVERS AND COMPONENTS

(continued)

STELLA NINE RANGE

A new range of instrument cases including most of the designs used in Practical Wireless and Practical Electronics, from September 1966 issues.

These will be made for stock, ready for return-of-post service.

Send now for free photostats and price lists.

Money back guarantee on all goods if not satisfactory.

E. R. NICHOLLS
46 LOWFIELD ROAD
STOCKPORT . CHESHIRE

RECEIVERS AND COMPONENTS

(continued)

PRINTED CIRCUIT KIT

- (1) 2 Copper Laminate Boards 4" x 2 1/2"
- (2) 1 Board for Matchbox Radio.
- (3) 1 Board for Wrist-Watch Radio, etc.
- (4) Resist. (5) Etchant. (6) Resist Solvent.
- (7) Cleanser/Degreaser. (8) 16-page booklet

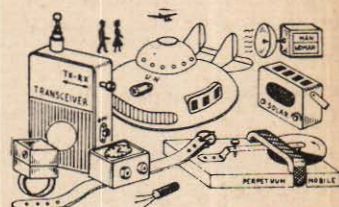
"PRINTED CIRCUITS FOR AMATEURS"

containing full etching instructions.

- (9) 2 Miniature Radio Dials SW/MW/LW also free with each kit. (10) Circuits and Plans of easy-to-build transistorised

30 SUGGESTED PROJECTS

which you can build with your own components on a chassis made from this kit. Drawings. Photographs. Many recently developed very efficient designs you probably haven't heard of



- yet. (1) Crystal set with biased detector. (2) Crystal set with voltage-quadrupler detector. (3) Crystal set with dynamic loudspeaker. (4) Crystal tuner with audio amplifier. (5) Carrier Power Conversion Receiver. (6) Split-Load Neutralised Double Reflex. (7) Matchbox or Photocell Radio. (8) "TRIFLEXON" Triple Reflex with self-adjusting regeneration (Patent Pending). (9) Solar Battery Loud-speaker Radio.

3 SUBMINIATURE RADIO RECEIVERS

The smallest 3 designs yet offered to the Home Constructor anywhere in the World. Based on the "Triflexon" circuit. Let us know if you know of a smaller design published anywhere. (10) Postage-Stamp Radio. Size only 1 1/2" x .95" x .25". (11) Wrist-watch Radio, 1.15" x .80" x .55". (12) Ring-Radio, .70" x .70" x .55". (13) Battery-powered Radio. Runs on sugar or bread. (14) Radio Control Receiver. (15) Transistor P/P amplifier. (16) Intercom. (17) 1-valve amplifier. (18) Reliable Burglar Alarm. (19) Light-Seeking Animal. Guided Missile. (20) "Perpetual Motion" Machine. Atmospheric Engine. (21) Metal Detector. (22) Simple Transistor Tester. (23) Human Body Radiation Detector. (24) Electronic Man/Woman Discriminator. Thermal Proximity Fuse. (25) Pocket Signal Injector. (26) Pocket Transceiver (Licence Required). (27) Constant volume Intercom. (28) Remote Control of Models by Induction. (29) Inductive Loop Transmitter. (30) Pocket Triple Reflex 6-transistor sensitive receiver with transformer-less push-pull output.

P.C. Kit Price 8/6. Post and Packing 1/6. Extra Laminate Board available.

Build 10 EXCITING PHOTOELECTRIC DEVICES

on a Printed Circuit Chassis. Basic Kit: 39/6. Post and Packing 2/6. Contents: 2 Copper Laminate Boards and all chemicals required. Etching Manual. Latching Relay and Bracket. Infra-red sensitive Photocell and Hood. 2 high-gain Transistors. Resistors, cond. Terminal Block. Elegant Plastic Case. Essential Data, Circuits and P.C. chassis plans of

10 PHOTOELECTRIC PROJECTS

- (1) Simple Photo-switch. (2) Modulated Light Alarm. (3) Long-Range Stray-Light Alarm. (4) Relay-less Alarm. (5) Warbling Tone Electronic Alarm. (6) Closed-Loop Alarm. (7) Projector Lamp Stabiliser. (8) Electronic Projector Modulator. (9) Mains Power Supply Unit. (10) Car Parking Light Controller. BASIC KIT enables you to build an efficient unmodulated light Photo-switch/Burglar Alarm. Counter, etc. (Project No. 1) which can be modified for modulated light operation by the addition of a few extra components obtainable separately. (No. 2, 3.)

"YORK ELECTRICS"

181a, York Road, London, S.W.11
Send S.A.E. for details and photographs

RECEIVERS AND COMPONENTS

(continued)

BY100 rectifiers 4/- each any quantity. Post paid. BLAKE, 52A Runcorn Road, Birmingham 12.

BRAND NEW MULLARD TRANSISTORS OC83

Output Transistors, can be used in place of OC81 with better results.

4/6d. each, 7/6d. for 2, 42/- a dozen.

C.W.O. p. and p. 2/6d. in the pound

Trade Enquiries Welcomed

NEW ERA, 70 Baring Road

London, S.E.12

Kip. 7978

REPANCO Transistor Coils and Transformer. for the Constructor. Send stamp for lists RADIO EXPERIMENTAL PRODUCTS LTD., 33 Much Park Street, Coventry.

QUALITY ELECTRONIC COMPONENTS

- * ASSORTED CAPACITORS — New Paper, Polyester, Electrolytic, etc., 100 off 9/6
- * ASSORTED RESISTORS — Hi-Stab. 300 off (5%, 10%, 1%, 1 watt, worth £3) ... 15/-
- * TRANSISTORS — Matched Output Kit: OC81D and 2-OC81 9/6 R.F. Kit: OC44 and 2-OC45 9/6 OC44, 45, 70, 72, 81 and 81D Equivalents, each ... 3/-
- * RESISTORS — 5% Hi-Stab Carbon Film 75Ω to 1MΩ (1/2 watt); 10 off, one preferred value ... 4/-
- * CAPACITORS — Miniature Polyester Foil: 160 VDC/100 VAC. 33 pF to .1μF 5 off, one preferred value 3/6 .15μF to .47μF 5 off, one value 5/- (P. & P. 1/6 per order, C.W.O.)

