PRACTICAL

ELECTRONICS

FEBRUARY 1971 3/6 (17½ NEW PENCE)

TAPE/SLIDE SYNCHRONISER

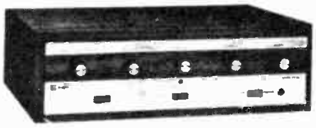
knight-kits FANTASTIC LOW PRICES!

Due to huge purchase these superb U.S.A. construction kits can be offered at 25%—50% off recommended list prices. Absolutely complete with most detailed construction and operating books. Available from all branches or by mail order for 7/6 CARRIAGE AND PACKING on each kit. Two kits or more carr. free.

KG-865 50 Watt Stereo Amplifier Kit

DELUXE FEATURES

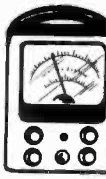
All Silicon Transistors for Stability, Cleaner Sound ● Extremely Wide Power Bandwidth and Frequency Response ● 50W IHF Power Output ● Specially Selected Low-Noise Preamp Transistors ● Two Printed Circuit Boards for Fast Easy Assembly ● Convenient Front-Panel Stereo Headphone Jack ● Teak-finished Extruded Aluminium Front Panel ● Two a.c. Convenience Outlets.



Output: *50W IHF, 25W per channel; 34W continuous sine wave* ● **Response:** *±1dB, 18 to 30,000Hz* ● **Output Impedances:** *4 through 16 ohms, plus stereo headphones* ● **IM Distortion:** *under 1% at 60Hz and 7,000Hz mixed 4 : 1 at rated power* ● **Input Sensitivity:** *Magnetic Phono, 5mV; Tuner and Auxiliary, 500mV* ● **Power Requirement:** *230–250V, 50Hz a.c.*

Recommended List Price £34.19.6: **26 GNS.** Assembled **29 GNS.** Teak Case **£5** Extra

KG-620 4½" VTVM KIT ★ NEW!



SPECIFICATIONS

Ranges: *0-1·5-5-15-50-150-500-1,500V full scale; with optional High-Voltage Probe, to 25,000V.*

Accuracy: *±3% Of full scale reading.*

Input Resistance: *11 megohms (1 meg in probe) up to 1,500V.*

Ranges (rms): *0-1·5-5-15-50-150-500-1,500V full scale (p-p); 0-4·2-14-42-140-420-1,400-4,200V full scale.*

Decibels: *−10 to +65 in 7 ranges.*

Response: *±1dB, 30Hz to 3MHz; ±3dB, 30Hz to 5MHz; with optional H.F. Probe, to 250MHz.*

Accuracy: *±5% of full scale reading.*

Ranges: *0-1,000-10,000-100,000 ohms; 0-1-10-100-1,000 megohms.*

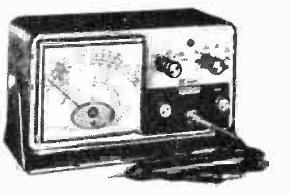
Centre Scales: *10, 100, 1,000, 10,000, 100,000 ohms; 1 and 10 megohms.*

Battery *1½V size U2.*

Recommended List Price £18.5.6: **9½ GNS.** Assembled Price **£14.** (RR Price £30.0.0)

KG-625 Deluxe 6in Vacuum Tube Voltmeter Kit

Huge 6in Meter Scale ● Ranges: *d.c. 0–0·5–1·5–5–15–50–150–500–1,500V full scale.* ● **Accuracy:** *±3% of full scale reading* ● **Input Resistance:** *11MΩ to 1,500V* ● **Ranges:** *a.c. 0–1·5–5–15–50–150–500–1,500V full scale. 0–4·2–14–42–140–420–1,400–4,200V full scale* ● **Accuracy:** *±5%* ● **Frequency Response:** *±1dB, 30Hz to 3MHz; ±3dB, 30Hz to 5MHz* ● **Ohmmeter Ranges:** *0–1,000–10,000 ohms; 0–1–10–100–1,000MΩ* ● **Battery:** *1½V U2.*
Recommended List Price £24.19.6:
12 GNS.



KG-790 Stereo AM-FM Tuner Kit

SUPERB CHASSIS MODEL WITH PERFORMANCE NEVER BEFORE ATTAINABLE IN A SOLID-STATE STEREO TUNER KIT

- **Has that "Factory-built" Look of the Finest Stereo Hi-Fi Tuners available**
- **Four Double-tuned IF Stages for Super-Sensitivity**
- **22 Transistors, 14 Diodes**
- **Whistle Filter**
- **Built-in Tuning Meter**
- **Size 5 × 16¾ × 15ins**
- **Automatic Stereo FM Switching**

FM SECTION

- **Usable IHF Sensitivity:** *2·5μV for 30dB quieting*
- **Range:** *87·5 to 108·5MHz*
- **Hum and Noise:** *−60dB*
- **IF Bandwidth:** *300kHz*
- **Response:** *±2dB, 50Hz to 15kHz*
- **Distortion:** *less than 0·75% at 1-volt output*
- **Aerial:** *unbalanced 300-ohm input*

AM SECTION

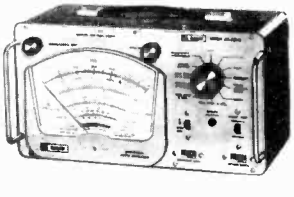
- **Sensitivity:** *3·5μV for 20dB S/N ratio; 1·5μV for 10dB S/N ratio.*
- **IF Bandwidth:** *7·5kHz*
- **IF Rejection:** *60dB min*
- **Image Rejection:** *70dB min* **at** *1kHz*
- **10-kc Rejection:** *40dB min*
- **Listed £92.12.11 49 GNS.**

KG-375A Deluxe Solid-State Auto Analyzer Kit

Tune-up and trouble-shoot any car, perform actual road tests

It's several testers in one . . . do all this

Set Engine Idle and Automatic Transmission Shift Points ● Detect Condition of Point Surfaces ● Detect Distributor Wear ● Check Voltage and Current Regulators ● Check Generators for both Current and Voltage Output ● Find Poor or Open Earth Circuits ● Detect Variation in Dwell Angle.
Recommended List Price £23.17.6:
16 GNS. Assembled Price **21 GNS.**



WHY NOT BUY THE PAIR?

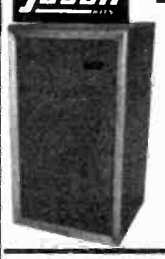
KG-371 Deluxe Solid-State Timing Light

Performance surpasses assembled units costing much more

Helps Set Ignition Timing ● Checks Synchronisation of Double Breaker Arms ● Checks for Sticking Automatic Spark-Advance Mechanism ● Checks Distributor Cam Wear ● Built-in d.c. Power Supply ● Reliable Solid-State Circuit ● Your car gives More miles per gallon; Improved performance; Greater reliability.
Recommended List Price £12.10.0: **9 GNS.** Available Assembled Only.

Introducing The New

Jason "Delta" Loudspeaker Enclosure.



Incorporating the famous EMI 150 set consisting of a 13×8in. bass unit with a high flux ceramic magnet and a concentric tweeter impedance 8Ω 20 watt peak handling power (10 watts RMS).

Heavy duty 16mm infinite baffle case in superb quality genuine golden teak veneers with solid mahogany contrasting leading edges. High quality foam loaded cloth fret. Acoustically loaded "Jason" rotating badge in genuine gold leaf for horizontal or vertical operation. Size 19in.×10in.×10½in. Weight 16lbs. A price break through at only £12.10.0 each. Carriage etc. 10/- singly.
Carriage free in pairs.

PLINTHS & COVERS for Garrard (all take current models except heavy transcription types) Beautiful heavy solid perspex top with "stereo" badge high quality base with solid wood sides machined ready for R/P deck to drop in without any further work. Terrific value at only 69/- complete. Carr. & Insurance 7/6.

Jason KITS

We offer you fully tensilised polyester/mylar 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 coppers than acetate, sub-standard, jointed or cheap imports. TRY ONE AND PROVE IT

Standard		Long		Double		Triple	
3in. 150ft.	2/3	3in. 225ft.	2/9	3in. 300ft.	4/-	4in. 900ft.	13/-
4in. 300ft.	4/6	4in. 450ft.	5/6	4in. 600ft.	8/-	5in. 1,800ft.	25/-
5in. 600ft.	7/6	5in. 900ft.	10/6	5in. 1,200ft.	15/-	5¾in. 2,400ft.	34/-
5¾in. 900ft.	10/6	5¾in. 1,200ft.	13/-	5¾in. 1,800ft.	19/-	7in. 3,600ft.	44/-
7in. 1,200ft.	12/6	7in. 1,800ft.	18/6	7in. 2,400ft.	27/-	Quadruple	
						3in. 600ft.	8/6

Post free less 5% on three reels. **Quality and Trade enquiries invited.** NOTE. *Large tape stocks at all branches.*

Stockists of Leak, Quad, Sharp, Goodman, Garrard, Akai, Eagle, Rodgers, Crown, Teleton, Wharfedale, etc.

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FREE FLOG LIST Nº 2

Scores Special Bargains

SEND S.A.E. OR CALL AT ANY BRANCH FOR YOURS

PERSONAL CALLERS Welcomed at branches listed to right where there are large Hi-Fi and Component stocks at the keenest prices including:
All Mail Orders Only to Arundel.

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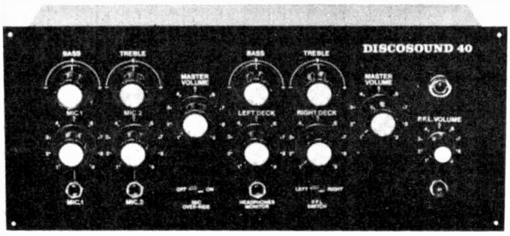
★ **BRIGHTON** 6 Queen's Road Tel. 23975

★ **PORTSMOUTH** 350-352 Fratton Road. Tel. 22034

★ **SOUTHAMPTON** 72 East Street Tel. 25851

DISCOSOUND



DISCOSOUND 40 PRE-AMP

The Discosound 40 offers the same specification as the D.J. Disco Amp without the power output stage. Size 16in · 7in · 7in. Self powered and ideal for use with the Discosound 100 Power Amplifier below and one of the outstanding features is that it is capable of running ten of these Power Amplifiers (Total 1,000W).

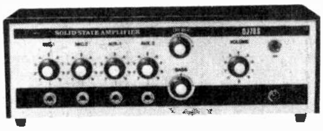
PRICE £40.10.0 inc. P. & P.

DISCOSOUND 100 POWER AMPLIFIER

A 100W RMS (8 Ohms) High Fidelity power Amplifier which utilises all silicon transistors of modular construction and features full automatic overload protection against short or open circuits. Frequency response: 20–20,000Hz · 2dB. The High output is ideally suited for discotheques, groups, clubs, etc., or anywhere where reliability and quality are required. This unit is the companion model for use with our control pre-amp Discosound 40, or can be used with any other high quality pre-amp control unit. Completely built and tested on steel Chassis.

PRICE £49.10.0 inc. P. & P.

DJ70S INTEGRATED MIXER-AMPLIFIER



One of the finest units available on the market today, regardless of price. The front end of the unit consists of a four channel mixer with separate inputs and volume controls, plus a separate bass, treble and master volume control. One of the main features of this remarkable amplifier is its elaborate protection against short and open circuit and we can guarantee that it is virtually indestructable. Allied to this is its very high power output (70W R.M.S.) a frequency response (30-20,000Hz ± 3dB) that is superb, and distortion that is well below 1% even at full output. The unit is suitable for use with discotheques, groups, P.A., clubs, etc., or anywhere that high quality high output is required. Size: 15½in × 5in × 6in.

PRICE £63.0.0 inc. P. & P.

Also available DJ105S 30W P.A. Amplifier. Similar specification to above.

PRICE £41.0.0 inc. P. & P.

For full details of these and all Discosound Products write direct to:

DISCOSOUND

122 BALLS POND ROAD, LONDON, N.1. Tel. 01-254 5779

Full money back guarantee if returned within 10 days
All Discosound Products are guaranteed for 12 months
Demonstrations given at any time

KONTAKT 60

FOR INACCESSIBLE CONTACTS—More than just a cleaner. KONTAKT 60 guarantees perfect cleaning of contacts chemically in accordance with today's technology.

KONTAKT offers the following advantages:—

1. Dissolves oxides and sulphides the safe way without attacking contact substances.
2. Contains carefully selected solvents which do not attack plastics whereas they do dissolve resinified contact greases and dirt.
3. Contains *no silicone*.
4. Contains a light lubricant in order to avoid the contact paths being corroded.
5. Prevents further oxidation setting in.
6. Prevents "creep" currents.

Because of these outstanding properties **KONTAKT 60 is one of the best and most popular contact cleansing agents in the world.**

Users include: Rolls Royce Ltd., C.E.G.B., South of Scotland Electricity Board, Trinity House Workshops, Kolster Brandes, Mullard, Plessey Cos., etc.

OTHER KONTAKT PRODUCTS ARE:

70 Protective Lacquer
72 Insulating Spray
75 Cold Spray For Fault Location
80 Special Siliconized Polish
100 Antistatic Agent For Plastics
101 Dehydration Fluid

Write for full details of above complete range of Kontakt products to:—

SPECIAL PRODUCTS DISTRIBUTORS LIMITED
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1 MILLION SILICON PLANAR TRANSISTORS

NPN-PNP PLASTIC AND METAL CAN TYPES

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

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

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

TYPE STNL
Silicon Plastic Epitaxial Planar Transistors TO-92 case. I.C. 200mA, 300mW medium to high gain, available in npn or pnp and types similar to:
NPN 2N2926 — 2N2711 — 2N3391 — 2N3707 — 2N3711 — BC167-8-9.
Price: 500 £7.10.0; 1,000 £13

TYPE STPL
As above but in pnp and similar to types 2N5354-56, 2N4058-2N4061 and 2N3702-3. Also used as complementary to the above npn devices type STNL.
Price: 500 £7.10.0; 1,000 £13

TYPE STNK
Silicon Planar Plastic Transistor npn with TO-18 pin circular lead configuration, I.C. 200mA, 300mW and similar to BC107-8-9, BC170, BC173, BC182-184, BC237-8-9 and BC337-8.
Price: 500 £9.10.0; 1,000 £16

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

All goods Ex-stock sent by return. Cash with order please to:

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P.O. Box 5, WARE, Herts.
S.A.E. For full list of surplus semiconductors

Astrad ORION

THE WORLD'S SMALLEST TWO WAVEBAND, 6 TRANSISTOR RADIO

Music, news, sport, wherever you are, 7-day money back guarantee if you are not absolutely delighted with the results. Make no mistake, this is a real radio, not a toy or crystal set! Fully built and tested, ready for immediate use. NO EXTRAS.
This minute radio will play anywhere—any time, beach, garden, park, home, office, school, etc. The super sensitive 6 transistor circuit is fully tuneable over both long and medium wavebands, with built-in ferrite rod aerial to provide excellent selection.
The Orion operates from one tiny battery, either mercury or nickel cadmium, for long life and economical running cost. The output is via a crystal-type personal earphone, giving extreme clarity, which prevents disturbing other people when used in public parks, open spaces, etc. The small size of the Orion allows it to be carried easily in the pocket or handbag, and it is also supplied with an attractive presentation case. Complete with earpiece, battery and carrying case.
Specification. Waveband coverage: Medium 525kc/s to 1,605kc/s; Long 150kc/s to 308kc/s. Sensitivity: 35mV/m max. Selectivity (at −30kc/s detuning) −10dB. Power consumption: 4mA max. Power source: 1 × 1·4V Mercury battery. Mallory type RM625 or equivalent. Mallory battery is not rechargeable.

COMPLETE WITH EARPIECE RECHARGEABLE BATTERY POCKET CARRYING CASE **ONLY £1·48** POST 18p

*Spare rechargeable battery 18p extra—post FREE with radio.

BARGAIN PACKAGE

COMPRISING—1 ORION RADIO 1 RECHARGEABLE BATTERY AND BATTERY CHARGER **£2** POST 20p

BATTERY CHARGER

THE BATTERY WE SUPPLY WITH THE ORION IS A RECHARGEABLE TYPE. BATTERY CHARGERS ARE AVAILABLE TO RECHARGE THE BATTERY AGAIN AND AGAIN. OPERATES ON HOME MAINS 200/240 VOLTS A.C.
Battery life is approx. 10 hours. Charging time: 10 hours. A spare battery will enable you to keep your Orion constantly in use.

LASKY'S PRICE **85p** POST FREE WITH RADIO

SONICS AS-57

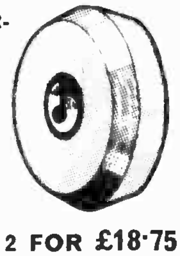
BUDGET BOOKSHELF SPEAKER SYSTEMS

The AS-57 is a real space saver. This fine miniature high-fidelity speaker system will provide good quality sound anywhere in your home at remarkably low cost. Designed for use where space is at a premium, the AS-57 system is ideal for the small apartment or isolated listening area. The special high efficiency 5 × 7 in. full range speaker has a frequency range of 70–18,000Hz with a peak handling capacity of 10 watts. Imp. 8 ohms. Finish: oiled walnut. Size 5¾ × 15¾ × 8¼in.

LASKY'S PRICE **£15 per PAIR** POST FREE

SOUND-SCAN AUDIO TRANSDUCERS

TURN ANY SURFACE-WALL-DOOR-WINDOW INTO A SPEAKER!!



The Sound Scan method employs a newly developed audio transducer which converts whole areas into sound reproducing surfaces. Sound just flows from walls, ceilings, windows, tables and chairs when fitted with these new units. Easily adaptable to most conventional radios, recorders and other music systems, the Sound Scan will reproduce efficiently when mounted on glass, plastic, fibre board, plaster board, wood, etc. Input impedance 8 ohms. Designed to work with amplifiers with an output of between 2–12 watts. Size: 4in. dia. × 1½in.

LASKY'S PRICE **£9·95 EACH** Post 20p Each **2 FOR £18·75**

McDONALD

MP.60 PROFESSIONAL SERIES FOUR SPEED SINGLE PLAY UNIT

High-precision low-mass fully counter-balanced pick-up arm, heavy balanced turntable, simply operated controls, viscous cueing device, slide in cartridge carrier, four pole motor.

LASKY'S PRICE **£11.50** POST 35p.

complete with plinth and cover **£15.00** POST 40p.

610 AUTOMATIC TURNTABLE

Same specifications as the MP60 but with synchronous four pole motor and full automatic change facilities.
LASKY'S PRICE **£13.95** POST 35p.
WITH PLINTH AND COVER £17.75 POST 40p.

510 AUTOMATIC TURNTABLE

Counter balanced pick-up arm, pressed steel turntable, bias compensator, viscous cueing and synchronous four pole motor.
LASKY'S PRICE **£11.75** POST 35p.
WITH PLINTH AND COVER £15.50 POST 40p.

310 AUTOMATIC TURNTABLE

Low mass square section pick-up arm, cue and pause lever, visual stylus pressure indicator, slide in cartridge carrier, four pole motor.
LASKY'S PRICE **£9.95** POST 35p.
WITH PLINTH AND COVER £13.75 POST 40p.

BSR McDONALD PACKAGES

PACKAGE No. 1

BSR McDONALD 510 4 Speed Autochange	£16.03
AUDIO DEVELOPMENT AD76K Magnetic Cartridge	£ 4.50
BSR Afromosia Plinth with black mounting board	£ 4.44
BSR Smoked Perspex Dust Cover	£ 3.17
Recommended retail price	**£28.14**

LASKY'S PRICE **£23.25** POST 40p.
ADD £5.50 if M2100/E is preferred
ADD £6.50 if Shure M44/5 is preferred

PACKAGE No. 2

BSR McDONALD 310 4 Speed Autochanger	£12.95
AD76K Magnetic Cartridge	£ 4.50
BSR Afromosia Plinth with black mounting board	£ 4.44
BSR Smoked Perspex Dust Cover	£ 3.17
Recommended retail price	**£25.06**

LASKY'S PRICE **£21.50**
ADD 50p if BSR Ceramic Cartridge is preferred

NOW AVAILABLE LASKY'S EXCLUSIVE

LASKY—McDONALD plinth and cover available separately at **£4·75** POST 25p

OUT NOW LASKY'S NEW 1971 AUDIO-TRONICS CATALOGUE

See page 174 for further details

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Order any or all of these. Bargain "SALE" PAKS Listed Below "NOW"

UNSORTED/UNTESTED/UNCODED/UNBEATABLE VALUE

PAK. Order No.	Qty.	Description	Price per PAK
SA1	150	Germ. Trans PNP Mixed lots	10/-
SA2	200	Germ. & Sil. Alloy Trans. PNP	10/-
SA3	100	Germ A.F. Trans. 300mW PNP	10/-
SA4	200	Sil. Alloy Low gain switching Trans. PNP	10/-
SA5	100	Sil. planar plastic trans. PNP	10/-
SA6	100	Sil. plastic planar trans. NPN	10/-
SA7	100	Sil. planar Trans. TO5 plastic PNP 800mW	20/-
SA8	100	Sil. planar trans. TO18 plastic NPN 500mW	20/-
SA9	100	Sil. planar trans. plastic NPN med. & high gain.	20/-
		DIODES	
SB1	200	GERM Diodes Gen.P.	10/-
SB2	200	GERM Gold Bonded	10/-
SB3	200	Sil. Switching Diodes 50mA	10/-
SB4	200	Sil. Gen.P. Diodes 200mA	10/-
SB5	300	Sil. & Germ. Mixed Diodes	10/-

The following are all new and Fully Tested Transistor Packs.