ELMBRIDGE INSTRUMENTS LTD.
Island Farm Ave., West Molesey, Surrey

RECEIVERS AND COMPONENTS

(continued)

ECONOMY SEMICONDUCTORS

Type	Build	β	V _{ce}	I _c	P _t	Price
2N3053	SN	50-250	60	700mA	1w	11/6
40319	SP	35-200	40	700mA	1w	13/6
2N3241	SN	70-250	25	100mA	0.5w	7/3
2N3403	SN	180-540	25	500mA	0.56w	7/6
2N3405	SN	180-540	50	500mA	0.56w	8/9
C407	SN	18 min	120	50mA	0.2w	8/6

S: sil., G: ger'm., N: NPN, P: PNP, * max.

Also types advertised last month:

2N1304	4/3	2N3702	(860-180)	4/9	etc.
2N1305	4/3	2N3702	(8150-300)	6/-	etc.
BC107	7/9	6645	(8250-550)	3/6	etc.
BC108	7/6	6645	(8500-1000)	4/3	etc.
BC109	8/6	2N2926	(any colour)	4/-	

Special for December only: Silicon Rectifiers

BY238, 850V PIV, 1A, 1.5KV surge, 3/6.

Top line in new resistors, 1W 5% Carbon

film, 4.7Ω to 10MΩ, 2/3 doz., 17/3 100.

Sensitive Photocells, type TPMD 5/3.

10V Electrolytics 5 to 50μF, 9d. 100, 200μF, 11d.

Catalogue 6d.

ELECTROVALUE

6 Mansfield Place, Ascot, Berkshire

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 μA 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, BFO, Pitch and Var. HF Tone controls, RF & AF Gain, Var. selectivity with Crystal Filter. Complete with Instructions/Service Manual, etc. £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 Power 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 5 ft. 9 in. Weight 21 lbs. Must have cost well over £20. Price 70/-, Carr. 5/-.

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

RECEIVERS AND COMPONENTS

(continued)

COMPONENTS BONANZA! S.A.E. for big list! A. J. BASSETT, 28 Park Road, Chorley, Lancs.

SEMICONDUCTOR BARGAINS

Ge. DIODES: OA5, OA7, OA47, OA81, all 1/6 each; GEX66 2/-; GEX941 2/6; AAZ12 3/-; AAZ13 5/-; SX631 3/-; OA10 3/-.

ZENERS: OAZ200 10/-; OAZ201 5/-; OAZ202 to OAZ206 7/-; OAZ207 9/-; OAZ208 to OAZ213 6/-; 27v 600mw 11/6.

TRANSISTORS: OC23 10/-; OC25 11/-; OC28 and 29 17/6; OC35 7/6; OC36 9/-; OC70 and 71 5/-; OC72 6/-; OC76 5/9; OC83 6/-; OC139 11/6; OC140 15/6; OC170 3/6; OC200 9/-; OC204 17/-; 2N706 5/9; 2N711 4/9; 2N1204 5/-; 2N1305 6/-; 2N1308 10/-; 2N1309 10/-.

Heat sink suitable for OC28, etc., 5/3 for 4".

Send for details of our new range of regulated power supplies.

25v/1A, 25v/1A, 25v/2A, 75v/1A.

P. & P. 2/6 in the £, minimum 1/6

ELECTRO PROCESS SERVICES

6d, SUN STREET, HITCHIN, HERTS

Tel. 51215

SPECIAL OFFER

1 Watt S.T.C. 300 MC/S N.P.N. Silicon Planer. Transistors. With data. Limited Stocks. £1 for 6.

3/- each. OC44, OC45, OC70, OC71, OC81, OC81D, OC200, Get 16, Get 20.

4/- each. AFI14, AFI15, AFI16, AFI17, OCI70, OCI71.

5/- each. OCI39, OCI40, 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

WENTWORTH RADIO

GENUINE HIGH QUALITY COMPONENTS

GENUINE LOW PRICES

NKT121	9/-	NKT227	8/6	OC44	2/6	AF115	4/6
NKT122	6/5	NKT228	4/4	OC45	2/6	AF116	4/6
NKT123	5/3	NKT261	3/6	OC70	5/-	AF117	2/6
NKT124	8/5	NKT262	3/6	OC72	2/6	AF118	6/-
NKT125	5/1	NKT263	3/6	OC75	5/-	OC26	10/-
NKT141	6/-	NKT264	3/6	OC77	3/-	OC28	10/-
NKT142	5/1	NKT265	3/6	OC77	3/-	OC35	10/-
NKT143	5/-	NKT271	3/6	OC81D	2/6	OC36	12/6
NKT162	4/11	NKT272	3/6	OC81	2/6	AD140	10/-
NKT163/25	4/11	NKT273	3/6	OC170	3/-	GET573	12/6
NKT164/25	4/11	NKT274	3/6	OC171	6/-	MAT100	7/9
NKT172	4/7	NKT275	3/6	OC172	4/6	MAT101	9/6
NKT216	8/6	NKT676	4/4	OC200	3/3	MAT120	7/9
NKT217	8/-	NKT713	6/6	OC201	10/6	MAT121	8/6
NKT218	4/4	NKT773	5/-	AC128	3/9	OA95	1/-
NKT221	4/11	NKT774	5/-	AF114	4/6	OA70	2/-

BARGAIN OF THE MONTH

FANTASTIC VALUE

OC72

ONLY 2/- EACH

12 OR MORE POST FREE

250MW ZENERS 4/-

MINIATURE POTS. LIN. 2/-

FULL RANGE TEXAS AND NEWMARKET TRANSISTORS. LISTS AVAILABLE. 5K, 10K, 25K, 50K, 100K, 250K, 500K, 1M, 2M, 2/- each

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

RETURN OF POST ORDER AND QUOTE SERVICE

1/4w RESISTORS 10Ω-22M 2d.

1/4w 10% MINIATURE 10Ω-1M 6d.

CERAMIC CAPACITORS 4d. 30/- 100

SILVER MICA 10PF-1000PF 6d.

HI-STABS 1% 1/4w 1/-

MINIATURE TRANSISTOR ELECTROLYTICS,

FULL RANGE 1/2. MAGNETIC EARPIECES

WITH PLUG 3/- CRYSTAL 4/4

RECEIVERS AND COMPONENTS

(continued)

SILICON RECTIFIERS 50 PIV, 1-5A; 400 PIV, 0-75A, 2/6. 12V zeners 5% 1W, 3/6. All orders post 6d. J. COOPER, Outwell, Wisbech, Cambs.