ST1	50	PNP Trans Mixed all coded Germ.	20/-
ST2	40	NPN Germ. To-5 2G339 Eqvt. 2N1302 AC127	20/-
ST3	40	PNP Germ. AF 2G371B OC71-75 type	20/-
ST4	30	PNP Germ. VHF-2G407L=AF117=OC170 uncoded	20/-
ST5	30	PNP Metal Alloy VHF 800m/cs Trans.	20/-
ST6	40	PNP/NPN Assorted Trans all coded	20/-
ST7	40	D1374 RF Trans Eqvt. ASY52 OC44/45	20/-
ST8	40	2N706 NPN Switching SIl. Trans.	20/-
ST9	30	2N708 NPN Sil. Trans.	20/-
ST10	30	BSY28 NPN Sil. Trans.	20/-
ST11	25	2N3703 PNP SIl. Trans'	20/-
ST12	25	TIS48=2N2368 NPN 400m/cs	20/-
ST13	25	SE/2N3646 NPN TO-18 plastic 350m/cs	20/-
ST14	40	2S3010 Sil. Alloy Trans PNP TO5	20/-

WHEN ORDERING PLEASE MENTION PAK. ORDER NO. IN ALL CASES. CLUBS, SCHOOLS & OTHER ORGANISATIONS REQUIRING LARGER QUANTITIES (1,000 MIN. SA & SB) (100 MIN. ST) MAY SUBMIT THEIR OFFERS NOT LATER THAN 1st FEB. 1971.

★ NEW STOCK ITEMS ★

1 AMP SILICON RECTIFIERS (MINIATURE PLASTIC CASE)

Type Price each and Quantity Price

	PIV	1-49	50-99	100+
1N4001	50	1/-	10d.	9d.
1N4002	100	1/-	10d.	9d.
1N4003	200	1/3	1/1	11d.
1N4004	400	1/6	1/4	1/1
1N4005	600	2/-	1/9	1/6
1N4006	800	2/6	2/3	2/-
1N4007	1000	3/-	2/9	2/6

300mW GLASS SILICON RECTIFIERS Do-7 Case

VOLTAGE RANGE 50-1000PIV AND PRICE AS FOLLOWS:—

	1-49	50-99	100up.
50V	9d. each	8d. each	7d. each
100V	10d. „	9d. „	8d. „
200V	11d. „	10d. „	9d. „
400V	1/2 „	1/1 „	1/- „
600V	1/4 „	1/3 „	1/2 „
800V	1/11 „	1/10 „	1/9 „
1000V	2/3 „	2/2 „	2/- „

GENERAL PURPOSE GERM. PNP POWER TRANSISTORS

Coded GP100. BRAND NEW To-3 CASE. POSS. REPLACEMENTS FOR:— OC25-28-29-30-35-36. NKT401-403-404-405-406-450-451-452-453. TI3027-3028. 2N250A, 2N456A-457A-458A. 2N511-511 A & B. 2G220-222. ETC.
SPECIFICATION.
VCBO 80V VCEO 50V IC 10A PT 30 WATTS HFE 30-170

PRICE	1-24	25-99	100up.
	8/6 each	8/- each	7/3 each.

GENERAL PURPOSE SILICON NPN POWER TRANSISTORS

Coded GP300. BRAND NEW To-3 CASE. POSSIBLE REPLACEMENT FOR:— 2N3055. BDY20. BDY11.
SPECIFICATION.
VCBO 100V. VCEO 60V. IC 15AMPS. PT. 115 WATTS. Hfe 20-100. FTI MHZ.

PRICE.	1-24	25-99	100+
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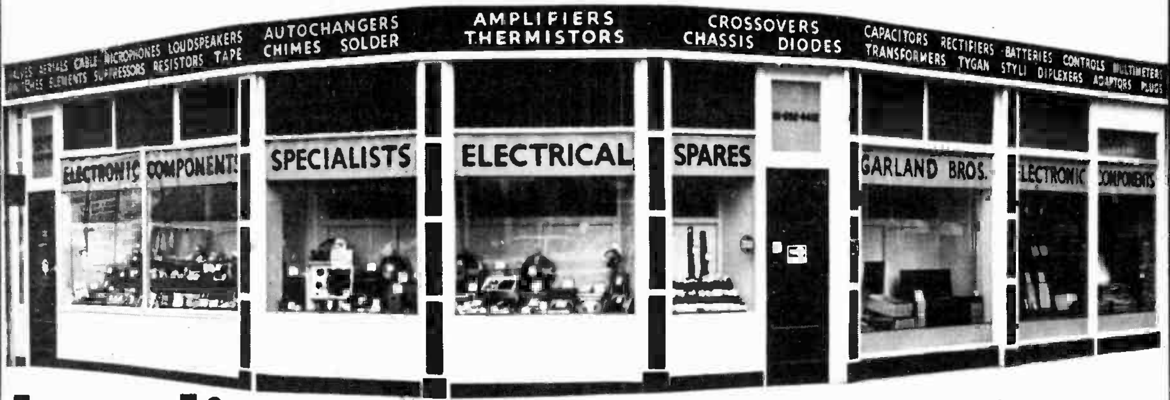

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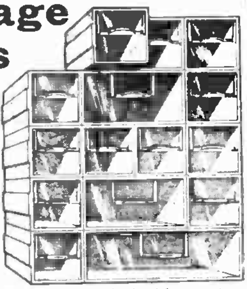

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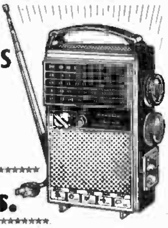

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MAINS TRANSFORMERS
Prim 200/240V a.c. TX1 425-0-425V 250 mA, 6·3V 4A CT, 6·3V 4A CT, 0-5-6V 3A, **135/-**; TX2, 250-0-250V 150 mA, 6·3V 4A, CT, 0-5-6·3V 3A, **78/6**; TX5 300-0-300V 120 mA, 6·3V 2A, CT, 6·3V 2A, 6·3V 1A, **78/6**; TX8 250-0-250V 65 mA, 6·3V 1·5A, **42/-**; MT1 200V 30 mA, 6·3V 1A, **24/-**; MT2 230V 45 mA, 6·3V 1·5A, **29/6**; MT2A 250V 60 mA, 6·3V 2A, **37/6**; MT3 Prim 110/240V Sec 250V 100 mA, 6·3V 2A, **45/-**.

MULTIVOLT TRANSFORMERS
Prim 200/240V a.c. OMT4/1 one tapped sec. 5-20-30-40-60V giving 5-10-15-20-25-30-35-40-55-60, 10-0-10, 20-0-20, 30-0-30V a.c. 1A, **45/-**; ditto transformer 2A OMT4/2, **67/6**; OMT5/1 one tapped sec, 40-50-60-80-90-100-110V, giving 10-20-30-40-50-60-70-80-90-100-110V, 10-0-10, 20-0-20, 30-0-30, 40-0-40, 50-0-50V a.c. 1A, **67/6**.

LOW VOLTAGE TRANSFORMERS
Prim 200/240V a.c.: 6·3V 1·5A, **16/9**; 3A, **20/-**; 6A CT, **34/-**; 12V 1·5A, **21/-**; 3A CT, **34/-**; 6A CT, **45/-**; 18V 1·5A CT, **26/6**; 24V 1·5A CT, **34/-**; 3A CT, **56/6**; 5A, **75/-**; 8A, **112/6**; 12A, **165/6**.

MIDGET RECTIFIER TRANSFORMER
For FW rectification, size 1¾ × 2 × 1½in, Prim 200/240V a.c., output PPT1 9-0-9V 0·3A, PPT2 12-0-12V 0·25A, PPT3 20-0-20V 0·15A, **22/6** each.

O/P TRANSFORMERS, P.P., sec tapped 3-7·5-15 ohms, A-A 6·6K 30 watts (KT66, etc.) **78/6**; 50 watt 3K (E134, KT88, etc.) **135/-**; 100 watt 3K (EL34, KT88, etc.) **225/-**.

LOUDSPEAKERS Ex-equipment, perfect, 3 ohms only 5ins, at **7/6** each, plus 3/- min p.p.

LOUDSPEAKERS, HI-FI, P.A., GUITARS, ETC.
New, boxed, famous makes, 25W, **110/-**; 35W, **180/-**; 50W, **200/-**; 60W, **240/-**; 100W, **400/-**; **E.M.I.** 13 × 8in, 10W, 3, 8 and 15 ohms, **45/-** each; 13 × 8in, **HI-FI**, fitted two tweeters, crossover network, 3, 8 and 15 ohms, **80/-** each.

BULK TAPE ERASERS
Instant erasure of magnetic tape, demagnetizing of tape heads. 200/240v ac, **47/6** post 2/6, leaflet S.A.E.

LT FLUORESCENT LIGHTING
12v fittings with tube, 8 watt **75/-**; 13 watt **120/-**; Inverters 12v, 20 watt **150/-**; twin 20 or single 40 watt **180/-**; twin 30 or single 50 watt **220/-**. Extensive range. List S.A.E.

Carriage extra all orders

S.A.E. ALL ENQUIRIES PLEASE. MAIL ORDER ONLY

46 Kenilworth Road, Edgware, Middx, HA8 8YG
Tel. 958 9314

COMPLETE STEREO SYSTEM

FOR ONLY 39 GNS

CARRIAGE 35/-

PREMIER STEREO SYSTEM "ONE" Consists of an all transistor stereo amplifier. Garrard 2025 T/C auto/manual record player unit fitted stereo/mono cartridge and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. The 10 transistor amplifier has an output of 5 watts per channel with inputs for pick-up, tape and tuner also tape output socket. Controls: Bass, Treble, Volume, Balance, Selector. Power on/off, stereo/mono switch. Brushed aluminium front panel. Black metal case with teakwood ends: Size 12 × 5½ × 3½in. high (Amplifier available separately if required **£14.19.6.** Carr. 7/6). **Now Available MATCHING F.M. TUNER 21gns.**

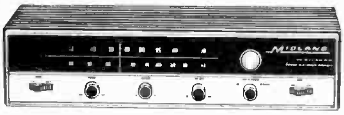
PREMIER STEREO SYSTEM "TWO"

As system "ONE" above but with Garrard SP25.

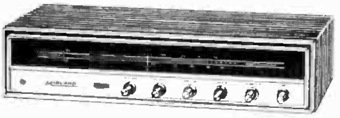
PREMIER PRICE 45 Gns. Carr. 35/-

MIDLAND AM/FM STEREO TUNER AMPLIFIERS

Two new all solid state receivers from Midland at economical prices. Beautifully styled in slimline cabinets.



MODEL 19—520



MODEL 19—542

Specifications	*Model 19–520*	*Model 19–542*
Semi conductors	19 transistors, 12 diodes, 2 varistors	22 transistors, 12 diodes
Tuning range	FM 88–108 MHz FM Stereo Multiplex AM 535–1635 kHz	FM 88–108 mHz FM Stereo Multiplex AM 535–1605 kHz
Aerial	Internal AM and external FM	Internal AM and external FM
Frequency Response	50–17,000 Hz	35–20,000 Hz
Power Output	2½ watts rms per channel (8 watts music power)	4 watts rms per channel (18 watts music power)
Inputs	Ceramic phono	Magnetic/Ceramic phono and aux.
Speaker impedance	4–8 ohm	8 ohm
Controls	Power on/off, Volume, tone, balance, tuning, AFC. Stereo indicator	On/off, Volume, bass, treble, balance, tuning, AFC. Stereo indicator
Function	AM, FM, FM Stereo, Phono (Stereo indicator light)	AM, FM, FM Stereo, Ceramic, Magnetic. Aux.
Size	15" × 8 3/16 × 3½"	16½" × 9½" × 3½"
PRICE	**29 GNS.** Carr. & Ins. 10/-	**42 GNS.** Carr. & Ins. 10/-

TELETON SAQ203E STEREO AMPLIFIER

A small but powerful amplifier designed for stereo hi-fi reproduction. 10 watts per channel music power. Inputs for Gram (Magnetic and Crystal), Tuner and Auxiliary. Tape Record output. Controls: Volume, Balance, Bass, Treble, Stereo/Mono slide switch. Stereo headphone socket. Attractive oiled walnut cabinet with brushed aluminium front panel. List Price £28.7.0.

PREMIER PRICE 22 Gns. P. & P. 10/-

E.M.I. 13×8in. HI-FI SPEAKERS

Fitted two 2½in tweeters and crossover network. Available with 8 or 15 ohm impedance. Handling capacity 10W. Brand new.

69/6 P. & P. 7/6

VERITAS V–149 MIXER

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

Mono Model 59/6 **Stereo Model 69/6** P. & P. 2/6

PREMIER STEREO SYSTEM "FOUR"

Teleton SAQ203E Amplifier (as above)	£23.2.0
Garrard SP25	£11.19.6
Shure M3D	£6.19.6
Teak base and cover	£5.10.0
Pair of Hi-Fi Enclosures fitted E.M.I. Speakers	£26.5.0
Total cost if purchased separately	£73.16.0

PREMIER PRICE 65 GNS. Carr. 35/-

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2½in. speaker units with soft padded ear muffs. Adjustable headband. 8 ohm impedance. Complete with 6ft. lead and stereo jack plug.

49/6 P. & P. 5/-.

STEREO STETHOSCOPE SET Low imp. 25/- P. & P. 2/-

MONO STETHOSCOPE SET Low imp. 10/6 P. & P. 2/-.

POCKET SIZE MULTI-TESTER With wide angle, jewelled meter movement, ceramic long-life, low-loss switching, tough impact resisting case. Sensitivity 20,000 ohms/volt D.C. 10,000 ohms/volt A.C. **19 Ranges:** 0–5–25–50–250–500–2500 volts D.C. 0–10–50–100–500–1000 volts A.C. 0–50μA–2·5mA–250mA D.C. 0–6000 ohms–6 megohms, 10μ μf–0·001 mfd–1 mfd. –20 to +22dB. Complete battery, test lead and instructions.

£4.19.6 P. & P. 3/6.

SPECIAL OFFER!

Garrard SP25 Mk. II Single Record Player. Fitted Audio Technica AT66 Magnetic Stereo Cartridge. Complete in Teak Plinth with Rigid Perspex Cover. Total list Price over £24.

PREMIER PRICE 18 Gns. P. & P. 10/-.

"VERITONE" RECORDING TAPE

SPECIALLY MANUFACTURED IN U.S.A. FROM EXTRA STRONG PRE-STRETCHED MATERIAL. THE QUALITY IS UNEQUALLED.

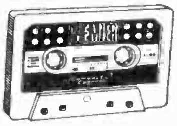
TENSILISED to ensure the most permanent base. Highly resistant to breakage, moisture, heat, cold or humidity. High polished splice free finish. Smooth output throughout the entire audio range. Double wrapped – attractively boxed.

LP3	3"	250'	P.V.C.	5/6
TT3	3"	450'	POLYESTER	7/6
DT3	3¼"	600'	POLYESTER	11/6
SP5	5"	600'	P.V.C.	8/6
LP5	5"	900'	P.V.C.	10/-
DT5	5"	1200'	POLYESTER	15/-
LP6	5¾"	1200'	P.V.C.	12/6
DT6	5¾"	1800'	POLYESTER	22/6
TT6	5¾"	2400'	POLYESTER	37/6
SP7	7"	1200'	P.V.C.	12/6
LP7	7"	1800'	P.V.C.	15/-
DT7	7"	2400'	POLYESTER	25/-
TT7	7"	3600'	POLYESTER	50/-

TAPE SPOOLS 3" 1/-, 5", 5¾", 7" 1/9.

Post and Packing 3" 1/-, 5", 5¾" 1/6, 7" 2/-. (3 reels and over Post Free.)

TAPE CASSETTES



C60 (60 min.) **7/6** 3 for 21/-

C90 (90 min.) **12/6** 3 for 36/-

C120 (120 min.) **17/6** 3 for 51/-

P. & P. 1/-.

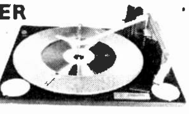
All cassettes can be supplied with library cases at 6d extra each.

PREMIER RADIO

10 & 23, TOTTENHAM COURT ROAD, LONDON, W.1 TEL: 01-636 3451/2639

HEAD OFFICE & MAIL ORDER DEPT. 23, TOTTENHAM CT. RD. TEL: 01-636 3451

PHILIPS STEREO AUTOCHANGER



£8.15.0 Post 5/-.

Precision hi-fi quality at bargain price. Silver and grey deck enamelled finish. 10½in. dia. turntable. 4 speeds, 16, 33⅓, 45 and 78 r.p.m. Plays 7, 10, 12in. discs which can be mixed. Fitted renowned Philips plug-in Xtal AG3306 with dual sapphire stylus for LP/EP/78. Sensitivity 100mV. Frequency response 30cps-16Kc/s. Lightweight stylus pressure 3-6 grammes. Board space required 14 × 12¼in. Above 4in. Below 2½in. 12 months guarantee. (Also available with GP310 diamond stylus LP Stereo/EP and Sapphire 78. £1 extra). MATCHED TEAK PLINTH with PLASTIC COVER. Only £6 extra or Cut-out plywood base board 10/- extra.

BSR 4-SPEED SUPERSLIM AUTO RECORD CHANGER

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. Size 13½ × 11¼in. Above motor board 3¼in. below 2½in. AC 200/250v.

with STEREO/MONO XTAL **£7** Post 5/-

BSR UA70 Stereo/Mono Transcription Auto Changer. Calibrated Stylus Pressure. **£14**

BSR Minichanger UA50 Stereo/Mono. Plays 12", 10" or 7" records. Size 12 × 8¼in. AC 200/250v. Post 5/-. **£8**

GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond/Mono Sapphire. SP25 Mk II £15. Model 3000 Stereo Autochanger £13. Post 5/-.

RECORD PLAYER PORTABLE CABINET Space for amplifier and autochanger. Post 5/-. **75/-**

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested. 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 5/-. **£4**

RCS 2 WATT AMPLIFIER with loudspeaker and valves UCL82 and UY85. Post 5/-. **£3**

R.C.S. TEAKWOOD BASE Ready cut out for mounting (state player make and model). **65/-**

R.C.S. PLASTIC COVERS FOR ABOVE BASE. Durable tinted plastic, attractive appearance. **65/-**

EMI PICK-UP ARM. With mono xtal and stylus 25/-.

EMI JUNIOR 4 SPEED RECORD PLAYER. Mains operated motor, turntable and pick up. Post 5/-. **£3**

HI-FI PICK UP CARTRIDGES

GP94 55/-; GP93 45/-; GP91 30/-; GP67 19/-, ACOS L.P. only 10/-. All standard fixing complete with stylus.

WEYRAD P50 — TRANSISTOR COILS

RA2W Ferrite Aerial	13/-	Spare Cores	7d.
Osc. P50/1AC	6/-	Driver Trans. LFDT4	10/-
I.F. P50/2CC 470 kc/s	6/7	Printed Circuit, PCA1	10/-
3rd I.F. P50/3CC	6/7	J.B. Tuning Gang	11/-
P51/1 or P51/2	6/7	Weyrad Booklet	2/-
P50/3V	6/7	OPT1	11/-

Mullard Ferrite Rod 8 × ⅜in. 4/-. 6 × ¼in. 5/-

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 3/-. D.P. 5/-. STEREO L/S 11/-. D.P. 15/-. Edge 5K. S.P. Transistor, 5/-.