NEW SILICON PRODUCTS

SILICON F.E. Ts N-2N3819 25/-, P-2N3820 25/-, U.I.T. BEN3000/TIS43 to trigger SCRs @ 13/-, SCR 2N3529 400PRV, 2A. RMS @ T_{fa}/25°C 22/6, SCR 2N3525 400PRV, 5A. RMS @ T_{fa}/25°C 25/-, SCR C22D 400PRV, 7-4A. RMS @ T_{fa}/80°C 35/-, 2N2926 B 55-110 @ 4/3, B 150-300 @ 4/9, 2N2926 B 90-180 @ 4/3, B 235-470 @ 4/9.
MILLTRONICS
1 ULLSWATER ROAD, LEVERSTOCK GREEN
HEMEL HEMPSTEAD, HERTFORDSHIRE
C.W.O. Post Free S.A.E. List Mail Order Only

COMPONENTS, VALVES, TRANSISTORS, etc. Call or send 6d. for list. ROGERS, 31 Nelson Street, Southport.

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/-	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/-
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 res. 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.

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**



**SUPPLIERS OF
ELECTRONIC
EQUIPMENT
TO...**

- * UNIVERSITIES
- * COLLEGES OF TECHNOLOGY
- * COLLEGES OF FURTHER
EDUCATION & SCHOOLS
- * ALL ENTHUSIASTS

**OFFICIAL 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

10/- BARGAIN SALE! 10/-

- | | |
|--|--|
| 10/- PISTOL-GRIP SOLDERING IRON (USUALLY 25/-) | 10/- 6 NPN or PNP Switching Transistors (min. 200 mc/s). |
| 10/- 20 well assorted TRANSISTOR ELECTROLYTICS. | 10/- 10 Transistor Holders. |
| 10/- 3 Television Smoothing Condensers. 200/200uf., 200/100uf., 300/125/50uf., 275 volt. | 10/- ACOS MONO PICK-UP HEAD COMPLETE WITH NEEDLES. |
| 10/- 50 assorted 1/4 Watt 5% Resistors. (Long Leads). | 10/- 3 Miniature earpieces complete with plug and lead. |
| 10/- 100 assorted 1/4 to 1/2 watt mixed resistor types, values. | 10/- 20 Diodes. Very high quality. |
| 10/- 100 1/2 to 3 watt Close Tolerance types. | 10/- Magnetic Lapel Microphone with plug and lead. |
| 10/- 100 assorted Silver Mica/Ceramic/Polystyrene Condensers. | 10/- 3", 4" or 5" Low impedance LOUDSPEAKER. |
| 10/- 50 assorted paper condensers .001 to .5uf. | 10/- SIGNAL INJECTOR R.F./I.F./A.F. parts and circuit. |
| 10/- 100 miniature paper condensers (Mixed values). | 10/- Car Rev. Counter, Parts and Circuit (excl. meter). |
| 10/- 50 untested TRANSISTORS (excellent value). | 10/- 12 pre-set potentiometers mixed. |
| | 10/- Remote control units for Philips/Stella/Cossor/T.V. |
| | 10/- Cost 3 gns. Special Bargain |

10/- FREE!

10/- FREE!

10/- FREE!

10/- FREE!

10/- FREE!

Any Eleven Items for £5/-!

10/- FREE!

Please include 1/- for post

Rush your order now! These prices cannot be repeated!

G. F. MILWARD

14 PEEL CLOSE, DRAYTON BASSETT, Nr. TAMWORTH, STAFFS.

Phone: TAMWORTH 2321

POST ONLY

Everything You need to know about

RADIO, TELEVISION & ELECTRICAL REPAIRS

AMAZING 'KNOW HOW' BOOK

Brings You RIGHT UP TO DATE!

576

PAGES

OVER 470

ILLUSTRATIONS

REVISED AND ENLARGED—this essential handbook for the enthusiast, handyman or professional repairer, is packed with detailed information and easy-to-follow instructions on how to service radio and TV sets (including all-transistor and U.H.F. circuits), audio equipment and domestic appliances of every kind. Shows every step in fault tracing and the use of modern test gear, from simple meters to complex oscilloscopes. Also provides practical guidance on household electrical installation work. 576 pages. Over 470 illustrations. Mammoth value — Special Library Edition, superbly bound in Leathercloth, 50/-, or on easy terms; 13/- down and 3 monthly instalments of 14/- (55/-). But first accept 7 Days' Home Trial Offer — without obligation!



COVERS ALL THE LATEST TECHNICAL ADVANCES!

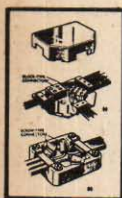
U.H.F. TELEVISION

Here are basic circuits and full instructions to enable you to service modern sets — get perfect 625-line reception.

Getting the best from RADIO AND TELEVISION SETS

How to make adjustments and repairs in order to get the best possible performance from any set.

All you need to know about DOMESTIC INSTALLATIONS

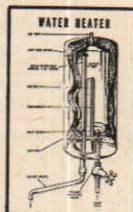


Learn from these helpful pages how to carry out modifications and extensions — with efficiency and safety! Complete guidance on lighting and power circuits, practical wiring work, safety regulations, cables, earthing, fuses, etc.

Also Fluorescent Lighting, Thermostats and Time Switches

WATER HEATING

All you should know about water heaters and how to install them and keep them in perfect working order. How to service FIRES and SPACE HEATERS.



HOW TO MAINTAIN AND REPAIR DOMESTIC APPLIANCES

From irons, toasters, hair dryers, etc., to cookers, washing machines and refrigerators. Also covers the repair and rewinding of small motors.

SPECIAL SECTION ON COLOUR TELEVISION

Explains clearly and concisely the principles of prospective colour systems.

FAULT FINDING

This grand book is invaluable for tracing faults in radio and TV sets (both valve and transistor circuits). Deals fully with tools and bench work — shows how to make the best use of test instruments. Tells everything you want to know — from how to carry out preliminary tests to how to align tuned circuits.

Servicing DOMESTIC AUDIO EQUIPMENT

How to locate and rectify faults in hi-fi equipment (mono or stereo), record players, tape recorders, etc.

ACT NOW!

Simply complete form, indicating method of payment preferred, and post in a 3d. stamped, unsealed envelope. Offer applies in the U.K. and Eire only. Hurry! Make sure of your copy.