80 Ohm Coax 9d. yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. 28/-; 60 yd. 40/-.

FRINGE LOW LOSS Ideal 625 lines **2/- yd.**

WIRE-WOUND 3-WATT POTS. Small type with small knob. Values 10Ω to 30 K., Carbon 30 K to 2 meg. **5/-**

WIRE-WOUND 3-WATT STANDARD SIZE POTS. LONG SPINDLE 10 OHMS to 100 K. **8/-**

VEROBOARD 0·15 MATRIX

2½ × 5in. 3/9. 2½ × 3¾in. 3/2. 3¾ × 3¾in. 3/9. 3¾ × 5in. 5/2.

EDGE CONNECTORS 16 way 5/-; 24 way 7/7.

PINS 36 per packet 3/5. FACE CUTTERS 7/7.

S.R.B.P. Board 0·15 MATRIX 2½in. wide 7d. per 1in., 3¾in. wide 9d. per 1in.; 5in. wide 1/- per 1in. (up to 17in.).

S.R.B.P. undrilled 1/16 in. Board 10 × 8in. 3/-.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides, 7 × 4in., 6/-; 11 × 3in., 8/-; 11 × 7in. 10/-; 13 × 9in., 12/-; 15 × 14in., 15/-; 9 × 7 × 2in., 8/6; 14 × 11 × 2in., 14/6.

ALUMINIUM PANELS 18 s.w.g. 12 × 12in. 7/-; 14 × 9in. 6/-; 12 × 8in. 5/-; 10 × 7in. 4/-; 8 × 6in. 3/-; 6 × 4in., 2/-.

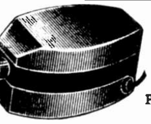
1¼inch DIAMETER WAVE-CHANGE SWITCHES. 2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 5/- each. 1 p. 12-way, or 4 p. 2-way, or 4 p. 3-way 5/- each. 1 inch DIAMETER Wavechange "MAKITS" 1 p. 12-way, 2 p. 6-way, 3 p. 4-way, 4 p. 3-way, 6 p. 2-way. 1 wafer 12/-, 2 wafer 18/-, 3 wafer 24/-, 4 wafer 30/-, 5 wafer 36/-, 6 wafer 42/-.

TOGGLE SWITCHES, sp. 2/9; sp. dt. 3/7; dp. 3/7; dp. dt. 4/7

ALL PURPOSE HEADPHONES

H.R. HEADPHONES 2000 ohms Super Sensitive	35/-
LOW RESISTANCE HEADPHONES 3-5 ohms	40/-
DE LUXE STEREO HEADPHONES 8 ohms	65/-

"THE INSTANT" BULK TAPE ERASER AND RECORDING HEAD DEMAGNETISER



200/250 v. A.C. Leaflet S.A.E. **47/-** Post 3/-

★ GENERAL PURPOSE TRANSISTOR PRE AMPLIFIER BRITISH MADE ★

for Mike, Tape, P.U., Guitar.

Battery 9-12v. or H.T. line 200-300v. D.C. operation. Size 1¾" × 1¼" × ¾". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. **18/-** Post free

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	2/9	100/25V	2/-	16+16/500V	11/-
4/350V	2/9	250/25V	2/9	50+50/350V	7/-
8/450V	2/9	500/25V	4/-	60+100/350V	11/7
16/450V	3/-	8+8/450V	3/7	32+32/250V	3/7
32/450V	4/-	8+16/450V	4/-	32+32/450V	6/7
25/25V	2/-	16+16/450V	5/-	32+32+32/350v.	8/7
50/50V	2/-	32+32/350V	5/-	100+50+50/350v.	9/7

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 2/-; 500, 1000mF 12V 3/7; 2000mF 25V 7/-.

CERAMIC. 1pF to 0.01mF, 9d. Silver Mica 2 to 5000pF, 9d.

PAPER 350V-0·1 9d, 0·5 2/6; 1mF 3/-; 2mF 150V 3/-.

500V-0·001 to 0·05 9d; 0·1 1/-; 0·25 1/6; 0·47 5/-.

1,000V-0·001, 0·0022, 0·0047, 0·01, 0·02, 1/6; 0·047, 0·1, 2/9.

SILVER MICA. Close tolerance 1%. 2·2-500pF 1/7; 560-2,200pF 2/-; 2,700-5,600pF 4/-; 6,800pF-0·01, mfd 6/-; each.

TWIN GANG. "0-0" 208pF+176pF, 11/-; Slow motion drive 365pF+365pF with 25pF+25pF, 11/-; 500pF slow motion, standard 9/-; small 3-gang 500pF 22/-.

SHORT WAVE SINGLE. 25pF, 50pF, 11/-.

CHROME TELESCOPIC AERIALS 23in. Swivel base 4/-.

TUNING. Solid dielectric. 100pF, 500pF, 7/- each.

TRIMMERS. Compression 30, 50, 70pF, 1/-; 100pF, 150pF, 1/7; 250pF, 1/7; 600pF, 750pF, 2/-; 1000pF, 2/-.

RECTIFIERS CONTACT COOLED half wave 60mA 7/7; 85mA 9/7. SILICON BYZ13 6/-; BY100 10/-.

Full wave Bridge Rectifiers 75mA 10/-; 150mA 19/7.

EX-GOVT. RECTIFIERS 250v. 200mA 6/-.

NEON PANEL INDICATORS 250v. AC/DC Red or Amber 4/-.

RESISTORS. Preferred values, 10 ohms to 10 meg. ¼ w., ½ w., 1 w., 20% 3d.; 2 w. 1/-.

HIGH STABILITY. ½ w. 2% 10 ohms to 10 meg., 2/-. Ditto 5%. Preferred values 10 ohms to 10 meg., 9d.

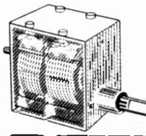
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K. 2/- each; 2½ watt. 1 ohm to 8·2 ohms. 2/-

Q MAX CHASSIS CUTTER

Complete: a die, a punch, an Allen screw and key

⅝in. 16/7 ¾in. 17/7 1⅛in. 19/7 1⅜in. 24/- 2 3/32in. 44/3
⅞in. 16/7 1in. 19/7 1¼in. 20/7 1½in. 29/- 2½in. 57/3
⅞in. 16/9 1 1/16in. 19/7 1⅝in. 21/7 2in. 39/9 1in. sq. 36/7

AM — FM/VHF TUNING GANG



Super quality small size 1½ × 1½ × 1¼in. plus spindle 1½ × ¼in. 365+365 pF with 25+25 pF. British made. Geared slow motion drive 6:1. Plastic dust cover. 6BA tapped front fixing.

10/- POST FREE

MAINS TRANSFORMERS Post 5/- each

250-0-250 50 mA. 6.3 v. 2 amps, centre tapped	22/-
250-0-250 80 mA. 6.3 v. 4 amp.	28/-
250-0-250 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	38/-
350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	38/-
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	50/-
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2½ × 2½ × 2in.	15/-
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2⅝ × 2 × 2in.	18/-
HEATER TRANS. 6.3 v. 1½ a.	11/-
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp.	16/-
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a.	38/-
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60.	38/-

AUTO TRANSFORMERS 0-115-230 v. Input/Output, 60w. 24/-; 150w. 38/-; 500w. £5; 1000w. £12.

CHARGER TRANSFORMERS. Input 200/250v for 6 or 12v., 1½ amp., 24/-; 4 amp., 38/-.

FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 8/-; 2 amp. 11/-; 4 amp. 17/-.

E.M.I. 13½ × 8in. LOUDSPEAKERS

With flared tweeter cone and ceramic magnet. 10 watts. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. Post 3/- each **45/-**

Also with twin tweeters. With crossover. 10 watt. State 3 or 8 or 15 ohm. Post 3/- each **£4**

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 5 **£5**

MINI-MODULE LOUDSPEAKER KIT

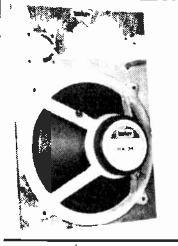
10 WATT **65/-** CARRIAGE 5/-

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8¾ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 8 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9 in. Modern Scandinavian fluted front design for Mini-Module. **£5** Post 5/-

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in MAJOR £9



30-14,500 c.p.s., 12in double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. State 3 or 8 or 15 ohm. Post Free.

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11.10.0**

BAKER "GROUP SOUND" SPEAKERS 8 or 15 ohm.

'Group 25'	'Group 35'	'Group 50'
12 inch 25 watt **£7**	12 inch 35 watt **£9**	15 inch 50 watt **£19**

TEAK HI-FI SPEAKER CABINETS. Fluted wood front.
For 10 or 12in round Loudspeaker £9 Post 5/-.
For 13 × 8in or 8in round Loudspeaker £5 Post 5/-.
For 10 × 6in or 6½in round Loudspeaker £4 Post 5/-.

LOUDSPEAKER CABINET WADDING 18in wide, 3/- ft

TWO-WAY CROSSOVER NETWORK 3,000 c/s

With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5½in. × 4in. with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm impedance. Post 2/-. **38/-**

Horn Tweeters 2-16kc/s. 10W 8 ohm or 15 ohm 30/-.
De Luxe Horn Tweeters 2-18 Kc/s, 15W, 8 ohm 60/-.
ELAC Moving Coil De Luxe Cone Tweeters 3 or 15 ohm 35/-.
TWO-WAY 3000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 19/-.

SPECIAL OFFER! 80 ohm, 2½in, 2¾in. dia.; 35 ohm, 3 in. 25 ohm, 3in. dia.; 6 × 4in; 8 × 5in. 15 ohm, 3½in. dia.; 7 × 4in; 8 × 5in. 8 ohm 6 × 4in; 3 ohm, 2¾in, 3in, 5in, 5 × 3in, 7 × 4in. **18/- EACH TYPE**

LOUDSPEAKERS P.M. 3 OHMS. 6½in 22/-; 8 × 5in, 25/-; 8 × 2½in 18/-; 8in 35/-; 10 × 6in 38/-.

5 in. WOOFER. 8 watts max. 20-10,000 cps. 8 or 15 ohm. 36/-.

ELAC 8 in. De Luxe Ceramic 3 ohm or 15 ohm 50/-.

RICHARD ALLAN TWIN CONE LOUDSPEAKERS 8in or 10in or 12in, 3 or 15 ohm 39/-.

OUTPUT TRANS. EL84 etc. 5/-. MIKE TRANS. 50:1 5/-.

SPEAKER COVERING MATERIALS. Samples Large S.A.E.

GOODMANS OUTPUT TRANSFORMER 4 watt push pull for valves EL84, etc., 3, 8 and 15 ohms 17/-. Post 4/-.

CRYSTAL MIKE INSERTS

1½" dia. 6/-. ACOS 1½" dia. 12/-. BM3, 1" dia. 9/-

PORTABLE AMPLIFIER

Portable mini p.a. system. Many uses — ideal for Parties, or as a Baby Alarm, Intercom, Telephone or Record Player Amplifier, etc. Attractive rexine covered cabinet, size 12 × 9 × 4in., with powerful 7 × 4in. speaker and four transistor one watt power amplifier. Uses PP9 battery. Brand new with famous makers' guarantee. Post 5/-. **75/-**

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SUPPLIED AT LOWEST PRICES.

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

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

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt. Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 × 5 × 4in. **£10**

BARGAIN FM TUNER as above, Chassis only, less cabinet. **£7.10**

FM STEREO MULTIPLEX ADAPTOR for above or general use. Ready made with 4 transistors, 6 diodes **£5**

BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3.10**

COAXIAL PLUG 1/3, PANEL SOCKETS 1/3, LINE 3/7

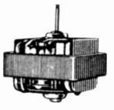
OUTLET BOXES. SURFACE OR FLUSH 5/-.

BALANCED TWIN FEEDERS 1/- yd. 80 ohms or 300 ohms.

JACK SOCKET Std. open-circuit 2/9, closed circuit 4/7; Chrome Lead Socket 7/7. Phono Plugs 1/-. Phono Socket 1/-.

JACK PLUGS Std. Chrome 3/-; 3·5mm Chrome 2/9. DIN SOCKETS Chassis 3-pin 1/7; 5-pin 2/-. DIN SOCKETS Lead 3-pin 3/7; 5-pin 5/-. DIN PLUGS 3-pin 3/7; 5-pin 5/-.

VALVE HOLDERS, 1/-; CERAMIC 1/7; CANS 1/-.



E.M.I. TAPE MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3½ × 2½ × 2¼in. (illustrated). Post 3/-. **25/-**

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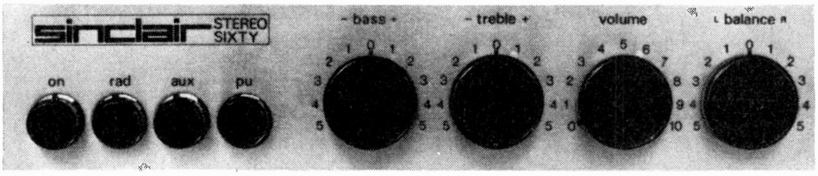
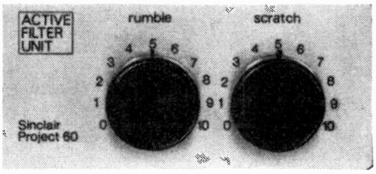
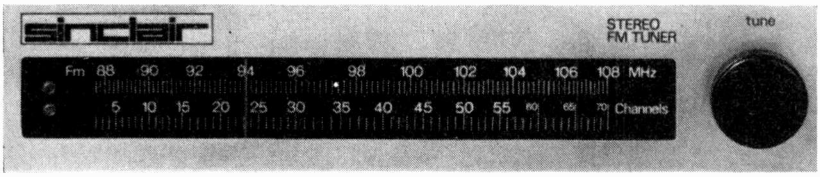
Project 60







the world's most advanced high fidelity modules

With the introduction of an entirely new and original high fidelity stereo F.M. tuner, the Project 60 range can be said at this stage to be complete. It offers the constructor a most attractive choice of modular arrangements whereby a high fidelity system can be selected to suit the user's personal requirements. Equally, it is possible to use any Project 60 modules separately or partially grouped and so benefit greatly from the flexibility in use these modules afford. The chart below shows some of the most popular applications for constructors to assemble. The Project 60 manual (free with the modules) suggests others as well and its 48 pages are packed with valuable information. The new tuner, for example can be used with any good high fidelity system as well as Project 60.

Project 60 now falls into four interdependent groups: – 1. The Z.30 and Z.50 amplifiers which have only 0.02% distortion at all output levels and are useful in a wide variety of other applications. 2. The control units comprising the Stereo 60 preamp and control unit and the Active Filter Unit (A.F.U.) with which both high pass and low pass filtering can be introduced between control unit and power amplifiers. 3. The Stereo F.M. tuner as described opposite; and 4. The power supply units PZ.5, PZ.6 and PZ.8. For most requirements when using Z.30 power amplifiers, the PZ.5 will be perfectly adequate; if low efficiency (high quality) loud speakers are used, the PZ.6 stabilised power supply unit will be used. The PZ.8 will be needed with Z.50s which can be used for any Project 60 system.

Project 60 modules incorporate some of the most advanced circuitry in the world to achieve unsurpassed standards of high fidelity and modern manufacturing techniques enable these modules to be sold at exceptionally attractive prices. Assembling the modules requires no skill or previous experience since the manual supplied with the modules explains clearly how everything can be done with nothing more than the simplest of domestic tools.

Project 60 manuals

How to assemble and use Project 60 modules to best advantage in the above and other applications will be found in the fully descriptive Project 60 manual included with Project 60 systems. This 48 page manual is available separately, price 2/6d including postage.

	System	The Units to use	In conjunction with	Cost of Units	+Project 60 tuner
A	Car Radio	**Z.30**	Existing car radio, Sinclair Micromatic	**89/6**	
B	Simple battery powered record player	**Z.30**	Crystal pick-up, 12V or more battery supply and volume control	**89/6**	
C	Mains powered record player	**Z.30 and PZ.5**	Crystal or ceramic P.U. Volume control etc.	**£9.9.0**	**£34.9.0**
D	20+20 watts R.M.S. stereo amplifier for most needs	**Two Z.30s, Stereo 60 and PZ.5**	Crystal, ceramic or magnetic P.U., most dynamic speakers, F.M. tuner etc.	**£23.18.0**	**£48.18.0**
E	20+20 watts R.M.S. stereo amplifier for use with low efficiency (high performance) speakers	**Two Z.30s, Stereo 60 and PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc All dynamic speakers	**£26.18.0**	**£51.18.9**
F	40+40 watts R.M.S. de-luxe stereo amplifier	**Two Z.50s, Stereo 60 PZ.8 and mains transformer**	As for E	**£32.17.6**	**£57.17.6**
G	Outdoor public address system	**Z.50**	Microphone, up to 4 P.A. speakers, 12V car battery with converter, or 45V d.c., controls	**£5.9.6**	
H	Indoor P.A.	**One Z.50, PZ.8 and mains transformer**	Microphone, guitar, heavy duty speakers etc., controls	**£17.8.6.**	
J	High pass and low pass filters	**A.F.U.**	D, E or F as above	**£5.19.6**	

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Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire
Telephone: St. Ives (04806) 4311

Sinclair IC10/Q16/Micromatic

IC10

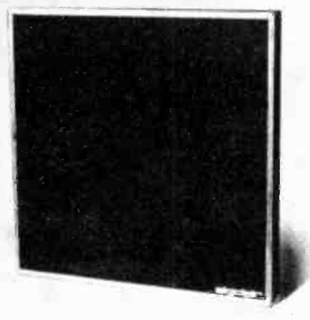
The world's most advanced high fidelity amplifier

This is the world's first monolithic integrated circuit high fidelity power amplifier and pre-amplifier. The circuit itself is a chip of silicon only a twentieth of an inch square by one hundredth of an inch thick, having 5 watts RMS output (10 watts peak). It contains 13 transistors (including two power types), 2 diodes, 1 zener diode and 18 resistors, and is encapsulated in a solid plastic package which holds the metal heat sink and connecting pins. This exciting device is more rugged and has considerable performance advantages, including complete freedom from thermal runaway and very low level of distortion. The IC10 is primarily intended as a full performance high fidelity power and preamplifier, for which application it only requires the addition of such components as tone and volume controls and a battery or mains power supply. It may also be used in other applications including car radios, electronic organs, servo amplifiers (it is dc coupled throughout), etc.

Circuit Description
The first three transistors are used in the pre-amp and the remaining 10 in the power amplifier. Class AB output is used with closely controlled quiescent current which is independent of temperature. Generous negative feedback round both sections and the amplifier is completely free from crossover distortion at all supply voltages, making battery operation eminently satisfactory.
Each IC10 is sold with a comprehensive manual giving circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include oscillators, etc. The pre-amp section can be used as an RF or IF, amplifier without any additional transistors.

Specifications
Output: 10 watts peak, 5 watts RMS continuous.
Frequency response: 5Hz to 100kHz ± 1dB.
Total harmonic distortion: Less than 1% at full output.
Load impedance: 3 to 15 ohms.
Power gain: 110dB (100,000,000,000 times) total.
Supply voltage: 8 to 18 volts.
Size: 1 × 0.4 × 0.2 in plus heat sink and tags.
Sensitivity: 5mV.
Input impedance: Adjustable externally up to 2.5 Mohms.
Price (with manual) 59/6.

Q16



High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies.

This shelf-mounted speaker brings genuine high fidelity within reach of every music lover.

Specifications
Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts RMS.
Input impedance: 8 ohms.
Frequency response: From 60 to 16,000Hz, confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension.
Size and styling: $9\frac{3}{4}$ in square on face $4\frac{3}{4}$ in deep with neat pedestal base. Black all-over cellular foam front with natural solid teak surround.
Price: £8 19 6.

Micromatic

Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver meticulously designed to provide remarkable standards of selectivity, power and quality. Powerful AGC counteracts fading from distant stations; bandspread at higher frequencies makes reception of Radio 1 easy. The plug-in magnetic earpiece provided matches the Micromatic's output to give wonderful standards of reproduction. Everything including the special ferrite rod aerial and batteries is contained within the minute and attractively designed case. Whether you build a Micromatic kit or buy this amazing receiver ready built and tested, you will find it as easy to take with you as your wrist-watch, and dependable under the severest listening conditions.

Specifications
Size: 46 × 33 × 13mm, ($1\frac{7}{8} \times 1\frac{3}{10} \times \frac{1}{2}$ in).
Weight: including batteries, 28.4 gm (one ounce).
Case: black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies, (550 to 1,600kHz).
Earpiece: magnetic type.
On/off switching: by inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **49/6.**
Ready built, tested and guaranteed, with earpiece **59/6.**
Two Mallory Mercury batteries type RM675 required. From radio shops, chemists, etc.