ONE GREAT VOLUME covers:

Current, Voltage and Resistance, Coils, Capacitors and Tuning, Valves, Tubes and Transistors, Radio Components, Receiver Design Principles, Transistor-Radio Circuits, Valve-Radio Circuits, Valve-Television Circuits, Transistor-Television Circuits, Colour-Television Systems, Audio Amplifier Circuits, Audio Equipment and Gramophones, Tape Recorders, Radio and Television Aerials, Tools and Bench Work, Test Instruments and Their Use, Fault Tracing and Circuit Testing, Alignment of Tuned Circuits, Television Fault Tracing, Interference Suppression, Domestic Power Supply Circuits, Electrical Wiring Work, Fluorescent Lighting, Thermostats and Time Switches, Motor Repair and Rewinding, Small Appliances, Space and Water Heaters, Electric Cookers, Washing, Drying and Ironing Machines, Electric Refrigerators, Suction Cleaners and Floor Polishers.

SEND NO MONEY NOW!

To: Dept. SA186, Odhams Books Ltd., Basted, Sevenoaks, Kent.

WITHOUT OBLIGATION please send me, on 7 Days' Home Trial, Radio, Television and Electrical Repairs. Within 8 days I will either (a) send the Cash Price of 50/- (plus charge for postage and packing), or (b) send a down payment of 13/- (plus postage charge), followed by 3 monthly payments of 14/- (Total Credit Price 55/-). Alternatively, I will return volume in good condition, postage paid, within 8 days.

Cross out words NOT applicable below:

I wish to pay by CASH/TERMS. I am (a) houseowner; (b) tenant in house or flat; (c) temporary resident; (d) single; (e) married; (f) over 21; (g) under 21.

PLEASE SIGN HERE

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

BLOCK LETTERS BELOW

NAME (Mr./Mrs./Miss)

Full Postal

ADDRESS

SA186/Jan. '67

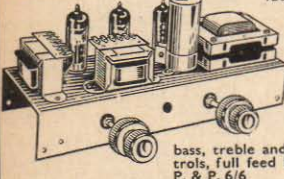
HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TAI

- Peak output in excess of 15 watts.
- All standard British components.
- Built on printed circuit panel, size 6 x 3 in.
- Generous size Driver and Output Transformers.
- Output transformer tapped for 3 ohm and 15 ohm speakers.
- Transistors (GET 114 or 51 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 TAI's are ideal for stereo.

STEREO AMPLIFIER

Incorporating 2 ECL86s and 1 E280, heavy duty, double wound mains transformer. Output 4 watts per channel. 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. 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 200/300 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 PCC80 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 1/2 in. per sec., simple control, uses 5 1/2 in. spools, 65/15/-.

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.

TSI CRYSTAL STICK MIKE. Listed at 45/-.

Our price, 18/6. P. & P. 1/6.

VYNAR AND REXINE SPEAKER AND CABINET FABRICS app. 54 in. wide. Usually 35/- yd., our price 13/6 per yd. length (min. 1 yd.) P. & P. 2/6. S.A.E. for samples.

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. This amplifier was used in a 29 gns. record player, employs heavy duty double wound mains transformer, ECC83, EL84, E280 valves. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7 in. w. x 2 1/2 in. d. x 5 1/2 in. h. Ready built and tested. **PRICE 69/6.** P. & P. 4/9.

ALSO AVAILABLE mounted on board with output transformer and 6 in. speaker ready to fit into cabinet below. **PRICE 89/6.** P. & P. 5/9.

QUALITY PORTABLE R/P CABINET

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or Single Record Player Unit. Size 18 x 14 x 8 1/2 in. **PRICE £39/6.** Carr. 7/6.

4-SPEED PLAYER UNIT BARGAINS

All brand new in maker's original packing.

SINGLE PLAYERS

B.S.R. TU12 £39/6. Carr. 5/6.
GARRARD SP25 De Luxe £12/10/6. Carr. 5/6.
B.S.R. GU7 with unit mounted pickup arm. £41/8/8. Carr. 5/6.

AUTO. CHANGERS

Latest B.S.R. UA25 Super slim £6 2 6
GARRARD 1000 with special Hi-Fi cartridge £19 6
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. £55.0/0; 35w. £88.0/0.

BRAND NEW 3 OHM LOUDSPEAKERS

5 in., 12/6; 6 1/2 in., 15/-; 8 in., 21/-; 10 in., 25/-; 7 in. x 4 in., 15/-; 10 in. x 6 in., 26/-.

E.M.I. 8 in. x 5 in. with high flux ceramic magnet 3 ohm 23/6.

E.M.I. 13 1/2 x 8 in. with high flux ceramic magnet, 42/- (15 ohm, 45/-). P. & P. 4" 5" 2 1/2", 6 1/2" 8" 2 1/2", 10" 12" 3/6 per speaker.

E.M.I. PLASTIC CONED TWEETER.

2 1/2" 3 ohm. Limited number: 12/6 each, P. & P. 1/6.

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.

7-10 watt ULTRA LINEAR OUTPUT TRANSFORMERS

to match pair of ECL 82's in push-pull to 3 ohm output. **ONLY 15/-**. P. & P. 2/6.

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 2 1/2". P. & P. 4/6.

SMOOTHING CONDENSER.

2800 mfd. 25v. 1 1/2" dia. x 3" high 3/-, P. & P. 1/-.

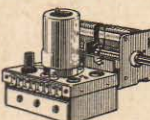
MATCHED PAIR OF 21 WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS.

Stack size 1 1/2" x 1 1/2" x 1 1/2". Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair plus 2/- P. & P.

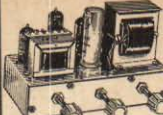
SPECIAL OFFER! FM/AM TUNER HEAD

Beautifully designed and precision engineered by Dorman and Wadsworth Ltd. Supplied ready fitted with twin .0005 tuning condenser for AM connection. Prealigned 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/-.
30/-, P. & P. 3/-.

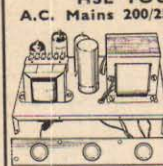


3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records, A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2 in. w. x 4 in. d. x 4 1/2 in. h. Incorporates ECC83, EL84, E280 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/-.

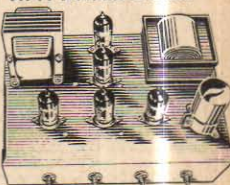
HSL 'FOUR' AMPLIFIER KIT



A.C. Mains 200/250v., 4 watt, using ECC83, EL84, E280 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. Overhaul height 4 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, wiring 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 lift and cut. Valve line-up 2 EL84s, ECC83, EF86, and E280 rectifier. Simple instruction booklet 1/6. (Free with parts.) All parts sold separately. **ONLY 67/9/6.** P. & P. 8/6. Also available ready built and tested complete with std. input sockets, 69/5/-, P. & P. 8/6. Matching 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 1/2" x 2 1/2" H. Will match FM/AM Tuner head on left. 11/- pair. P. & P. 2/-.

HARVERSON SURPLUS CO. LTD.

170 HIGH ST., MERTON, S.W.19 CHERRYWOOD 3985

Open all day Saturday Early closing Wed., 1 p.m.

A few minutes from South Wimbledon Tube Station. (Please write clearly)

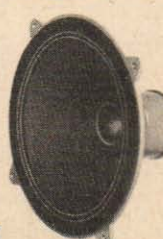
OVERSEAS P. & P. CHARGED EXTRA. S.A.E. with all enquiries

BAKER 12in. STANDARD

The ideal High Fidelity Speaker for use where higher outputs are desired in the home, public address, schools, theatres, etc.

Maximum Power	20 watts	Available from all
Bass Resonance	40-50 c.p.s.	Radio &
Flux Density	14,000 gauss	Hi-Fi
Voice coil diameter	1 1/2"	Dealers
Voice coil impedance	15 ohms	
Voice coil material	Copper	
Useful response	40-14,500 c.p.s.	
Cone surround	Roll	
Chassis material	Solid aluminium	
Overall diameter	12 1/2"	Post Free

Send for New catalogue and enclosure plans



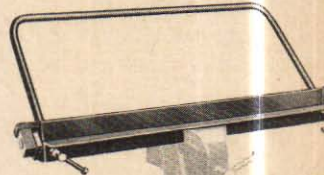
Baker Reproducers Ltd

(DEPT. P.E.13)

Bensham Manor Road Passage, Thornton Heath, Surrey. THO 1665

PARKERS SHEET METAL FOLDING MACHINES HEAVY VICE MODELS

With Bevelled Former Bars



No. 1.	Capacity 18 gauge mild steel x 36 in. wide	£12.10.0
No. 2.	Capacity 18 gauge mild steel x 24 in. wide	£7.5.0
No. 3.	Capacity 16 gauge mild steel x 18 in. wide	£7.5.0

Also new bench models. Capacities 48 in. x 18 gauge £40. 36 in. x 18 gauge £25. 24 in. x 16 gauge £24. Carriage free.

End folding attachments for radio chassis. Tray and Box making for 36 in. model, 5/6 per ft. Other models 3/6. The two smaller models will form flanges. As supplied to Government Departments, Universities, Hospitals.

One year's guarantee. Money refunded if not satisfied. Send for details.

A. B. PARKER, Wheatcroft Works, Wellington St., Batley, Yorks. Tel. 3426



YOURS FREE FOR 7 DAYS

The New 'Picture - Book' way of learning

BASIC

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

... and I should like to congratulate you on such a fine set of manuals with which I am highly delighted and will purchase the other manuals ... A.M., RETFORD

... These excellent books are exactly what I have been looking for ... P.J., NORFOLK

... I think the Basic books are the best I have ever read and I've read a heck of a lot ... J.E., DONCASTER

POST NOW FOR THIS OFFER!

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 UNITED KINGDOM ONLY.

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

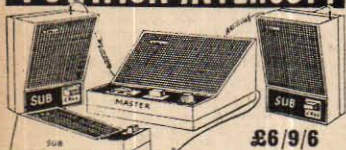
BASIC ELECTRICITY 70/-	☐	BASIC ELECTRONICS 82/-	☐
BASIC ELECTRONIC CIRCUITS 40/-	☐		☐
BASIC INDUSTRIAL ELECTRICITY 40/-	☐		☐
BASIC SYNCHROS & SERVOMECHANISMS 38/-	☐		☐
ALL PRICES INCLUDE POSTAGE			

PE1

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

NAME.....
FULL POSTAL ADDRESS.....
BLOCK LETTERS BELOW

4-STATION INTERCOM



£6/9/6

Solve your communication problems with this 4-Station Transistor Intercom system (1 master and 3 Subs), in de-luxe plastic cabinets for desk or wall mounting. Call/talk/listen from Master to Subs and Subs to Master. Ideally suitable for Business, Surgery, Schools, Hospital, Office and Home. Operates on one 9V battery. On/off switch. Volume control. Complete with 3 connecting wires each 60ft. and other accessories. P. & P. 3/6.

INTERCOM/BABY ALARM



Usually ~~£6/9/6~~
Our Price ONLY

49/6

Modernize business or home with this new two-way Portable Transistor Intercom, consisting of Master and Sub, in strong plastic cabinets with chromium stands. Designed as a two-way instant communication system. Call/talk/listen from Master to Sub and Sub to Master. Operates on one 9V battery. Complete with 60 ft. wire. Battery 2/6. P. & P. 2/6

Transistor TELEPHONE AMPLIFIER



Why not boost business efficiency with this incredible De-luxe

Telephone Amplifier. Take down long telephone messages or converse without holding the handset. A status symbol? Yes, but very useful one. On/off switch. Volume Control. Operates on one 9V battery supplied for 2/6 extra. P. & P. 2/6. Full money refunded if not satisfied in 7 days.
WEST LONDON DIRECT SUPPLIES (PE1)
189 KENSINGTON HIGH STREET, LONDON, W.8.

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. **Master 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,** 1/6 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. P.E.)
27 Central Parade, New Addington
Surrey
LOD 2266

The most accurate
pocket size
CALCULATOR
in the world

Send a postcard today for free booklet, or if you prefer, send 75/- for this invaluable spiral slide rule on approval, with money back guarantee if not satisfied.



CARBIC LTD.