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R+TV

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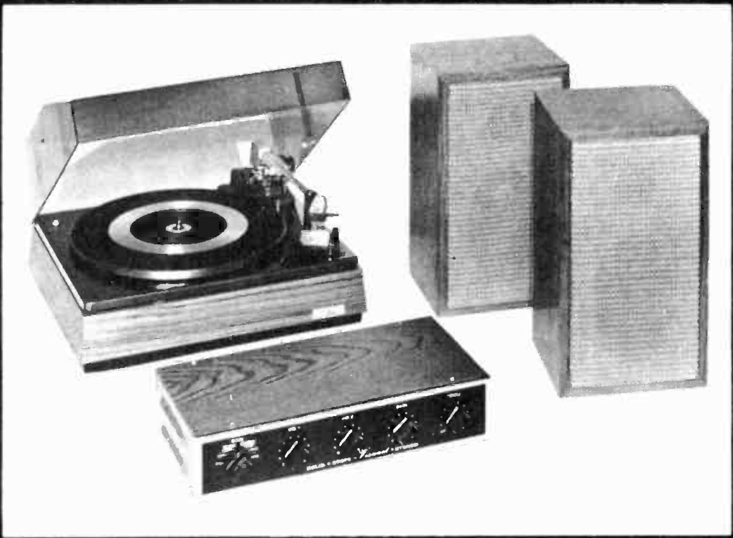
Complete Stereo System £41

WITH VISCOUNT F.E.T. FIELD EFFECT TRANSISTORS AMPLIFIER



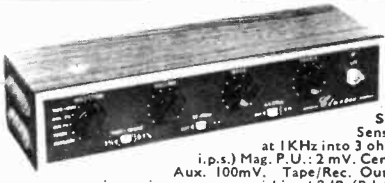
This superb stereo system is a real price breakthrough. It comprises the VISCOUNT F.E.T. Mk. I amplifier on which full details are given below, the famous Garrard SP25 (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers.

Measuring 17½in × 10¾in × 6¾in, the Duo type 2 speakers are beautifully finished in teak veneer. They incorporate a 10½in × 6½in drive unit and high frequency speaker, both of which are of 3 ohms. impedance. The Duo speaker system is also available separately at

£6.6.0 (£6·30) each plus 15/- (75p) P. & P.

Complete stereo system **£41** plus £2.10.0 (£2·50) P. & P.

With Mk. II Amplifier and Magnetic Cartridge **£45** plus £2.10.0 (£2·50) P. & P.



The Classic

Simulated teak case

£9.10.0 (£9·50)
Plus P. & P. 10/- (50p)

SPECIFICATION: Sensitivities for 10 watt output at 1KHz into 3 ohms. Tape Head: 3mV (at 3¾ i.p.s.) Mag. P.U.: 2 mV. Cer.P.U.: 80mV. Tuner: 100mV. Aux. 100mV. Tape/Rec. Output. Equalisation for each input is correct to within +2dB (R.I.A.A.) from 20Hz to 20KHz. *Tone Control Range: Bass:* 13dB at 60Hz. *Treble:* ±14dB at 15KHz. *Total Distortion:* (for 10 watt output) < 1·5%. Signal Noise: < −60dB. A.C. Mains 200–250V. Size 12½in long, 4¼in deep, 2¾in high. **Built and tested.**

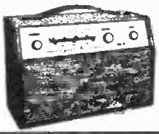
THE RELIANT Mk. II

SOLID STATE GENERAL PURPOSE AMPLIFIER

£7.5.0 (£7·25) Plus P. & P. 7/6 (37p)

Simulated teak case

SPECIFICATION: *Output:* 10 watts into a 3 ohms speaker. *Inputs:* (1) for mike (10mV). Input (2) for gram. radio (250mV). *Transistors:* 4 silicon and three germanium. *Mains input:* 220/250 volts. *Size:* 10¼ × 4¾ × 2¼in.



ELEGANT SEVEN Mk. III (350mW Output)

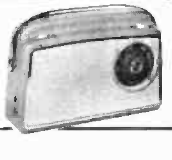
7-transistor fully tunable M.W.-L.W. Superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction. **MAINS POWER PACK KIT: 9/6 (47p) extra.**

£5.5.0 (£5·25) Plus P. & P. 7/6 (37p). Circuit 2/6 (13p). Free with parts.

THE DORSET (600mW Output)

7-transistor fully tunable M.W.-L.W. Superhet portable with baby alarm facility. Set of parts. The latest modulated and pre-alignment techniques makes this simple to build. Sizes: 12 × 8 × 3in.
MAINS POWER PACK KIT: 9/6 (47p) extra.

£5.5.0 (£5·25) Plus P. & P. 7/6 (37p). Circuit 2/6 (13p). Free with parts.



The Viscount F.E.T. Mk. I £14.5.0 (£14·25) Plus 10/- (50p) P.&P.

High fidelity transistor stereo amplifier employing field effect transistors. With this feature and accompanying guaranteed specifications below, the Viscount F.E.T. vastly surpasses amplifiers costing far more.

SPECIFICATION

Output per channel—10W rms.
Frequency bandwidth 20Hz to 20kHz ±1dB @ 1W.
Total distortion @ 1kHz @ 9W 0·5%.
Input sensitivities—CER. P.U. 100mV into 3 MΩ; Tuner 100mV into 100KΩ; Tape 100mV into 100kΩ.
Overload Factor—Better than 26dB.
Signal to noise ratio—70dB on all inputs (with vol. max).
Controls—6 position selector switch (3 pos. stereo and 3 pos. mono), separate vol. controls for left and right channels. Bass ±14dB @ 60Hz; Treble (with D.P.S. on/off) ±12dB @ 10kHz.
Tape recording output sockets on each channel.
Size 12½in × 6in × 2¾in in simulated teak case. Built and tested.

Mk. II (MAG. P.U.) £15.15.0 (£15·75) Post & packing 10/- (50p) extra.

Specification same as Mk. I, but with the following inputs: Mag. P.U. CER. P.U. Tuner. Spec. on Mag. P.U. 3mV @ 1kHz input impedance 47kΩ. Fully equalised to within ±1dB RIAA. Signal to noise ratio—65dB (vol. max.).

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DANSETTE

TOURISTE MK3

CAR RADIO

ALL TRANSISTOR

Beautifully designed to blend with the interiors of all cars. Permeability tuning and long wave loading coils ensure excellent tracking, sensitivity and selectivity on both wave bands. R.F. sensitivity at 1 MHz is better than 8 micro volts. Power output into 3 ohm speaker is 3 watts. Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7" × 2" × 4½" deep.

Originally sold completely built for £15.4.6 (£15·23)

Circuit diagram 2/6 (13p), free with parts Speaker, baffle and fixing kit 25/- (£1·25) extra plus 4/- (20p) P.& P.

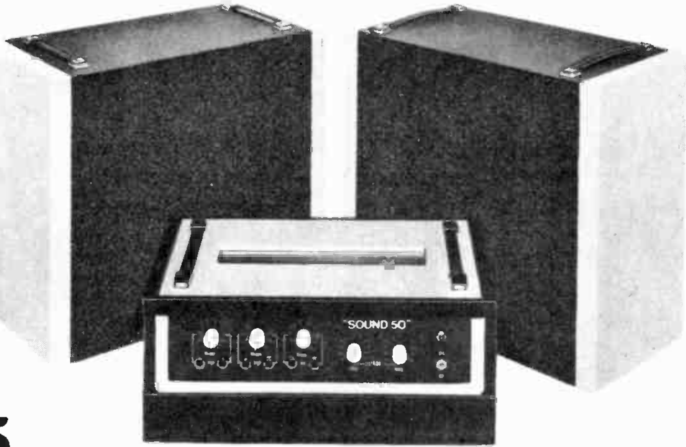
SET OF PARTS £6.6.0 (£6·30) plus 7/6 (37p) P. & P.

Speaker postage free when ordered with parts

SOUND 50

SOUND 50 AMPLIFIER AND SPEAKER SYSTEM

The Sound Fifty valve amplifier and speakers are sturdily constructed with smart housings and thoroughly tested electronics. They are designed to last—to withstand the knocks and bumps of life on the road. Built for the small and medium sized gig, they are easy to handle and quick to set up and can be relied upon to come over with all the quality and power you need.



Output Power 45 watts R.M.S. (Sine wave drive). **Frequency response**—3db points 30 Hz at 18 KHz. **Total distortion** less than 2% at rated output. **Signal to noise ratio:** better than 60db. **Speaker Impedance** 3, 8 or 15 ohms. **Bass Control Range** ± 13db at 60 Hz. **Treble Control Range** ± 12db at 10 KHz. **Inputs** 4 inputs at 5 mV into 470 K. Each pair of inputs controlled by separate volume control. 2 inputs at 200 mV into 470 K.

To protect the output valves, the incorporated fail safe circuit will enable the amplifier to be used at half power.

SPEAKERS! Size 20" × 20" × 10" incorporating Baker's 12" heavy duty 25 watt high flux, quality loudspeaker with cast frame. Cabinets attractively finished in two tone colour scheme—Black and grey.

COMPLETE SYSTEM £45

plus £4 P. & P.

Amplifier £28.10.0 (£28·50) plus £1 P. & P.

Speakers each £12.10.0 (£12·50) plus 30/- (£1·50) P. & P.

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THIN GAUGE SOLDER, ESSENTIAL FOR soldering small components and thin wires. High tin content, low melting point, 60/40 alloy, 170 ft. 22 gauge on plastic reel. Recommended retail price 75p

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*Recommended Price

INVALUABLE FOR STRIPPING FLEX, THE NEW AUTOMATIC OPENING BIB WIRE STRIPPER AND CUTTER, easily adjustable for all standard diameters. Plastic covered handles can also be used as wire cutter. Recommended retail price 50p

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Low initial cost Marksman irons, to cover most soldering needs. Screw-in tips on 15W and 25W make it easier to change the tips, which are nickel-plated and factory pre-tinned for longer life. The shanks are stainless steel to concentrate heat at the tips.

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Instant heat soldering guns to deal with intermittent soldering. Working heat is reached within seconds of pressing the trigger, so the job is finished in less time than it takes for a normal iron to heat up. Expert dual heat (100/140W) and Heavy Duty (275W) models available. Alternative tips available for plastics working.

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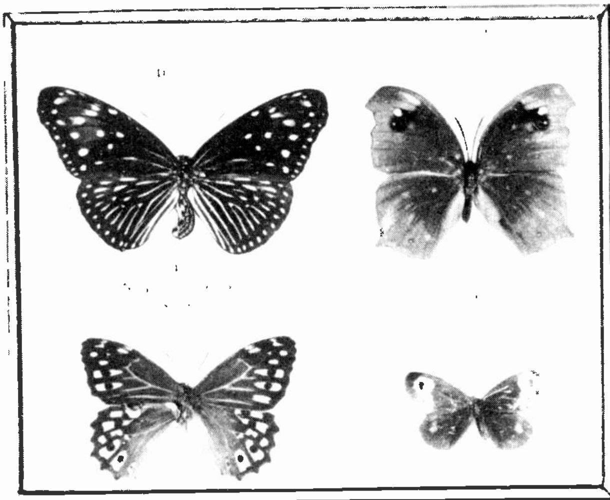

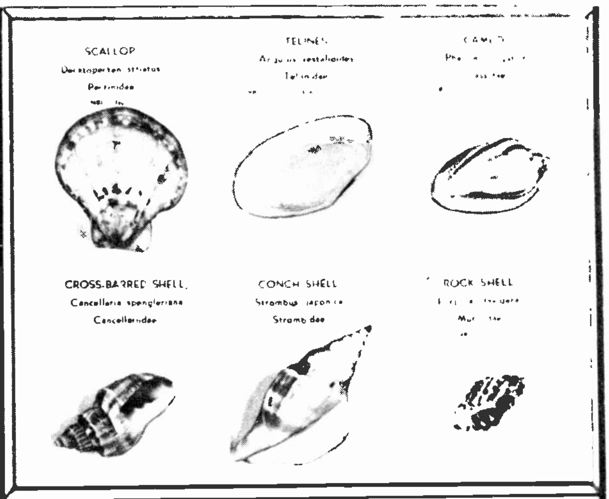

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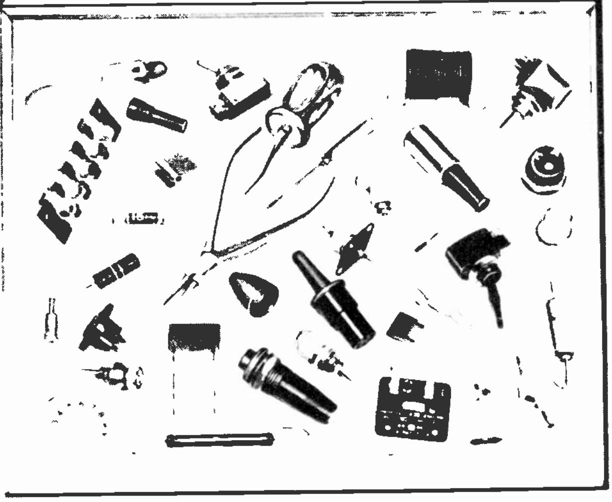

We realise of course that you don't want components for displaying in a case, but for putting to good use in your latest radio or electronic project. You want to be able to get just what you need quickly and easily, preferably from a single supplier. That's where the Home Radio Components Catalogue comes to your aid.

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VOL. 7 No. 2
February 1971

PRACTICAL ELECTRONICS

ASTRONAUTS OR AUTOMATONS?

THE landing of the unmanned vehicle *Lunokhod-1* on the moon's surface and its subsequent control from earth some 239,000 miles away was a unique and outstanding technical achievement: model control *par excellence!* This Soviet exploit has demonstrated quite clearly that man can devise and build automated equipment that will extend his influence over vast distances in space without incurring hazard to himself.

In everyday earthbound affairs, automation—which generally relies upon electronics for its brain power—has already made its indelible mark. Introduced primarily for sound economic reasons to overcome manpower shortage and to provide improved all-round efficiency, it brings about undoubted social improvements by removing many unattractive and irksome tasks from human hands. While automation can already supplant man to a lesser or greater degree in many activities, the ultimate extent of this takeover by machines is hard to predict. But the indications are that it will be determined by man's wishes, rather than by any technological limitations.

Clearly there are particular areas where man will not willingly abdicate his personal involvement in favour of a robot. The challenge of the unknown has impelled men to embark upon heroic adventures from the beginning of time. The mere invention of more speedy and comfortable means of conveyance has not extinguished the pioneer spirit that feels the urge to circumnavigate the globe alone, or to climb some colossal mountain peak. When all the formidable tasks of exploration presented by this earth have been successfully undertaken, man must needs look elsewhere for fresh fields to conquer. He is already looking impatiently out into space.

In this connection the achievement of the Russian lunar vehicle is especially interesting. It adds further fuel to the argument concerning whether it is wise or not to send men to the moon when the same kind of information they bring back can be gathered by an unmanned vehicle equipped with measuring and sensing devices and telemetry apparatus for transmitting data back to earth; and when rock specimens can be cored from the moon's surface and then be brought back to earth entirely by automatic means.

On a purely rational basis it would seem more sensible and logical to opt for the automated approach. Human lives would not be put in jeopardy and the cost would be a fraction of that for a comparable manned mission. But technical competence and cost efficiency will never dampen the human instinct to go and see for oneself; nor will risk to the person. The American astronaut Aldrin, the second man on the moon, afterwards remarked of "... the human need to do these things ..." This is certain, man will not be satisfied with exploring by remote control alone.

F.E.B.

THIS MONTH

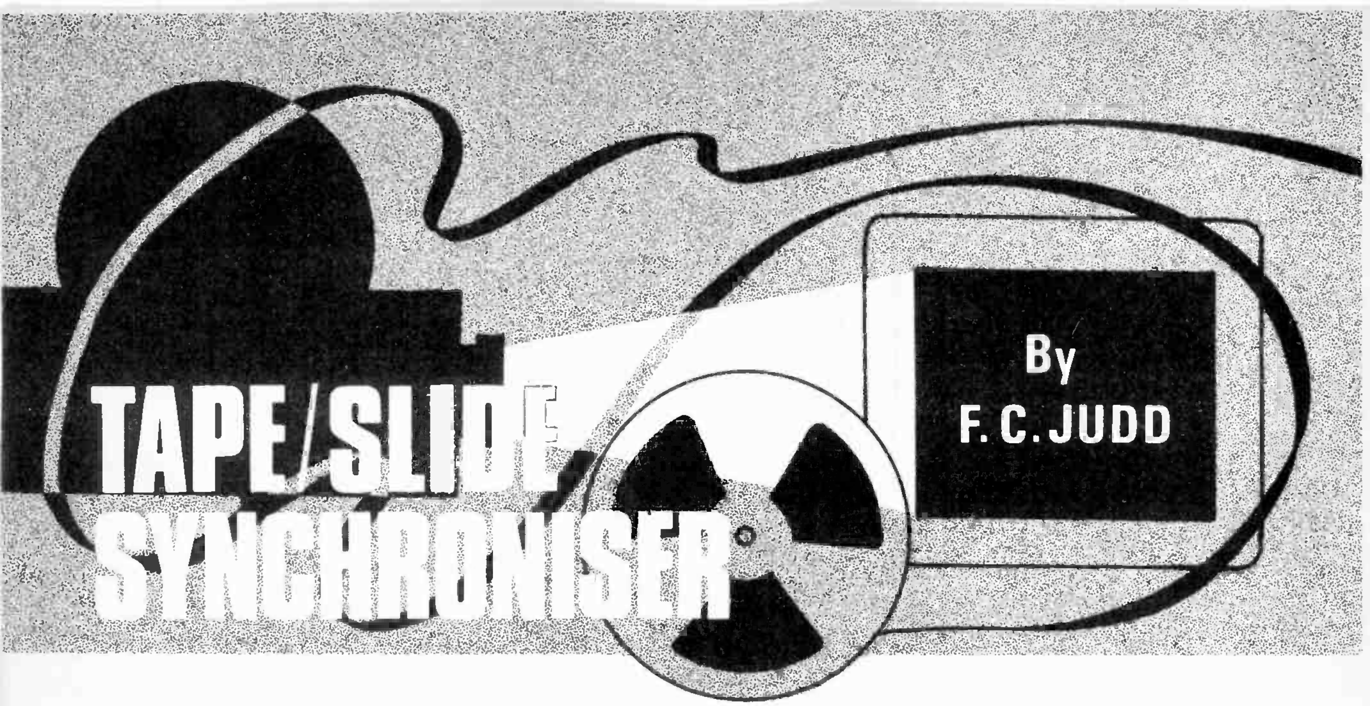
CONSTRUCTIONAL PROJECTS

SPECIAL SERIES

GENERAL FEATURES

NEWS AND COMMENT

Our March issue will be published on Friday, February 19



TAPE/SLIDE SYNCHRONISER

By F. C. JUDD

A COLOUR slide show can be enhanced with a well spoken commentary, background music and even sound effects which, if recorded on magnetic tape, leaves the projector operator free to concentrate on changing the slides in time with the recording.

If the slide projector is an automatic one, normally operated from a remote control box, then it can be directly controlled from the tape on which the commentary has been recorded, which means that the slides can be changed automatically in accordance with the sound track.

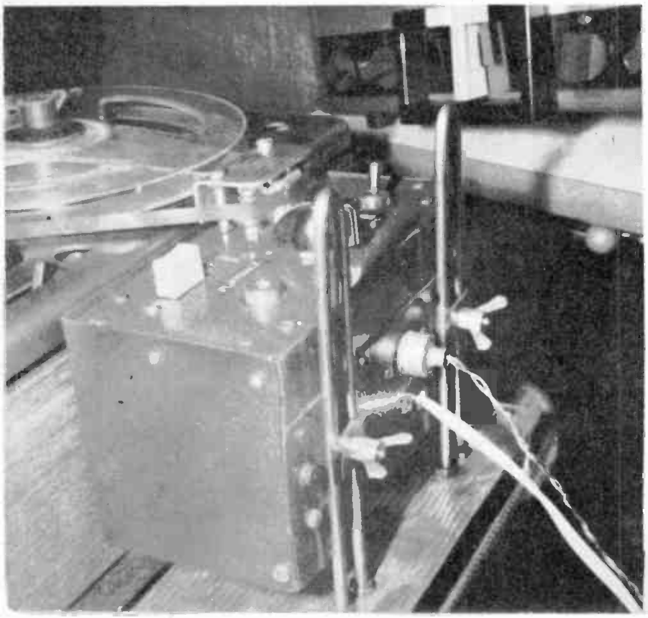
CONTROL SYSTEMS

The operator's slide change button on the projector remote control box simply actuates a make and break contact which, in turn, applies current to the mechanism for changing the slides. This contact needs only to be replaced by a relay contact which can be operated electronically by impulses recorded on the magnetic tape containing the sound track.

One way of doing this is to record sub-audio impulses on the same track as the commentary and music but this necessitates filter circuits in the sound replay amplifier chain. One could, of course, fit an extra record/replay head on the tape deck so that impulses could be recorded on an unused track. This is fine providing there is space for the head and that it could be fitted without spoiling the tape deck.

The ideal system is one which can be used with any conventional tape recorder, stereo or mono, half-track or quarter-track, at any of the standard tape speeds and without any modification whatsoever to the tape recorder or of tape cutting and splicing.

The impulse control system to be described can be used with any automatic slide projector that requires only a single make and break contact to change the slides.



AUTOMATIC PROJECTORS

Automatic slide projectors are normally controlled from a push button on a small remote control box attached to the projector by a long cable. When the button is pressed the slide is changed and the slide carrier moves up ready for the next slide.

The remote control box has additional buttons for remote focusing and for reversing the slide change. These functions are not affected in any way by the use of an impulse controller and all that is required for impulse control is a pair of leads connecting the impulse control unit to the two contacts of the slide change button in the manual control box.

Most automatic slide projectors do in fact have a socket on the projector for connection to an impulse controller.

CIRCUIT DESCRIPTION

The circuit diagram shown in Fig. 1 is designed to record 100Hz pulses on to the lower half or quarter-track of standard ¼in wide tape. The pulses can be recorded whilst listening to the pre-recorded sound track.

When the tape is running through the controller the pulse track is being constantly erased by a direct voltage applied to the head X1, via R10 and S2a. With the controller switched to "Record" the record indicator lamp will also be switched on.

When the pulse record button is depressed the direct erase voltage is disconnected and a 100Hz pulse, derived from the rectified supply input, is connected to the record/replay head. This pulse will be recorded on the tape. About one second is quite sufficient for the pulse time.

As the pulse button is depressed the 100Hz signal is also applied to the D1, C7, R12 network and consequently to the base of TR3 which will now conduct and close the relay. This means that whilst the pulses are being recorded the slides will automatically change.

When the pulses have been recorded the controller is switched to "Playback", the tape rewound and the projector re-loaded. The whole programme can now be run entirely from the tape recorder as the projector will change slides automatically and in synchronism with the sound track.

During playback the pulses from the tape are picked up by the record/replay head on the controller, amplified by TR1 and TR2 and applied to the network C7, D1 and R12. On each pulse TR3 will conduct, the relay will operate and a slide will be changed.

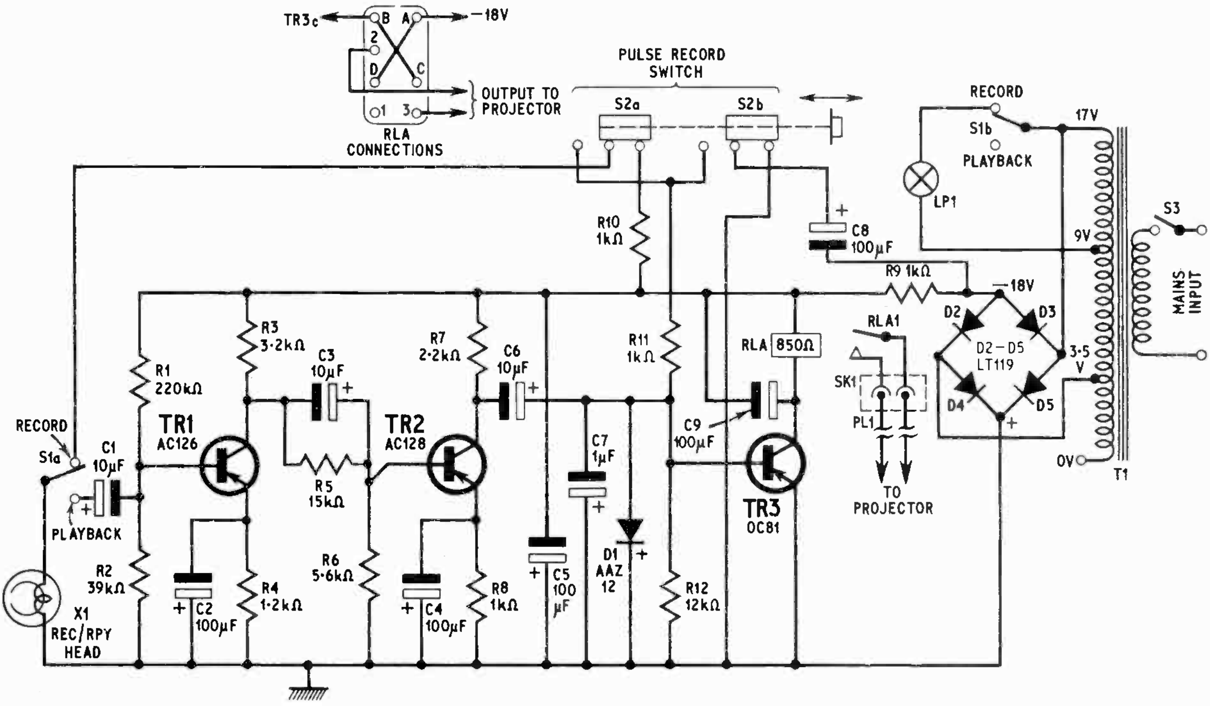


Fig. 1. Circuit diagram of tape/slide synchroniser

COMPONENTS . . .

Resistors

R1 220kΩ	R4 1·2kΩ	R7 2·2kΩ	R10 1kΩ
R2 39kΩ	R5 15kΩ	R8 1kΩ	R11 1kΩ
R3 3·2kΩ	R6 5·6kΩ	R9 1kΩ	R12 12kΩ

All ¼ watt, 10% carbon

Capacitors

C1	10µF	elect. 12V	C6	10µF	elect. 25V
C2	100µF	elect. 12V	C7	1µF	elect. 12V
C3	10µF	elect. 12V	C8	100µF	elect. 25V
C4	100µF	elect. 12V	C9	100µF	elect. 25V
C5	100µF	elect. 25V			

Transistors

TR1 AC126 TR2 AC128 TR3 OC81

Diodes

D1 AAZ 12 (Mullard)
D2–D5 Bridge rectifier Type LT119 (Henry's Radio)

Switches

S1 2-pole, 2-way wafer switch
S2 6-pole, 2-way; push on, release off (Henry's Radio)
S3 Single pole, on-off toggle switch

Transformer

T1 Mains transformer Type CT1/1 (Henry's Radio)

Record/Replay Head

X1 Marriott R/RP1 half track

Relay

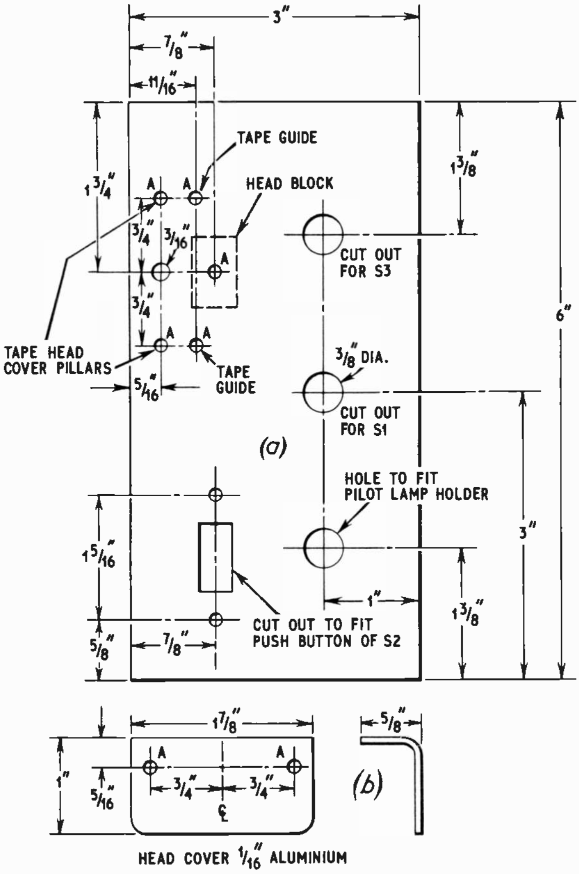
RLA 1,700Ω + 1,700Ω single pole changeover (Henry's Radio)

Lamp

LP1 12 V 0·1A MES Pilot lamp

Miscellaneous

Universal Chassis 6in × 4in × 3in and 6in × 4in bottom plate (Home Radio)
18 s.w.g. aluminium base plate 7¾in × 3½in
Mild steel rod 14in × $\frac{3}{16}$in (2 off)
Brass rod or sleeves for guides ¼in dia (2 off)
4B.A. wing nuts (2 off), s.r.b.p. board and pins
SK1, PL1 Two pin plug and socket



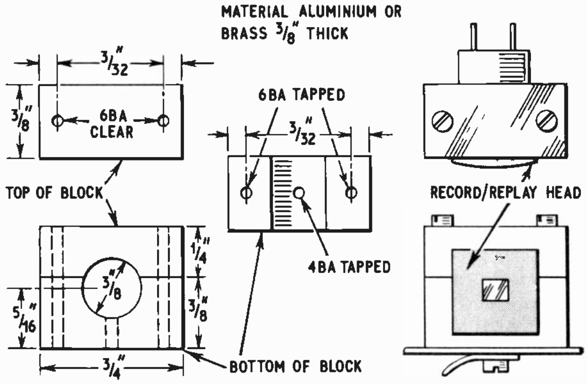
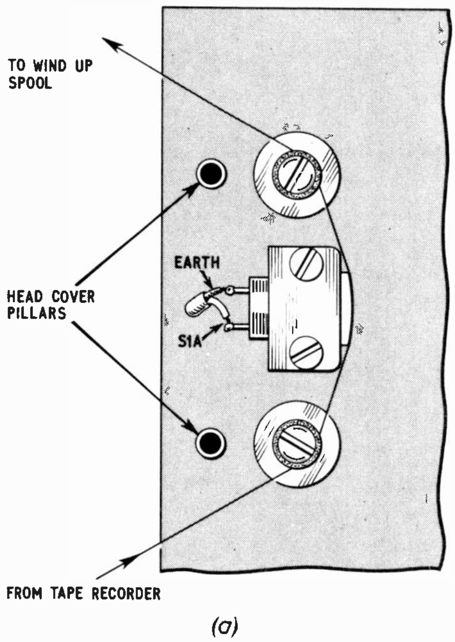


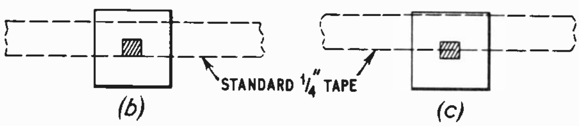
Fig. 2 (above). (a) Cutting and drilling details of top panel; (b) drilling and bending details of head cover

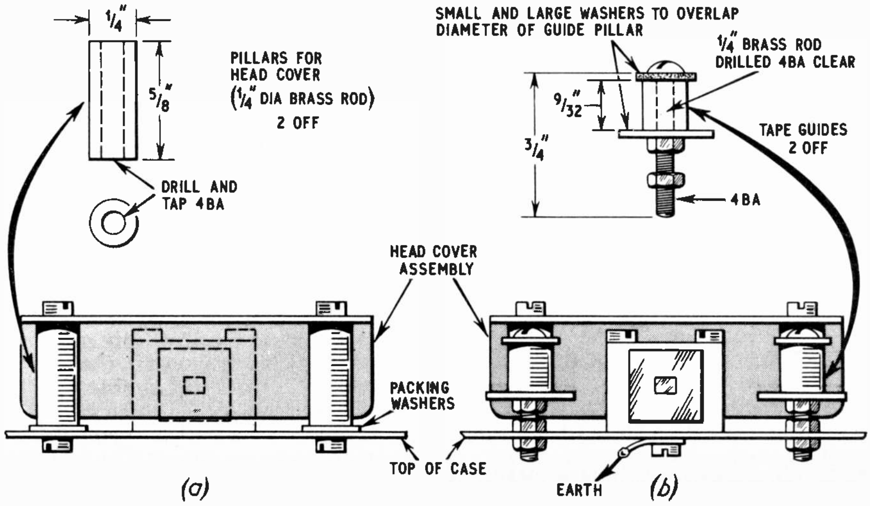
Fig. 3 (top right). Head mounting clock assembly details

Fig. 4 (below). (a) Construction and mounting details of the head cover pillars; (b) tape guide assembly and mounting details

Fig. 5 (right) (a) Showing the mounting of the pillars and guides on the control panel. The spooling direction at the head is made clear by reference to the photograph on page 000; (b) alignment of tape for half-track pulse recording; (c) alignment for quarter-track recording







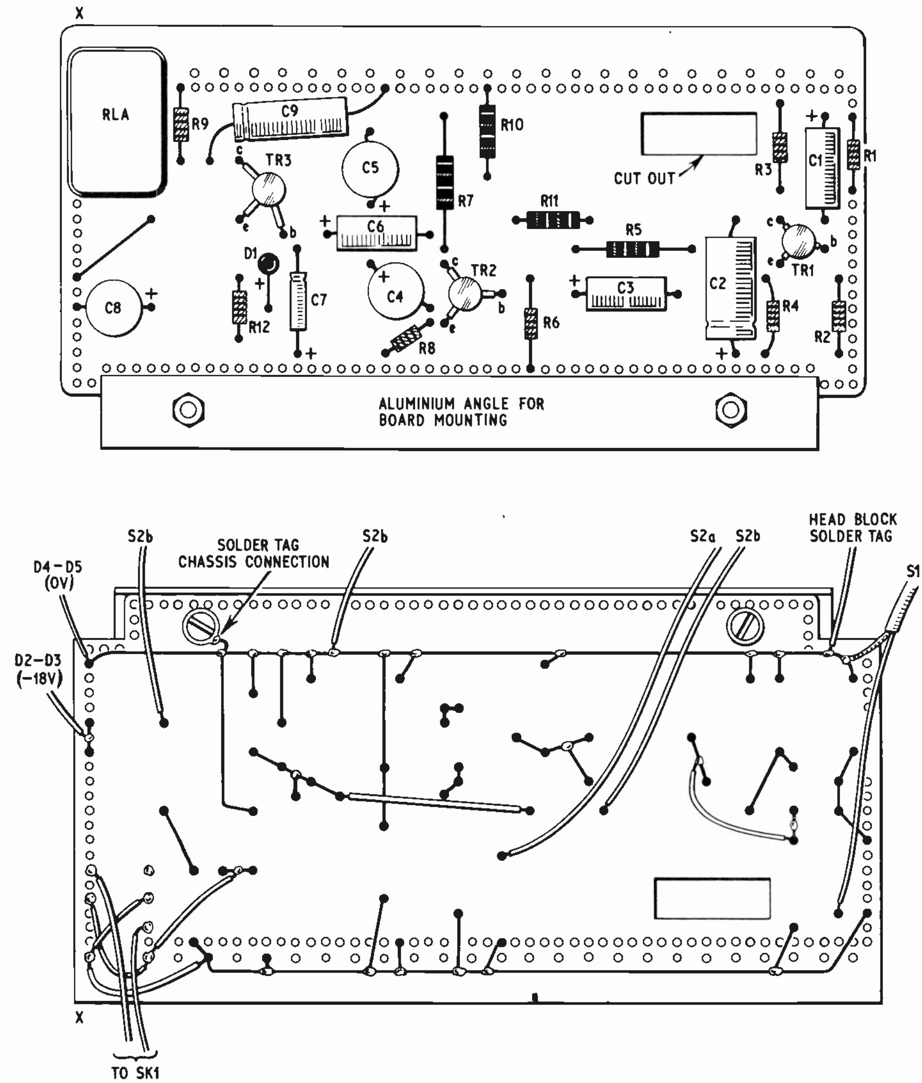


Fig. 6. Top and underside details of component mounting and wiring on plain Veroboard. Details of the relay wiring is given in Fig. 1

CONSTRUCTION

The prototype unit was made up of 20 s.w.g. aluminium, but 18 s.w.g. is to be preferred for the extra rigidity afforded. A Universal chassis, 6in by 4in by 3in with a bottom plate, is suitable for housing and mounting the various parts.

Drilling and cutting details for the top panel are given in Fig. 2 (a). Fig. 2 (b) shows the tape head cover which is made from aluminium.

The tape head specified is a Marriott R/RP1 high impedance type, and is supplied without a mounting. Details of the mounting block are given in Fig. 3.

This forms a clamp for the cylindrical body of the head and can be made from brass or aluminium to the dimensions given. The centre hole, tapped 4B.A. at the base of the block, is for the bolt which secures it to the top of the controller box.

Next for construction are the tape guides as shown in Figs. 4 (a) and (b). These can be adjusted for height so aligning the tape with the head gap as seen in Fig. 5.

BOARD ASSEMBLY

The transistors and small components are mounted and wired on a piece of plain Veroboard, 3in by $5\frac{1}{4}$in as in Fig. 6. The cut-out at the end allows for the projection of the S2 switch assembly inside the case.

The relay has a double winding which, in this particular application, is connected in parallel to give a total resistance of 850 ohms. On the prototype no screws were needed to fix the relay to the board as the solder connections at the pins were sufficient to retain it in position.

CHASSIS ASSEMBLY

The tape head assembly and pillars should first be mounted on the drilled top panel followed by the various controls as shown in Fig. 7. The chassis base plate bears the mains transformer T1, the bridge rectifier and the two-pin socket which carries the twin lead to the projector automatic control socket or remote control, whichever is applicable.