(Dept. PE8),
54 Dundonald Road
London, S.W.19

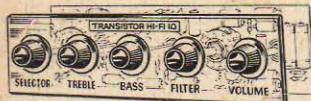
FREE
BOOKLET ON
REQUEST



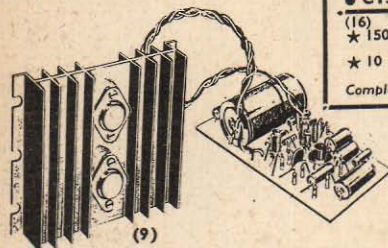
(14)



(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

SEE BACK COVER FOR MORE ITEMS OF INTEREST

10 AND 20 WATT MONO AND STEREO TRANSISTOR AMPLIFIERS

(9) **POWER AMPLIFIERS.** 10 watts RMS output, 100mV input, 30 c/s to 20 k/c/s $\pm$ 1dB. 6-Transistor Push-pull. Panel size 4 $\times$ 2 $\frac{1}{2}$ $\times$ 1 in. 14/5 4 $\times$ 4 in. TPA10/3 3-5 ohm spkr. £4.10.0, p.p. 2/6. TPA10/15 12-16 ohm spkr. £5.5.0, p.p. 2/6 (Mains unit for 1 or 2 amplifiers, 59/6, p.p. 2/6)

The Finest High Fidelity at Unbeatable Prices

25 WATT AMPLIFIER
New 8-Transistor design. Push-pull output for 7 $\frac{1}{2}$ to 16 ohm speaker. 150mV input, 30c/s to 20k/c/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 39/6 EP30K 30kV £6.10.0
TP10 2kV 75/- EP50K 50kV £8.15.0
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/-

(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.
Complete range of test equipment in stock

(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. 6/- buys 150-page catalogue with discount vouchers.

(10) **PREAMPLIFIERS.** 8 input selector. Treble, bass, volume, filter controls. 14mV to 100mV inputs. Battery operated or from Mains Unit. Output up to 150mV RMS.

MP2 Mono 9 $\frac{1}{2}$ $\times$ 2 $\frac{1}{2}$ $\times$ 2 in. £5.10.0, p.p. 2/6 (grey and gold front panel 8/6).
SP4 Mono/Stereo, 9 $\times$ 3 $\frac{1}{2}$ $\times$ 1 $\frac{1}{2}$ 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 $\frac{1}{2}$ volt peak. Complete with front panel, etc. 9 volt operated. For use with any amplifier or tape recorder.

TOTAL COST £3.19.6 P.P. 2/6
TO BUILD

(14) VHF FM TUNER

Supplied as 2 Preassembled Panels, plus metal work Superhet design, 88-108 Mc/s, 9 volt operated.
Total cost to assemble £12.17.6, p.p. 2/6

STABILISED PRICE SUPPLY

Two outputs, 3.6 volt and 9.6 volt up to 250mA each. Transistorised and Tuner 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 $\times$ 2 $\times$ 1 $\frac{1}{2}$ in.

BUILT AND TESTED 69/6 P.P. 2/-
(optional mains units 54/-)

14 watts version 59/6.
Matching Pre-amplifier, 6 inputs, treble/bass/selector/volume controls, 6-10mV o/p, 9-18V supply, 79/6, p.p. 2/-.
For use with any Transistor Amplifier

(18) **FMT41 FM TUNER.** 6-transistor 3 diode design. Completely built and tested £8.10.0 2/-

(19) **AMT31, Med. Wave Tuner.** Built ready to use, 79/6, p.p. 2/-.



(16)



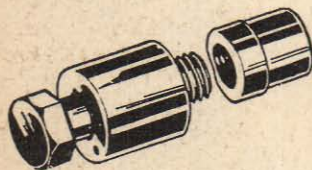
(17)



(13)



(15)



The PUNCH you need!

HOLE PUNCHES

Instant Type		
1 $\frac{1}{2}$ " diameter	...	6/10 ea.
Screw-up Type		
1 $\frac{1}{2}$ " diameter Toggle switch	...	8/6 "
" " B7G	...	8/6 "
" " B8A, B9A	...	9/- "
" " " " " "	...	9/6 "
" " " " " "	...	10/2 "
" " " " " "	...	10/8 "
" " " " " "	...	11/8 "
1 $\frac{1}{4}$ " diameter Int. Octal	...	13/4 "
1 $\frac{1}{2}$ " " " " " "	...	16/2 "
1 $\frac{1}{4}$ " " " " " "	...	18/10 "
1 $\frac{1}{2}$ " " " " " "	...	21/8 "
1 $\frac{1}{4}$ " " " " " "	...	24/4 "
2 $\frac{1}{2}$ " " " " " "	...	33/2 "

Complete Set £9.3.6.

No extra charge for postage and packing in the U.K.

Now supplied by:

TOMPKINS & LONGMAN LTD.

237 GIPSY ROAD
WEST NORWOOD, S.E.27
Tel.: Gipsy Hill 5000

NEW CIRCUITS

Football Pool Computer
Multiplying/Dividing Computer
Simultaneous Equation Solver
Quadratic Equation Solver

The above analogue computer circuits, all based on the Wheatstone Bridge, are not expensive to build and all parts are available. Circuits, wiring diagrams, instructions, price lists, 4/6 the set of four post free.

Multimeters at new reduced prices. TK20A, 33/- post 3/-; EP10K, 67/6 post 3/-; EP20K, 85/- post 3/-; EP30K, 105/- post 4/6; EP50K, 145/- post 4/6. Further details on request.

1% High Stab Resistors, $\frac{1}{2}$ W, 2/- Stock list on request.

PLANET INSTRUMENT CO.

25 (E.) Dominion Avenue, Leeds 7

MULLARD 10W A.B. TRANSISTOR AMPLIFIER SPECIAL CLEARANCE

Printed Circuit Boards to Mullard specification fully drilled and fluxed. Price 4/- each or 7/- for two post free.
Layout Diagram 9d. each.

List of other parts available sent with each order.

HART ELECTRONICS

321 GREAT WESTERN ST., MANCHESTER 14

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 9v; 6v; 4.5v (single output) 39/6 each. P. & P. 2/9.
9v + 9v; 6v + 6v; or 4.5v + 4.5v (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 (RADIOS) LTD.

(Dept. P.E.), 11 Oliver Road, London, E.17

COMPONENTS Send your list of requirements for competitive quotation by return of post.

HI-K CERAMIC CAPACITORS (DISC)
500v. DC working. 1,000 pF 2/6 per dozen. P.P. 9d. 10,000 pF 3/9 per dozen. P.P. 9d.

RESISTORS $\frac{1}{2}$ watt 5% carbon film resistors, 10 Ω to 10M Ω . Brand new, not surplus. 5d. each. P.P. 1/- on any order.

POTENTIOMETERS 5K Ω lin, 10K Ω lin, 100K Ω lin, 250K Ω lin, 1M Ω log, 2M Ω log, 2M Ω lin. 1/- each. P.P. 6d.

With double pole switch 500K Ω log, 500K Ω lin, 1M Ω log, 2/- each. P.P. 6d.

With single pole switch 10K Ω lin, 50K Ω lin, 2/- each. P.P. 6d.