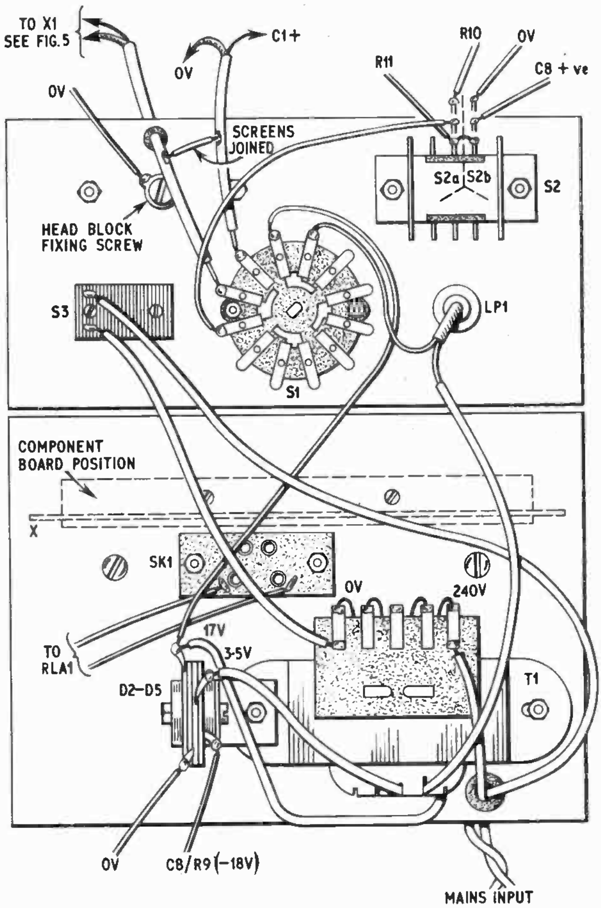


Fig. 7. Interwiring between control panel and base plate components. For Verboard connections Fig. 6 should be consulted

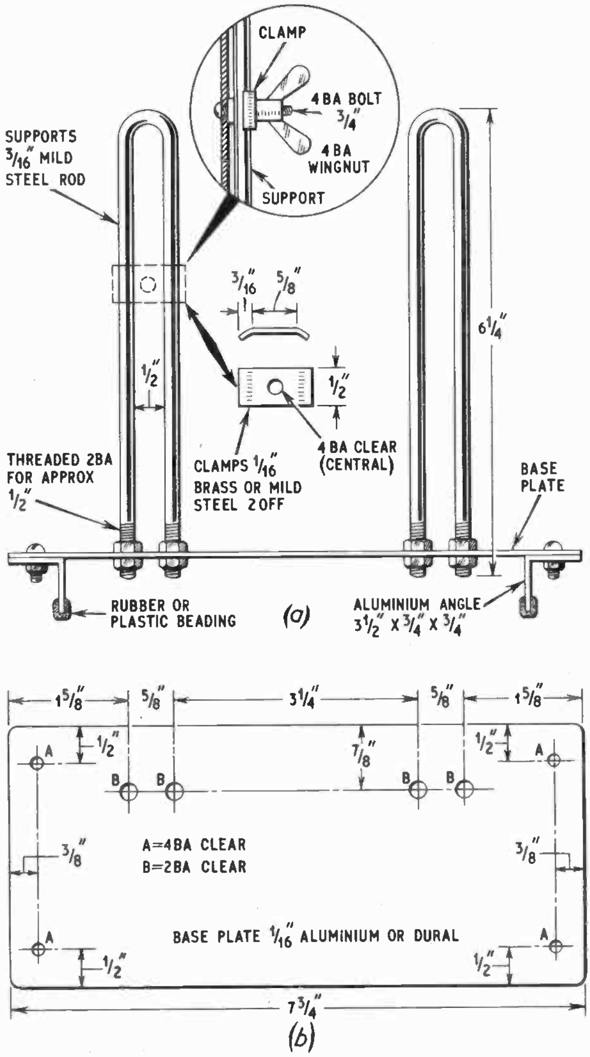
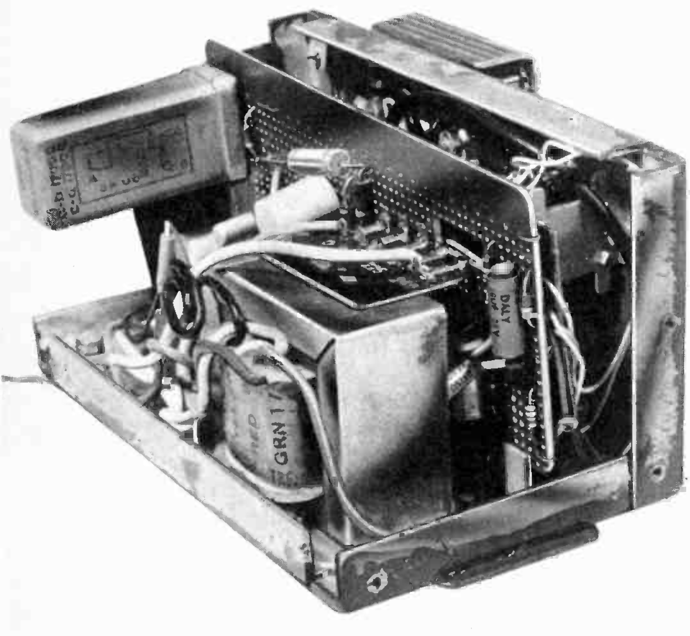


Fig. 8. (a) Supports and fixing clamps which allow the synchroniser to be positioned relative to the tape recorder deck; (b) base plate for support mounting



Interior view of the tape/slide synchroniser

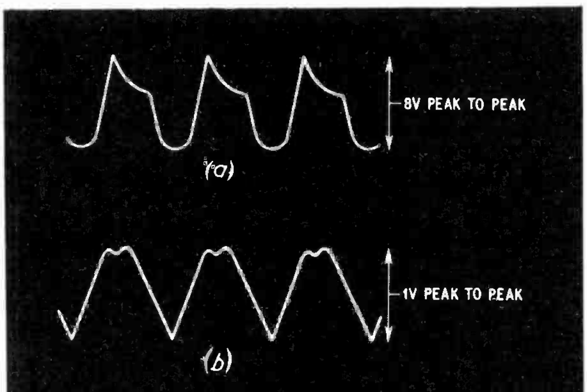


Fig. 9. (a) Typical pulse waveform at record replay head; (b) waveform at TR3 collector

Mount the assembled board on a piece of aluminium angle, ¾in by ¾in by 5in, then fix this to the chassis, where indicated, using kalons.

Interwiring should now be completed using Figs. 6 and 7. Note that screened leads must be used for the head connections with the screening braid earthed at the solder tag under the head block fixing screw.

CONTROLLER STAND

The stand for the controller unit allows the height of the tape head to be varied from about 4½ to over 8 inches above table top level so that it can be used with almost any domestic tape recorder.

Details for the base of the stand and the two main supports and the remainder of the assembly are given in Fig. 8. Note that the ¾in, 4B.A. bolts on which the wing nuts are used, go through from the inside of the box and are then secured with 4B.A. nuts. The clamps and wing nuts will firmly hold the box at any height on the supports.

CHECKING OPERATION

The measured supply should be approximately 18V at the junction of R9 and C8 with the unit switched to "Playback". The total current measured at this point should be approximately 8mA.

When the unit is switched to "Record" and S2 button depressed the line voltage should fall to about 14V and the current will increase to around 18mA.

With the unit still switched to "Record" but with the impulse button off, the voltage across the record/playback head should be approximately 1V.

With the controller switched to "Playback" the voltage at the junction of R7 and R9 should be about 14V.

If an oscilloscope is available, the waveforms and their respective peak to peak amplitudes at the record/replay head and at TR3 collector can be checked as shown in Fig. 9.

TRACK ALIGNMENT

The tape head and guides can be aligned for either the lower half or quarter-track width as shown in Figs. 5 (b) and (c). With half-track recorders the upper half-track is used for sound. With quarter-track recorders the two inner tracks could be used for sound and the two outer tracks for pulses, which means that two different programmes could be accommodated on one length of tape.

Accurate azimuth alignment of the head is not necessary and so long as the gap is vertical, it will operate efficiently. It is more important to get the track width aligned so that the pulse track does not overlap the sound track. If this should occur the pulses would be audible whilst playing the sound track.

USING THE CONTROLLER

First the sound track should be completed in its entirety, then the projector set up and the slide carrier loaded with all the slides in the correct order. Set the tape recorder for replay so that the sound track is audible and set the controller to "Record". The tape is taken off the tape recorder, around the controller head and back onto the wind up spool.

Set the tape recorder running and then simply press the pulse record button for about half to one second each time a slide is to be changed. When the pulses have been recorded, switch the controller to replay, disengage the tape from the controller head and rewind it.

If the tape is rewound whilst still in contact with the controller head and with the controller switched to record, all the pulses will be erased. If rewound with the controller set to replay then the slide projector mechanism will be rapidly operated.

For entirely automatic projection of the slides in synchronism with the sound track, it is only necessary to load the slides, connect up the controller and play the tape.

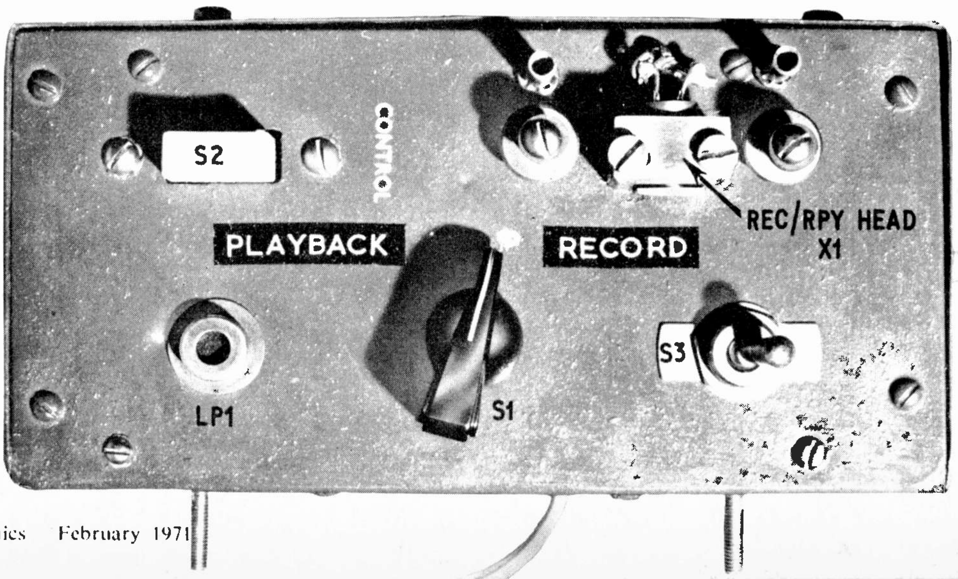
CONNECTING TO A PROJECTOR

For connections to a projector, twin leads should be suitably terminated with a two-pin plug for connection to the controller output socket SK1.

If the projector has a socket for connection to a controller, and most of them do, simply connect the free lead ends to this as instructed in the manufacturer's booklet.

Both the manual button on the projector control box and the pulse button on the controller can be used to override the recorded pulses during replay, but this will, of course, throw the slide sequence out of synchronism with the sound track. ★

View of the control panel. Here the head cover is removed



PE GEMINI

DUAL PURPOSE STEREO AMPLIFIER PART FOUR

By D. S. GIBBS and I. M. SHAW (FERRANTI LTD)

HAVING introduced the pre-amplifier circuit briefly last month and given some of the individual circuit descriptions, we now go on to describe the rest of the circuit parts in detail, give the components list and start construction details of the pre-amplifier. Now that we are able to specify all the components, it is possible to say that the approximate cost of the complete amplifier and pre-amplifier will be £45. This cost is made up of £28 for the main amplifier and £17 for the pre-amplifier; prices of components vary by large amounts for some items and this price is only to give readers an approximate estimate of overall cost.

STEREO-MONO SWITCHING

Stereo-mono switching (Fig. 30) is performed by switch S5 which cross-connects the inputs so that equal amounts of left and right are fed into each of the input mixers. This facility is useful when playing mono records with a stereo pick-up as it cancels out certain distortion products present in the output of the pick-up. It also enables a stereo recording to be converted to mono so that it may be recorded on a mono tape recorder.

TREBLE FILTER

The treble filter has two sections. The first section comprises capacitors C40 to C43 which appear in parallel with the amplifier feed-back resistor R60. These capacitors cause the gain of the amplifier to fall at 6dB per octave above the cut-off frequency. The second section is provided by inductor L2 and capacitors C36 to C39 which give a further 12dB per

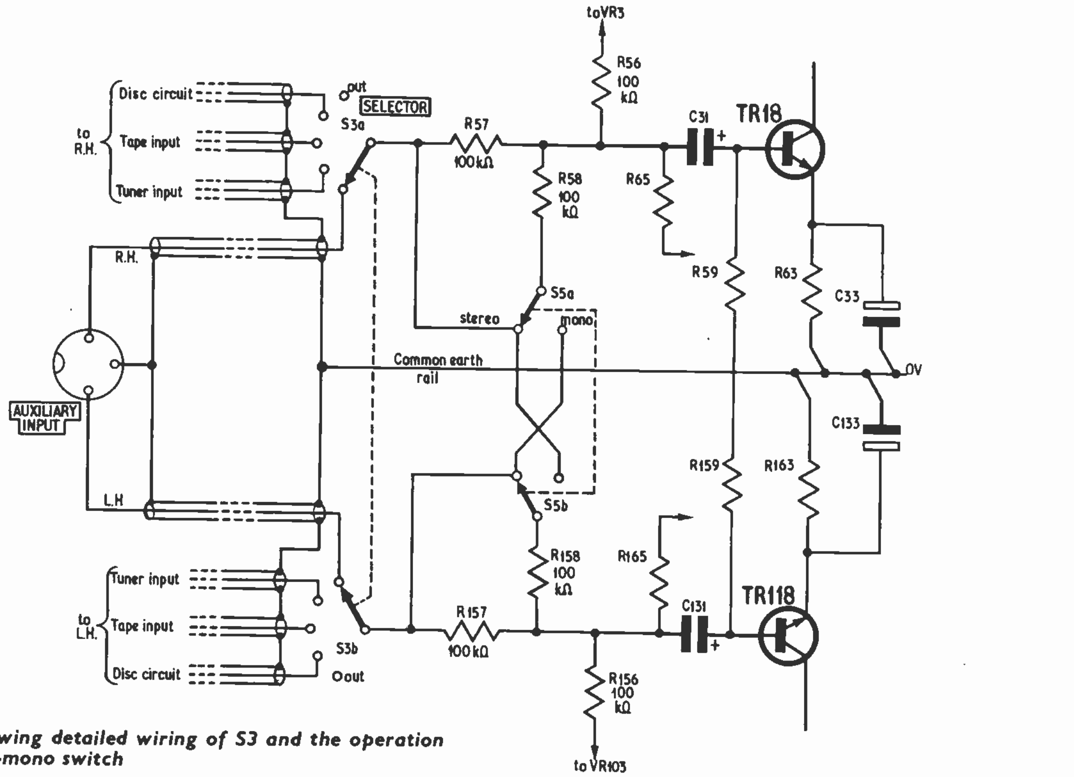


Fig. 30. Showing detailed wiring of S3 and the operation of the stereo-mono switch

octave to give a total slope of 18dB per octave. The LC section has been designed to give a peak of about 3dB before its cut-off to compensate for the initial slowly falling frequency response of the amplifier section.

The overall frequency response is quite flat up to the cut-off point and has a sharp knee as shown in Fig. 31. Four cut-off frequencies have been provided. The 5, 7 and 10kHz positions can be used to remove spurious noise or harsh treble from poor recordings, whilst the 15kHz filter makes very little difference to the reproduced sound but gives a worthwhile reduction in the 19kHz and 38kHz components present in the output of a stereo v.h.f. tuner. In the out position the frequency response is −3dB at 40kHz.

The transient response of the treble filter is illustrated by Figs. 32a to 32e which show that the ringing produced is very well damped and inoffensive. Generally speaking the sharper the cut-off in the frequency response the worse the transient response becomes so that one has to strike a compromise which gives both a well damped transient response and a satisfying clean frequency response. The popular "parallel T" type of treble filter is particularly difficult in this respect.

TONE CONTROL

The tone control circuit comprising TR20, TR21, TR120 and TR121, uses the popular Baxendall configuration. In this design the tone control circuit is after the volume control so that it does not impose any limitation on the dynamic range of the pre-amplifier. When the tone control is placed before the volume control the dynamic range is reduced by the amount of boost employed, i.e., assuming such a pre-amplifier with a dynamic range of 20dB, turning up the bass control to give 15dB of bass boost will cause the dynamic range at low frequencies to be reduced to 5dB.

However when the tone control is placed after the volume control one has to take particular care to achieve a low noise level, since the noise output remains constant instead of being proportional to the setting of the volume control. The noise level generated by this design is 90dB below maximum output (−100dB weighted) and with loudspeakers of average efficiency this is inaudible at more than about three feet away from the loudspeakers. With loudspeakers of very high efficiency the noise level may be just perceptible under normal listening conditions. If this is found to

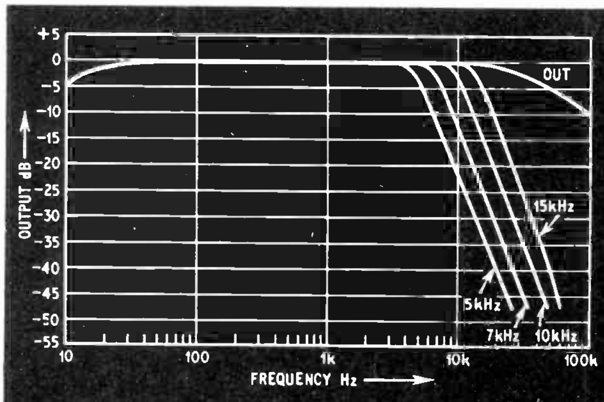


Fig. 31a. Frequency response curves of mixer and treble filter

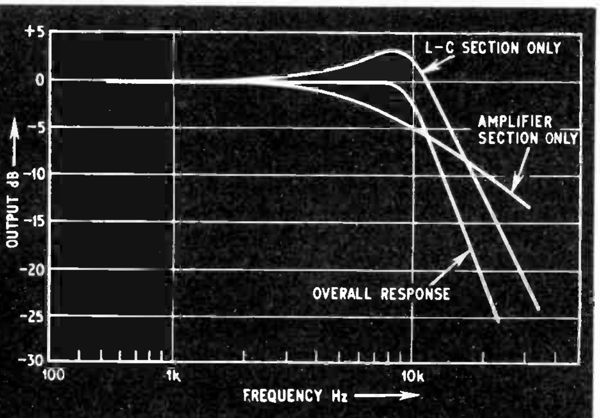


Fig. 31b. Showing how the frequency responses of the amplifier and LC sections combine to give a flat frequency response within the pass-band and a sharp cut-off (10kHz filter shown)

COMPONENTS . . .

PRE-AMPLIFIER

(both channels—components for L.H. channel are R.H. numbers plus 100)

Resistors

R32 R132	47kΩ	R57 R157	100kΩ
R33 R133	2·7kΩ	R58 R158	100kΩ
R34 R134	1MΩ	R59 R159	100kΩ
R35 R135	1MΩ	R60 R160	220kΩ
R36 R136	100kΩ	R61 R161	27kΩ
R37 R137	56kΩ	R62 R162	27kΩ
R38 R138	390Ω	R63 R163	22kΩ
R39 R139	180kΩ	R64 R164	3·3kΩ
R40 R140	10kΩ	R65 R165	4·7kΩ
R41 R141	10kΩ	R66 R166	47kΩ
R42 R142	4·7kΩ	R67 R167	3·3kΩ
R43 R143	1MΩ ±10%	R68 R168	3·3kΩ
R44 R144	470Ω ±10%	R69 R169	47Ω
R45 R145	10MΩ ±10%	R70 R170	100kΩ
R46 R146	470kΩ	R71 R171	330kΩ
R47 R147	470kΩ	R72 R172	100kΩ
R48 R148	470kΩ	R73 R173	220kΩ
R49 R149	100kΩ	R74 R174	2·2kΩ
R50 R150	56kΩ	R75 R175	10kΩ
R51 R151	10kΩ	R76 R176	1kΩ
R52 R152	470Ω	R77	100kΩ ±10%
R53 R153	56Ω		
R54 R154	4·7kΩ		
R55 R155	10kΩ		
R56 R156	100kΩ		

R77 is not required if the neon lamp has a built in resistor.

Unless otherwise stated all resistors are ½ watt carbon film or metal oxide of 5% tolerance or better. 2 off each except R77.

Potentiometers

VR3 VR103	100kΩ log twin-gang (single gang for mono microphone—see text)
VR4 VR104	10kΩ log twin gang
VR5 VR105	470kΩ linear twin gang
VR6 VR106	100kΩ linear twin gang
VR7	10kΩ linear single gang wirewound (see text)

Capacitors

C16 C116	250μF elect. 40V	Mullard
C17 C117	1μF plastic film 63V	WIMA MKS
C18 C118	50μF elect. 40V	Mullard
C19 C119	0·022μF polyester 160V	Mullard
C20 C120	1500pF polystyrene 125V	Radiospares
C21 C121	8200pF polystyrene 125V	Radiospares
C22 C122	47pF polystyrene 125V	Radiospares
C23 C123	20μF elect. 16V	Mullard
C24 C124*	1μF plastic film 63V	WIMA MKS
C25 C125	1μF plastic film 63V	WIMA MKS
C26 C126	1μF plastic film 63V	WIMA MKS
C27 C127	50μF elect. 40V	Mullard
C28 C128	47pF polystyrene 125V	Radiospares
C29 C129	20μF elect. 16V	Mullard
C30 C130*	1μF plastic film 63V	WIMA MKS
C31 C131*	1μF plastic film 63V	WIMA MKS
C32 C132	10pF polystyrene 125V	Radiospares
C33 C133	20μF elect. 16V	Mullard
C34 C134	5μF elect. 64V	Mullard
C35 C135*	1μF plastic film 63V	WIMA MKS
C36 C136	1500pF polystyrene 125V	Radiospares
C37 C137	2200pF polystyrene 125V	Radiospares
C38 C138	3300pF polystyrene 125V	Radiospares
C39 C139	4700pF polystyrene 125V	Radiospares
C40 C140	220pF polystyrene 125V	Radiospares
C41 C141	150pF polystyrene 125V	Radiospares
C42 C142	100pF polystyrene 125V	Radiospares
C43 C143	47pF polystyrene 125V	Radiospares
C44 C144	2·5μF elect. 64V	Mullard
C45 C145	6800pF polyster 400V	Mullard
C46 C146	6800pF polyester 400V	Mullard
C47 C147	1500pF polystyrene 125V	Radiospares
C48 C148	2·5μF elect. 64V	Mullard
C49 C149	10pF polystyrene 125V	Radiospares
C50 C150	20μF elect. 16V	Mullard
C51 C151	8μF elect. 40V	Mullard
C52	500μF elect. 64V	Mullard

* plastic film 1μF capacitors are recommended for these positions but as these are rather expensive 1μF 40V electrolytic capacitors may be used instead if desired. The correct polarity is shown on the circuit diagram. 2 off each except C52.

Semiconductors

T14 T114	ZTX 107 Ferranti
T15 T115	ZTX 531 Ferranti
T16 T116	ZTX 107 Ferranti
T17 T117	ZTX 503 Ferranti
T18 T118	ZTX 107 Ferranti
T19 T119	ZTX 107 Ferranti
T20 T120	ZTX 107 Ferranti
T21 T121	ZTX 107 Ferranti

2 off each

Switches

S1	DPDT toggle or slide switch
S2	DPDT ditto
S2	2 pole 5 way rotary Maka switch
S4	6 pole 5 way rotary Maka switch
S6	DPDT rotary mains switch

Inductors

L2 L102 FX2239 pot core assembly with DT2204 coil former wound with 228 turns of 34 s.w.g. enamelled wire tapped as follows (2 off):

5kHz	full winding
7kHz	tapped at 196 turns
10kHz	tapped at 162 turns
15kHz	tapped at 134 turns

Note that two FX2239 Ferrite cups are required for each complete pot core.

Miscellaneous

SK5–10	DIN 180° 3 pin or 5 pin socket (6 off)
SK11 SK12	DIN 300° 5 pin socket (2 off)
SK13	3 pin mains plug & socket (Bulgin P429 and P430)
LP1	neon panel lamp
	Control knobs: Eagle type k30/3 used on the prototype (8 off)

Case Contil MOD-2 size G obtainable from West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middlesex.

Printed circuit board

Capacitor clamp

½in spacers 6B.A. 4 off

6B.A. fixings

Aluminium panel 12¾ × 2¾ × 18 s.w.g. for dummy front panel (cut from unused main amplifier chassis)

C3-2800 μF 100V Mullard is obtainable from Home Radio Ltd.

Electroniques address is Edinburgh Way, Harlow, Essex.

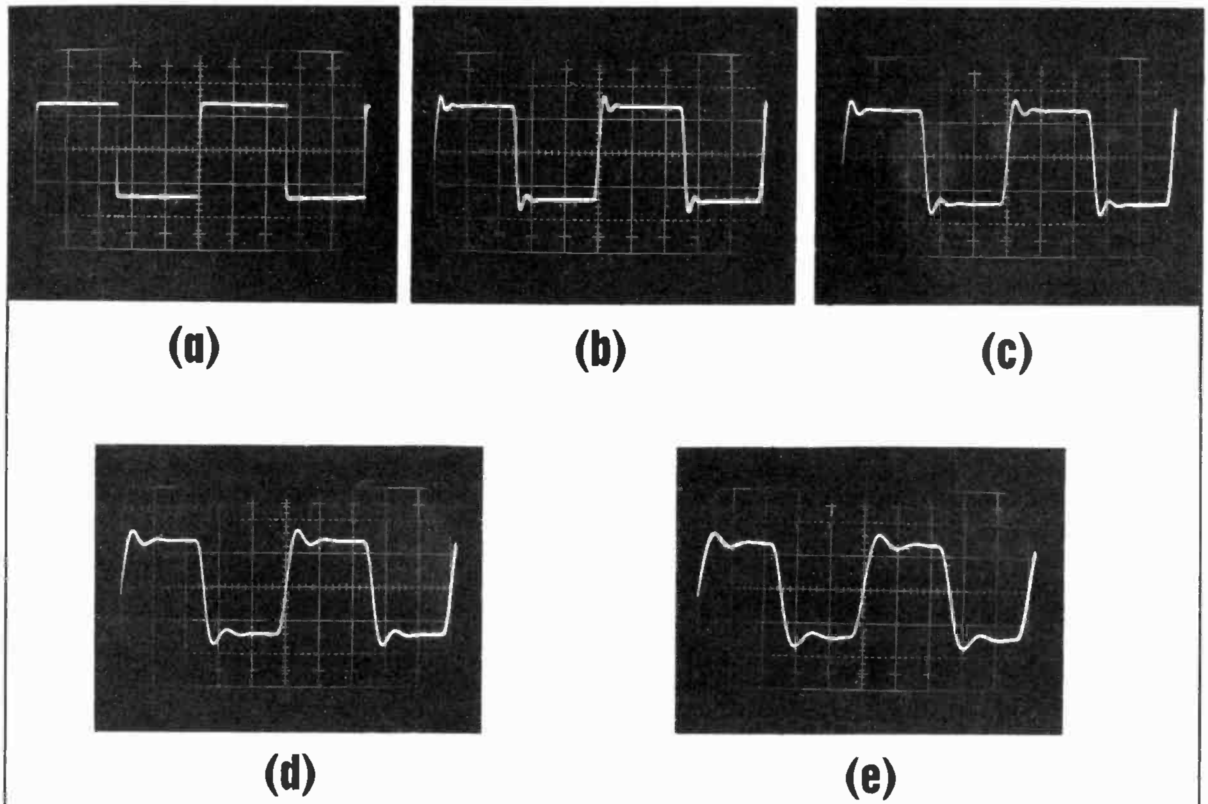


Fig. 32. Treble filter transient response (a) filter out—1kHz signal, (b) 15kHz position—1kHz signal, (c) 10kHz position—1kHz signal, (d) 7kHz position—1kHz signal, (e) 5kHz position—1kHz signal

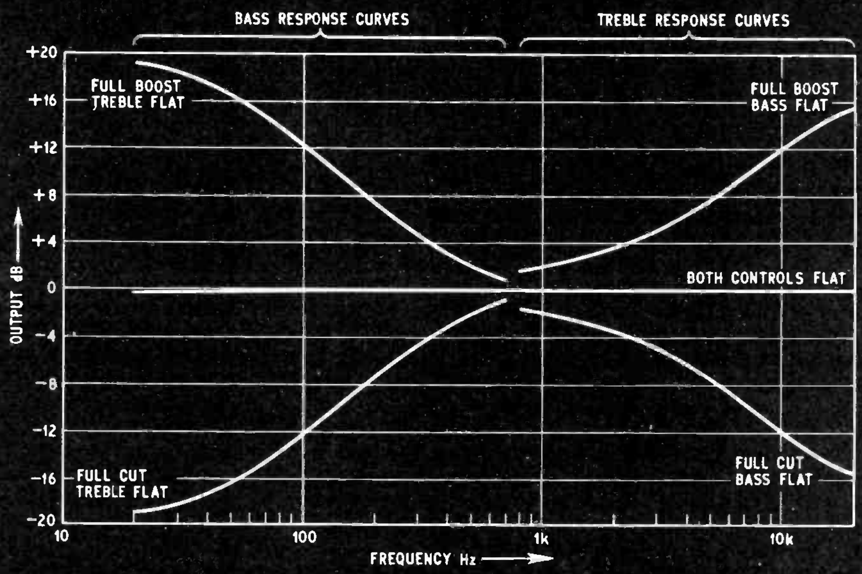
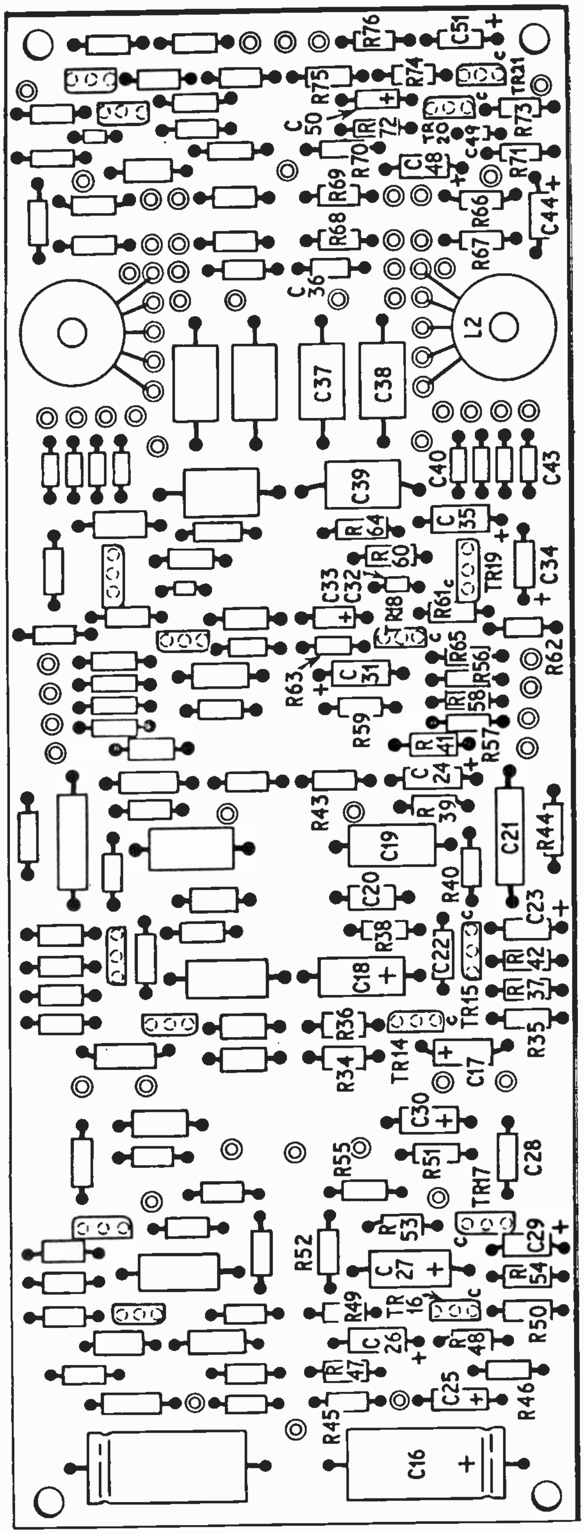


Fig. 33. Tone control characteristics



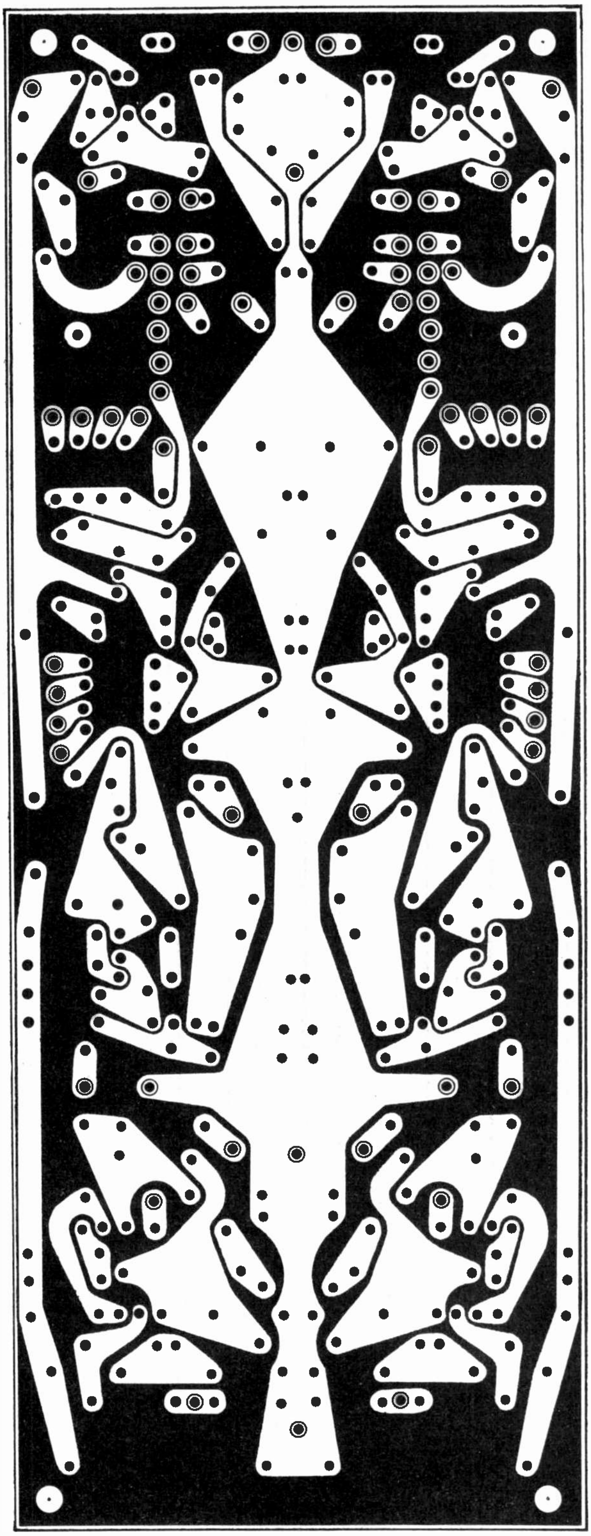
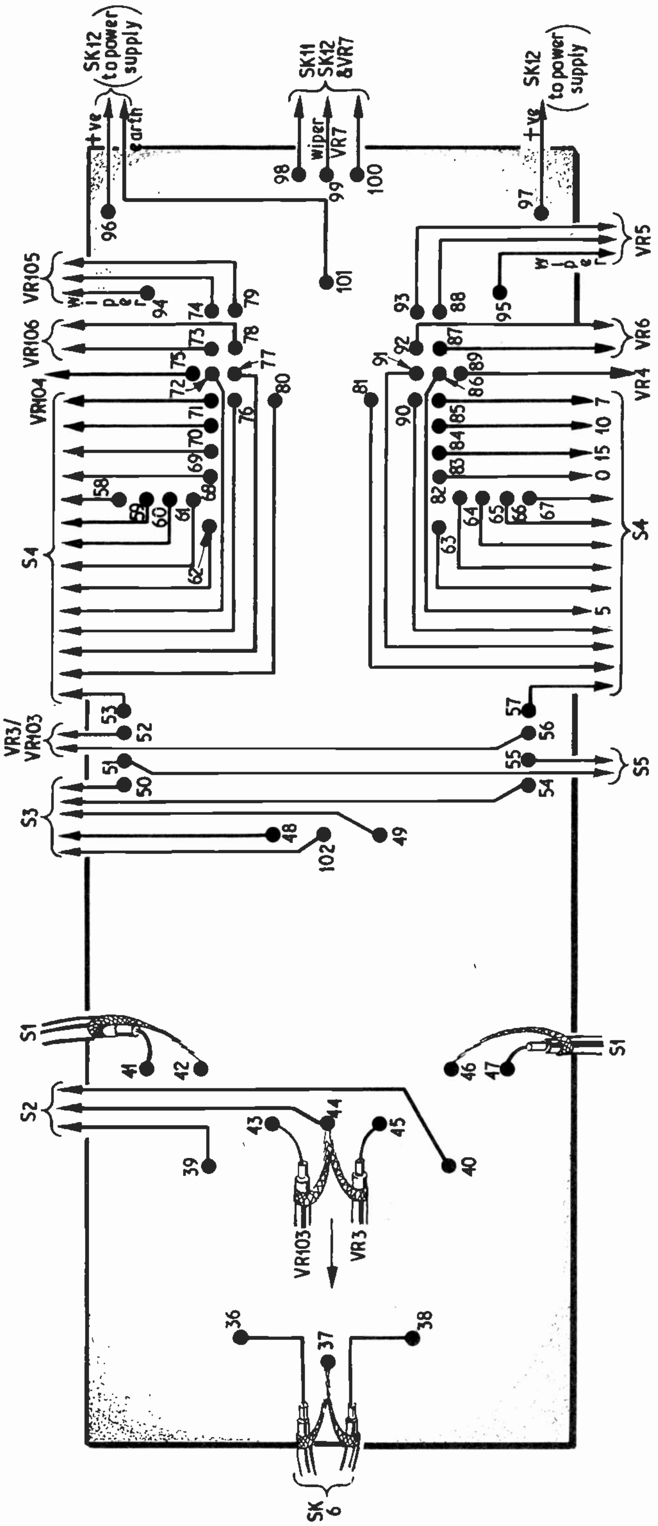


Fig. 34. Layout diagram of both channels of the pre-amplifier printed circuit board. Components for the left-hand channel have not been designated as this section is a mirror image of the right-hand channel—designations are right-hand channel numbers plus 100. The finished size of this board is $10\frac{3}{4}$in by $4\frac{1}{8}$in

Fig. 35 (right). Tag numbering and wiring details of the printed circuit board. Care must be taken when wiring up that left and right channel leads are identified and wired to the correct switch, potentiometer or socket positions be the case the situation can be improved by increasing R76 and R176 to 4·7 kilohms or 10 kilohms, giving a 6 or 10dB reduction.

The tone control circuit uses two transistors instead of the usual single transistor to enable a very low noise level to be obtained and to minimise distortion. The distortion generated is below 0·01 per cent at maximum output between 100Hz and 10kHz. The balance control is connected to the output of the tone control and works by progressively shorting out one channel or the other so that either channel can be completely cut off. To minimise cross-talk a wire wound potentiometer is preferred for VR7 but excellent results can be obtained with the ordinary carbon type.

Full rotation of the bass control gives a cut or boost of ±12dB at 100Hz and ±18dB at 30Hz. The treble control gives ±12dB at 10kHz and ±15dB at 20kHz. The frequency response curves of the tone control are shown in Fig. 33.



POWER SUPPLY

The complete stereo pre-amp requires approximately 35mA at 40 volts. A 470 ohm dropping resistor (R7) is included on the power supply board previously described and the h.t. line is decoupled in the pre-amp by C52 (500μF 64V).

The mains supply lead is connected to the pre-amplifier where the earth is connected, the live and neutral leads being switched by S6 and fed out to the main amplifier together with the earth. This part of the circuit must be carefully screened from the rest of the pre-amplifier, the small chassis supplied with the case specified being ideal for this.

CIRCUIT BOARD CONSTRUCTION

The pre-amplifier components are mounted on one large fibreglass printed circuit board, Fig. 34. Sixty-seven turret tags are used, numbered 36 to 102 as indicated in Fig. 35. The high frequency filter coils L2 and L102 should be wound as indicated in the pre-amplifier components list, with the wires colour coded with sleeves for identification. The coils are fastened to the printed circuit board with either nylon or brass 4B.A. bolts and connected as follows:—

L2 Start-82, 15kHz-83, 10kHz-84, 7kHz-85, 5kHz-86.
L102 Start-68, 15kHz-69, 10kHz-70, 7kHz-71, 5kHz-72.

The component values should be thoroughly checked at this stage since it will be difficult to rectify mistakes after the 67 tags have been wired up.

Note: In Fig. 23 (December 1970 issue) the lead from the neutral connection on SK4 should go to the OV tag on T1 and *not* to the screen as indicated.

Next month: final construction details.

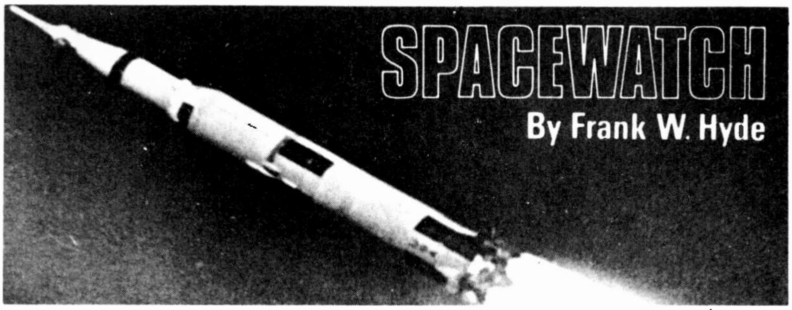
P.E. PROJECTS ON VIEW

The *P.E. Gemini* aroused much interest when it was demonstrated, together with the *P.E. Aurora Lighting Display*, last Autumn at the London Audio Fair.

It is hoped to provide a further opportunity for readers to hear this amplifier during the Public Address Engineers' Exhibition **"Sound 71"** to be held at Camden Town Hall, London, from March 16–19.

The *P.E. Aurora Lighting Display*, due to commence publication in a few months' time, will also be on show at **"Sound 71,"** and additionally, at the **"Electric Theatre"** Exhibition organised by the Institute of Contemporary Arts, and to be held in London, mid-March to mid-April.

Further details will appear next month.



THE MAN WHO CAME BACK

The United States' first man in space, Alan B. Shepard, watched with satisfaction the slow movement of the *Saturn-Apollo* rocket moonship to become *Apollo 14* as it moved toward the launching pad on November 9, 1970.

He first made history in the space age when he made a 15 minute suborbital flight almost ten years ago on May 5, 1961. From then, he became almost forgotten for he was grounded by a condition of the inner ear.