Pre-sets 250K Ω lin, 250K Ω log, 300K Ω lin, 2M Ω lin, 1M Ω lin. 1/- each. P.P. 6d.

FERROXCUBE TOROIDS Leaflet on complete range available on request.

TOROID TRANSFORMERS for inverter applications, etc. 20 watt version: 12v. input, 250v. 80mA output. 19/6. P.P. 4/6. 60 watt version: 12v. input, 300v. 200mA output. 39/6. P.P. 5/-.

Toroid transformers also supplied to your requirements.

RESISTOR PACKS 100 well assorted values and types, mainly $\frac{1}{2}$ W. hy-stabs, but also some 1/10W, $\frac{1}{4}$ W, 1W, 2W. 1% to 10%.

A super buy at 7/6. P.P. 1/6.

CAPACITOR PACKS 100 well assorted silver micas, ceramics, polyesters, papers, electrolytics, etc. 10/- P.P. 1/6.

VALVEHOLDERS B9A paxolin 2/- per dozen. P.P. 1/6.

UX7 10/- per dozen. P.P. 2/6.

HEADPHONES German made with cushioned ear-pads. 5 and 2,000 ohm versions. 29/-. P.P. 2/-.

COMMUNICATIONS EQUIPMENT A large selection of receivers, etc. always available.

BRIAN J. AYRES & CO.

Dept. EC, 8 Hartfield Road

Wimbledon, London, S.W.19

Telephone: Wimbledon 6063

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?

MECH. ENGINEERING
Gen. Mech. Eng.—Maintenance Eng.—Diesel Eng.—Press Tool Design—Sheet Metal Work—Welding—Eng. Pattern Making—Inspection—Draughtsmanship—Metallurgy—Production Eng.

RADIO ENGINEERING
General Radio—Radio & TV Servicing—TV Eng.—Telecommunications—Electronics—Sound Recording—Automation—Practical Radio—Radio Amateurs' Exam.

CIVIL ENGINEERING
General Civil Eng.—Municipal Eng.—Structural Eng.—Sanitary Eng.—Road Eng.—Hydraulics—Mining—Water Supply—Petrol Tech.

ELEC. ENGINEERING
General Electrical Eng.—Installations—Draughtsmanship—Illuminating Eng.—Refrigeration—Elem. Elec. Science—Elec. Supply—Mining Elec. Eng.

AUTO ENGINEERING
General Auto Eng.—Auto. Maintenance—Repair—Auto. Diesel Maintenance—Auto. Electrical Equipment—Garage Management.

BUILDING
General Building—Heating & Ventilation—Plumbing—Architecture—Carpentry—Painting—Decorating—Specifications & Quantities—Surveying—Architectural Draughtsmanship.

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.O.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.

156 PAGES OF EXPERT
CAREER - GUIDANCE

PRACTICAL EQUIPMENT

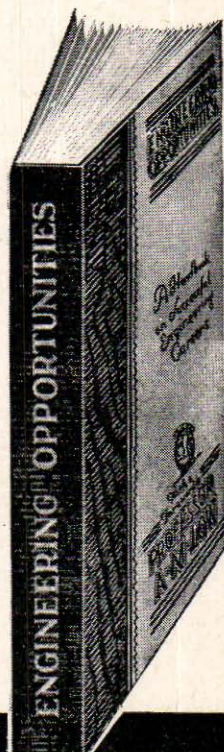
Basic Practical and Theoretical Courses for beginners in Radio, T.V., Electronics, Etc., A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Radio & Television Servicing Practical Electronics Electronics Engineering Automation

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.

Published about the 15th of the month by GEORGE NEWNES LIMITED, Tower House, Southampton Street, London, W.C.2. Printed in England by THE CHAPEL RIVER PRESS, Andover, Hants. Sole Agents for Australia and New Zealand: GORDON & GOTCH (A/sia) Ltd.; South Africa and Rhodesia: CENTRAL NEWS AGENCY LTD.; East Africa: STATIONERY & OFFICE SUPPLIES LTD. Subscription rate including postage for one year: To any part of the World £1 16. 0.



Designed by
L. W. Roche

**CALL
IN AND
HEAR
ONE
PLAYED**

BUILD THE WORLD'S FIRST ALL TRANSISTOR PORTABLE ORGAN KIT

- ★ EASY TO BUILD WITH PRINTED CIRCUITS AND FULLY COMPREHENSIVE HANDBOOK
- ★ CIRCUITS USE 170 TRANSISTORS AND DEVICES
- ★ 10 SELECTED TONE COLOURS PLUS VIBRATO
- ★ PORTABLE TWO COLOUR CABINET WITH DETACHABLE LEGS, MUSIC STAND, SWELL PEDAL
- ★ THE ONLY COMPLETE KIT AVAILABLE IN THE WORLD
- ★ FOR GROUPS, CLUBS, HOBBYISTS, HOME ENTERTAINMENT

SPECIFICATIONS:

- TONE COLOURS (ROCK TABS) 10 DIFFERENT TONES CAN BE SELECTED
- SWITCHED VIBRATO BINET SIZE 30½ x 15½ x 9 in. ● WEIGHT 35 lb.
- 49 NOTE C-C FULLY SP KEYBOARD ● 6 OCTAVES OF GENERATORS
- PRESET VOLUME CONTR ● TONE COLOUR BLEND CONTROL
- FOOT SWELL PEDAL ● OUTPUT UP TO ½ VOLT ● 110/250 VOLT MAINS OR 18 VOLT BATTERY ● FULLY POLYPHONIC OPERATION
- PLUG-IN PRINTED CIRCUIT PANELS ● SIMPLE LOCKED-IN TUNING
- DETACHABLE LEGS WITH STOWAGE
- FULLY DETAILED INSTRUCTION HANDBOOK, PHOTOS AND CIRCUITS

**UNBEATABLE
FOR PRICE
PERFORMANCE
AND QUALITY**

- COMPLETE KIT WITH CABINET, ALL COMPONENTS AND HANDBOOK
- ALL PARTS AVAILABLE SEPARATELY
- HP AVAILABLE FOR COMPLETE KIT
- HANDBOOK SEPARATELY, 20/- post paid

**MAYFAIR PORTABLE
ELECTRONIC ORGAN
ACCLAIMED BY EVERYONE**



**TO BUILD
YOURSELF IN EASY
STAGES. ALL PARTS
SOLD SEPARATELY
AND FULLY GUARANTEED**

Latest 4-page
Illustrated
Catalogue
Supplement.
Free on request.

(CARRIAGE AND
PACKING 30/- EXTRA
U.K. ONLY)

99 GNS.

**DETAILED LEAFLET FREE
ON REQUEST
CALL FOR DEMONSTRATION**

TRANSISTORS

Latest 14-page Transistor/Rectifier catalogue now ready. Many new devices—plenty of price reductions. Send 3d. stamp for free copy. The Largest Range available.

TUNNEL DIODES

1mA 22/8; 5mA 15/-; 15mA 12/6. Brand new at fraction of normal price. Free specs. supplied.

(1) **REGENT-6 MW/LW**
Pocket Radio to Build
6-Transistor superhet.
Geared tuning. Push-pull
speaker output. Molded
cabinet 5 x 3 x 1½ in.
Phone socket. **69/6**
TOTAL COST
TO BUILD P.P. 2/-
Full tuning on both bands

SCR'S (THYRISTORS)

● 1 AMP SERIES WIRE LEADS

50 PIV .. 7/6 100 PIV .. 7/6
200 PIV .. 12/6 300 PIV .. 15/-
400 PIV (280V Rms) .. 17/6
100 PIV, 3 Amp Stud Type .. 9/6
400 PIV, 7 Amp (280V Rms) Stud Type 25/-

● SA100. 5 + 5 watt
Stereo, 300mV Input PM
Tuners, PU's, etc. O/P 4
to 16 ohms. Mains op'd.
£15.15.0 P.P. 5/-

VALVE AMPLIFIERS AND TUNERS IN CABINETS

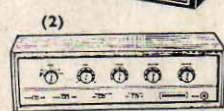
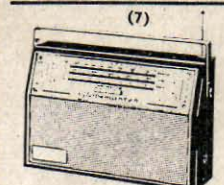
● SA200. 7½ + 7½ watt ● AFM 100. AM/FM
version. Also inputs for tuner to match SA100,
Mag Mic, Mag PU's, etc. etc. self-powered mains.
£27.10.0 P.P. 7/6
£23.10.0 5/-

(3) DEAC RECHARGEABLE BATTERY

YOUR LAST CHANCE FOR THIS OFFER
● 9.6 volt 225mA/H DEAC CHARGER
To charge 3.6 volt and 9.6 volt packs.
Fully mains isolated.
In moulded case, **45/-** P.P. 2/-

(2) HI-FI EQUIPMENT

Complete range in stock. Send list of requirements for special price quote. Hi-fi demonstration room open.



FM STEREO DECODER
7-Transistor Printed Circuit
Design with Stereo Indicator.
For use with any valve or transistor FM. Uses pot cores to Mullard design and ger. and silicon transistors.
Complete **£5 19 6** P.P. 2/-
Kit Price

(4) BUILD A QUALITY 2 OR 4 TRACK TAPE RECORDER

New 3-speed version using new '363' decks
● TWO-TRACK. Deck £10.10.0. Martin Amplifier £14.19.6. 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 £15.19.6. 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 6	SP25 stereo	£10 10 0	40/less cart./arm	£27 10 0
1000 stereo	£6 6 0	SP25 Deram	£12 19 6	AT6 mono	£8 19 6
2000 mono	£6 6 0	AT60 less cart.	£9 10 0	AT6 stereo	£9 10 0
2000 stereo	£6 9 6	AT60 Deram	£19 6 0	AT6 Deram	£11 19 6
3000/1m stereo	£7 10 0	AT60 stereo	£10 10 0	Decade Mk.II	£17 10 0
SP25 less cart.	£9 10 0	AT60 Deram	£12 19 6	A70 less cart.	£17 10 0
SP25 mono	£9 19 6	LAB80 less cart.	£27 0 0	(P. & P. 5/- any type)	

(7) GLOBEMASTER MW/LW/SW PORTABLE RADIO TO BUILD

Full 3-waveband tuning. Pushbutton wave-change. Superhet printed circuit. Black-chromed cabinet 11 x 7½ x 3½ in. (SW 17.50 metres). Ear/Record sockets. 1 watt Push/Pull output.

TOTAL COST TO BUILD **£7.19.6** P.P. 3/6

WE CAN SUPPLY FROM STOCK MOST OF THE PARTS SPECIFIED ON CIRCUITS IN THIS MAGAZINE. SEND LIST FOR QUOTATION. ASK FOR NEW 4-PAGE CATALOGUE SUPPLEMENT ALSO LIST OF SPECIAL HIGH-FIDELITY EQUIPMENT. DISCOUNTS AVAILABLE.

7SA90. Transistor Stereo Amplifier in Case. 4½ + 4½ watts. 3 to 16 ohms O/p. Input 80mV. Tuner and P.U.'s. Mains operated. P.P. 5/- **£9.19.6**

(5) VHF FM TUNER TO BUILD

87/105 Mc/s Transistor Superhet. Geared tuning. Terrific quality and sensitivity. For valve or transistor amplifiers. 4 x 3½ x 2½ in. Complete with dial plate. (FM Decoder Kit £5.19.6. P.P. 2/-).
TOTAL COST TO BUILD **£6.19.6** P.P. 2/6
(Cabinet Assembly 20/- extra)

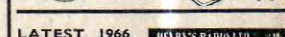
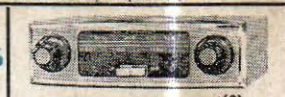
(8) TROMASTER TRANSISTOR CAR RADIO

7-Transistor MW/LW Car Radio. 12 watt operated. 3 watt output. Push-button wave-change. RF stage. Supplied built, boxed, ready to use with Speaker and Baffle. Car fixing kit and manufacturers' current guarantee. Special Bargain Offer. Buy Now! List Price 13 gns. P.P. 3/6
PRICE **£9.9.0**

HENRY'S RADIO LTD.

303 EDGWARE RD., LONDON, W.2

PADDINGTON 1008/9 (STD 01-723-1008)
Open Mon. to Sat. 9-6. Thurs. 1 p.m.
Open all day Saturday



LATEST 1966 CATALOGUE

Have you a copy? Fully detailed and illustrated. 150 pages of components, equipment, etc. Over 5,000 stock items. PRICE 6/-, post paid. Free discount vouchers with every catalogue. You cannot afford to be without a copy of this catalogue



SEE PAGE 80
FOR MORE
ADVERTS

SUPPLIERS OF QUALITY COMPONENTS AND EQUIPMENT