During the remainder of the 60's he remained on the sidelines, although still in the "astronaut corps", where he helped to train young and new astronauts, some of whom became heroes of space. Now he comes back as mission commander for the *Apollo 14* flight.

Captain Shepard undertook, on his own decision, to have an operation for the minor problem of his inner ear. Although he was perfectly fit on the ground, space doctors were afraid that his balance might be affected under space conditions. This has now been cured and the first astronaut becomes the leader of the *Apollo 14* mission to the Fra Maro region.

SPIN-OF FROM SPACE RESEARCH

When space research comes up in conversation, there are still many who do not appear to be aware of the advantages that have affected the daily life of the community. Indeed, many would be surprised at the number of new techniques that are in common use, which were the direct result of some specialised facet of a space requirement.

A few of these are given here and will help perhaps to act as a reminder of the number of things that are taken for granted with no thought given to their origin.

The latest example is an automated technique for the detection of urinary tract infections. The device uses a very sensitive photo-electronic recorder to detect a flash of light when certain chemicals (luciferin and luciferase) contact bacteria in the urine sample.

A single specimen can be tested in 15 minutes and the instrument can accept a further sample in one minute after completion of the previous one. This compares with the normal 24–48 hour period required with the bacteria culture methods.

This new technique opens up many possibilities. With such rapid testing there is no need to treat patients with anti-biotics while waiting for results. The new device also paves the way for inexpensive mass testing of people for suspected infections like diabetes, kidney and bladder diseases. Experienced microbiology staff would be freed for more advanced work.

The testing of urine is a common diagnostic tool in many hospitals no matter what the suspected ailment may be. The origin of this particular device came from the design of an instrument to detect life on other planets.

The chemicals responsible for the "cold light" emitted by fireflies, spark when coming into contact with a high energy biochemical called adenosine triphosphate. This compound is found universally in living organisms so that the activation of the chemicals would indicate that a form of life was present.

OTHER EXAMPLES

A few more examples of spin-off are listed below with their origins.

(a) A special computer technique developed to enhance the television pictures sent back fron Venus and Mars is now in use to clarify X-ray photographs in medical centres.

(b) A minute instrument developed to measure air pressures on small flight models used in wind tunnels has been applied to medicine. The instrument is so small that it can be introduced into an artery through a hypodermic needle, then manœuvred through the artery to the heart, where it measures the blood pressure.

(c) In order to prevent the icing of spacecraft a special canopy was developed. This has been adapted as a cradle type of cover for the precise temperature control of a unit for housing premature babies. It has also been adapted for adults and a number of severely burned patients have been successfully treated.

(d) A sensor developed for astronauts sounds an alarm within ten seconds when a patient is threatened with the clogging of the trachea and there is danger of strangulation. Immediate efforts to restore the breathing can be made.

(e) A new switch which is controlled by small movement of the head alone was developed for astronauts. This is now being used for handicapped patients who, with what is virtually another "arm", can operate a call board or even manipulate an electric wheel chair.

(f) Spray-on electrodes are now available so that a patient's electrocardiogram, taken while he is being rushed to hospital, can be radioed ahead to the waiting doctor, who can take immediate action on the patient's arrival.

(g) New alloys, that have been developed for space use, can be adapted for use in artificial limbs and joints. The alloys are the result of a discovery by NASA metallurgists that hexagonal crystals make better bearings than the normal cubic crystal structure.

(h) A lunar walker with eight legs has been applied to the relief of handicapped people. It allows a considerable freedom of movement and can be controlled from a chin cup by those who are not able to use arms or hands.

MAKING WATER ON THE MOON

A new and important step toward the sustaining of life on the moon has been made at the Manned Spacecraft Centre of the U.S. Space Agency. The first experiments provided a pound of water from 100 pounds of soil. This could be increased to 14 pounds per 100 pounds of soil, if it were concentrated magnetically.

The process is a simple one and ideally suited to the moon (though it can be used on earth). A mirror is used to concentrate the sun's rays on a container of soil and raise its temperature to between 600 and 1,300 degrees centrigrade. Hydrogen is then introduced into the container. It reduces the oxygen atoms in the soil to form steam. When this is cooled it condenses to water.

To obtain oxygen, steam is passed through an electrolysis cell where the steam separates into oxygen and hydrogen. The oxygen can come from an iron-titanium oxide called ilmenite. This is abundant in the lunar soil as revealed by the samples brought back by the *Apollo 11* and *Apollo 12* astronauts.

The hydrogen would have to be taken to the moon but it could be recirculated and used many times over to produce more oxygen.

None of the lunar specimens have been used for the purpose of this experiment. The soil was made from the proper proportions of ground basalt from Hawaii and ilmenite from Canada. However, the scientists responsible have sufficient faith in the process to have taken out a patent for the process.

MAKING THE MOST OF LOGIC IC's

PART EIGHT—By R. W. COLES

TTL SYSTEMS

HAVING discussed TTL gates and flip-flops in previous articles, let us now see how these circuits can be put together to perform specific tasks.

SYNCHRONOUS COUNTER

These counters can become quite complex when counts which are not binary multiples are required, and it is beyond the scope of this article to delve into the design procedure necessary.

Straight binary counts are, however, quite simple in design. As an example, have a go at a divide-by-sixteen counter of this type. Remember that a JK flip-flop will change state when both its J and its K input, or inputs, are at 1. If they are anything other than this, the information presented will merely be stored in the flip-flop. The truth table of a binary counter shows that any given flip-flop in the chain is required to change state only when all the flip-flops preceding it are in the 1 state.

If all the stages are clocked simultaneously, but only the J and K inputs of any stage are at 1 when the preceding flip-flop outputs are also 1, the flip-flop acts as a synchronous counter. By feeding the Q outputs of the earlier stages into an AND gate, and feeding its output into the J input (the K input may be left as a permanent one), the required JK inputs are satisfied.

Fortunately, flip-flops are available with this AND gate built in. The 7472 will be ideal as a synchronous counter and is shown in Fig. 8.1. Note that with this type of counter the number of AND gate inputs increases linearly with the number of stages in the counter.

If a five stage version is required, external gates would be needed because there are only three inputs to the internal J gates on the 7472.

SHIFT REGISTERS

Shift registers are used in logic circuitry as a form of temporary storage, or memory, and may contain either a number or some form of instruction which is represented by a number. The basic shift register would consist of a string of flip-flops with the outputs of the first connected to the inputs of the second and so on. A common clock line initiates the propagation of information down the register when required.

If JK flip-flops are employed in such a register, the Q outputs are connected to the J inputs of the following flip-flop, and the $\bar{Q}$ outputs are connected to the K inputs. If, on the other hand, a type D flip-flop is employed, only one interconnection is needed, i.e. Q output to D input. For this reason, it is easier to deal with the type D for such use, and the diagrams will be simpler as a result.

SERIAL INPUTS

A basic shift register is shown in Fig. 8.2a. If the register is in the all 0 state, and the data input is connected to the output of a similar register which contains a binary word, say 10101, then on the first clock pulse (both registers clocked), a 1 will be entered into the first flip-flop.

On the second clock pulse a 0 will be shifted into the first flip-flop, and the one which it contained previously will be shifted into the second flip-flop.

On the third clock pulse another 1 will be entered into the first stage, a 0 will be entered into the second stage and a 1 into the third stage.

This process continues until after five clock pulses; the word which was in the first register has been transferred completely into the second. If the input of the first register had been connected to a permanent 0 during this period, it would now contain all 0.

This type of shift register operation is termed serial-in/serial-out, and although it is the primary way in which registers are employed, it is by no means the only way. Consider Fig. 8.2b; the register shown here is identical to the first except that all the Q outputs are taken out at once, enabling us to extract the stored word in parallel form, perhaps to drive indicator lamps, or even another register.

This kind of register is operating in the serial-in/parallel-out mode, and its operation is obvious.

PARALLEL INPUTS

Its complement, the parallel-in/serial-out register, shown in Fig. 8.2c, takes advantage of the type D flip-flop asynchronous inputs to enter data into the register.

This input data could come from the type of register described previously or from a bank of switches or relays. The only thing to bear in mind in this case is that a "low" voltage on the preset input sets the Q output to 1 (high voltage level) and a low voltage on the clear input sets the $\bar{Q}$ output to a 1.

To start the sequence the register must be cleared by applying a low input to the common clear line, so that all the stages contain zeros. Next the input data to be stored is connected in parallel to the preset inputs; this must be inverted data, because a low input sets up a high output.

When the data is required to be shifted out, five clock pulses are applied to the clock line, and the output data is taken from the final stage of the register in serial form.

As an alternative, the circuit in Fig. 8.2d could be employed to achieve the same result if both the "true" and the "not" version of the input data is available. In

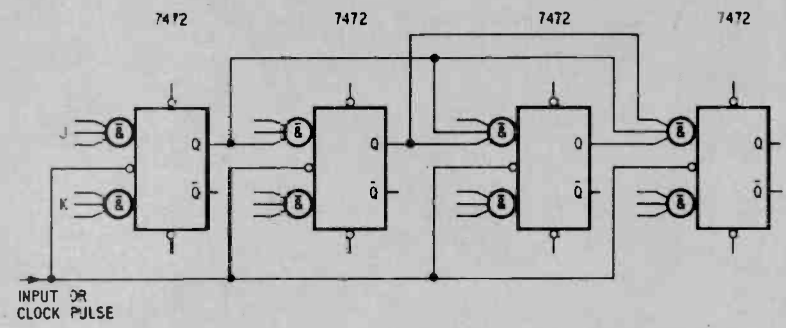


Fig. 8.1. Synchronous counter to divide by sixteen

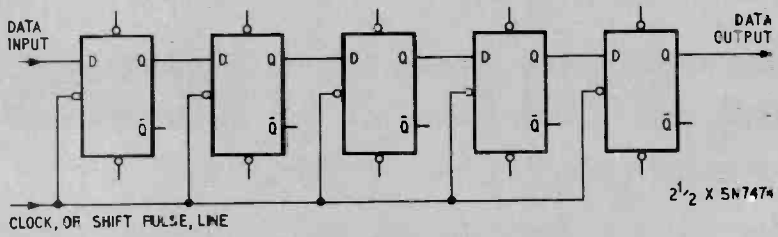


Fig. 8.2a. Serial in, serial out register

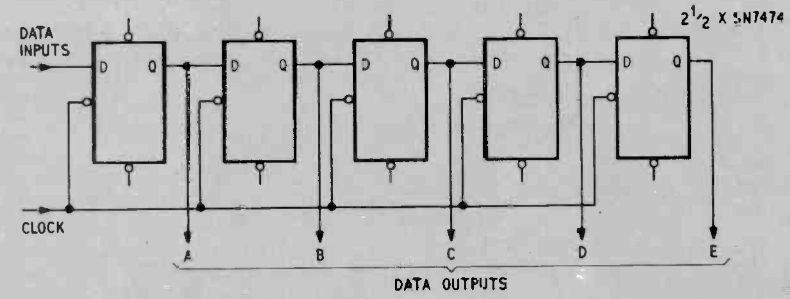


Fig. 8.2b. Serial in, parallel out register

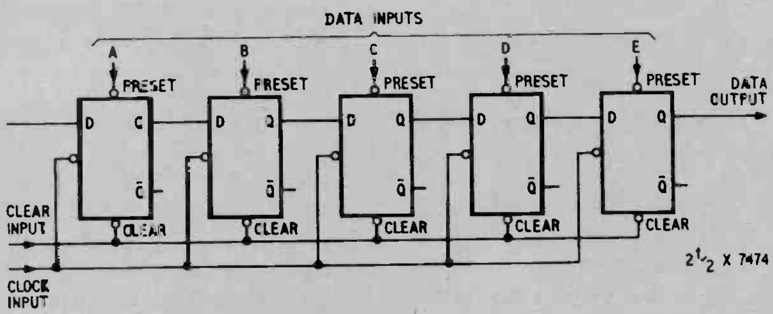


Fig. 8.2c. Parallel in, serial out register

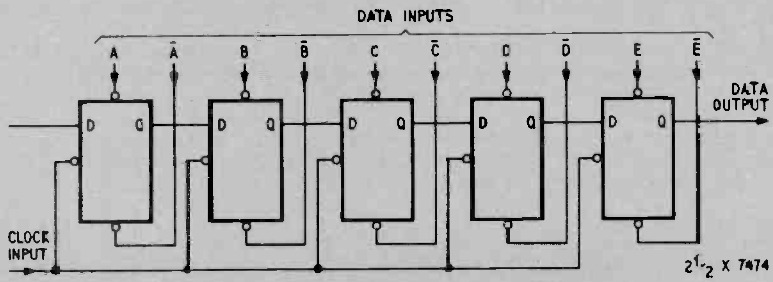


Fig. 8.2d. Alternative version of Fig. 8.2c

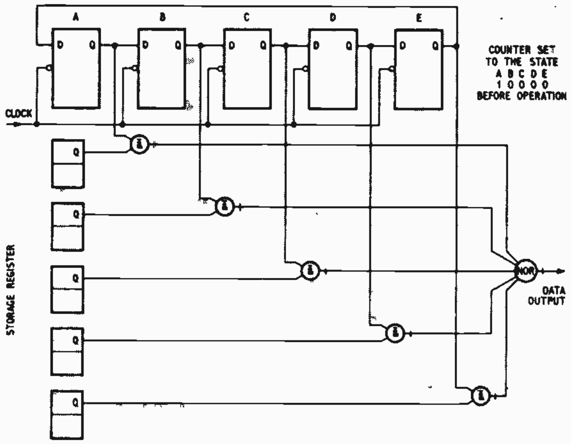
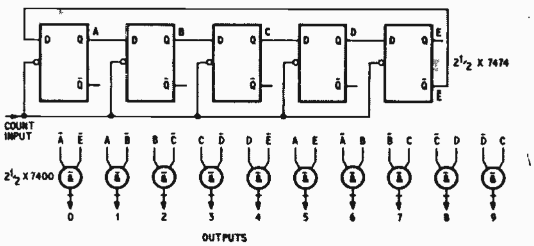


Fig. 8.3. Unitary or ring counter

this case there is no need for a common clear input, as any residual data in the register is "overwritten" by the input data.

Perhaps it would be as well to mention here that it is also possible to perform the parallel-in/serial-out function using the synchronous flip-flop inputs, but this does require extra gating to allow the D input to be connected either to the input data, or the preceding stage. A control line to order the register to "enter data" or "shift data" would also be necessary.

This winds up the subject of shift register construction and operation, but before leaving them, have a look at some uses of these registers, apart from simple data storage.



CLOCK PULSE	A	B	C	D	E	DECODE INPUT	
0	0	0	0	0	0	Ā	Ē
1	1	0	0	0	0	A	B̄
2	1	1	0	0	0	B	C̄
3	1	1	1	0	0	C	D̄
4	1	1	1	1	0	D	Ē
5	1	1	1	1	1	A	E
6	0	1	1	1	1	Ā	B
7	0	0	1	1	1	B̄	C
8	0	0	0	1	1	C̄	D
9	0	0	0	0	1	D̄	C

Fig. 8.4. Johnson decade counter with decoding

RING COUNTER

Several types of counter can be built using a shift register, the simplest being the "unitary counter" or commutator. In this application the register is set, by means of the asynchronous inputs to the state 100000 . . . .; that is, a 1 in the first stage and zeros in all the others. The output is connected back to the input. On receipt of clock pulses, the 1 in the first stage is propagated down the register, round the end and back into the first stage again.

This process gives rise to another name for it, the "ring-counter", as all the stages of the register form a complete loop. These counters need a separate stage for each of the required counter states, but they have the advantage that no gates are necessary to decode a particular state.

A typical application of this kind of counter is shown in Fig. 8.3. Here the 1 travelling round the counter is used to enable each of the five NAND gates in turn, the other inputs of which are connected to a storage register. The outputs of the NAND gates are fed to a NOR gate, to convert the parallel data stored in the parallel register into serial form; the output is taken from the output of the NOR gate. If a binary counter is used in this position, decoding gates would be necessary.

TWISTED RING COUNTER

A similar sort of arrangement is used to construct a "Johnson", or "twisted ring" counter, only in this case the $\overline{Q}$ output of the final stage is fed back to the input, not the Q output as before. These counters require only half as many stages as the unitary counters of the same cycle length, and do not normally need to be set to any special starting state, although this depends on the cycle length employed.

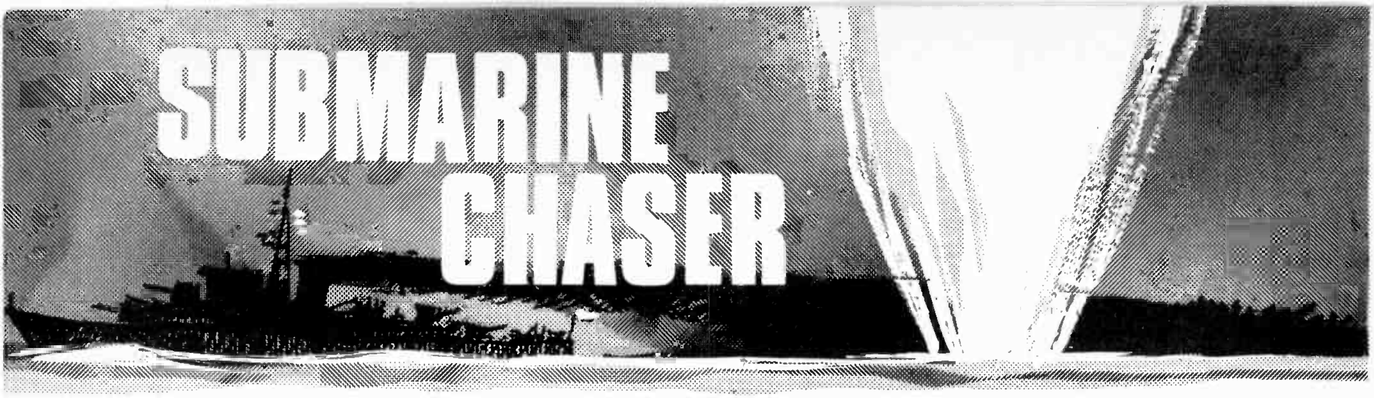
Their main advantages over binary counters are that they are synchronous and also any state, no matter how long the cycle length, can be decoded with only a 2-input gate. A typical application is shown in Fig. 8.4, a decade (divide by ten) counter, with decoding to decimal so that it could be used in frequency counters or similar equipment, where the outputs are used to drive "Nixie" indicator tubes.

TTL MEDIUM SCALE INTEGRATION

When the manufacturers of logic integrated circuits were in full volume production of gate and flip-flop families, and the "bugs" were ironed out of the manufacturing process, so that a high yield was being obtained from each slice of silicon, it was a relatively straightforward process to increase the amount of logic contained in each package. The results of this second generation of i.c. manufacture are now readily available, under the name "medium scale integration" (MSI) or "complex function devices".

The logic family which has by far the greatest range of these is TTL.

Next month's article will consider the advantages of medium scale integration (MSI), in which several logic circuits are contained in one package, such as is used in the "Digi-Clock".



Another war game by D. R. DAINES.
This can be added to Operation Seasearch, published in December 1970, or built on its own

SUBMARINE CHASER is very different from Operation Seasearch (December 1970 issue), but because both games utilise co-ordinate switching the opportunity has been taken to enclose both in the same unit, the game to be played being selected by a two-way four-pole rotary switch. As before we have North/South and East/West co-ordinates but with the added dimension of depth. To the submarine player, the depth represents the actual depth he is supposed to be; to the destroyer player the depth represents that at which his depth charges are set to explode.

By far the greater difference between this and last month's game, however, is in the method of search. Hunting the raider in Operation Seasearch was very largely blind; Submarine Chaser uses a pseudo Asdic.

ASDIC

It is fair to say that the invention of asdic revolutionised anti-submarine warfare in World War 2, and the present game arose out of a desire to simulate as closely as possible the conditions arising out of the use of it, in game form. In real life, a searching vessel emits a high-frequency sound at regular intervals. The sound wave travels underwater at a regular speed dependent upon the temperature and salinity of the water. If the sound wave strikes a solid object it is reflected back and detected by listening gear. Obviously, the time taken for the sound wave to travel the double journey is a fair indication of distance. If the reflecting body is a submarine, a series of readings taken over a period will enable course and speed to be determined.

The asdic used in this game works on a completely different principle, but is utilised in the same way and gives a convincing impression of genuine asdic. The difference of position between the submarine and the destroyer is represented by electrical resistance which affects the rate of a slow-running multivibrator. The multivibrator gates a high frequency audio tone which is monitored by both players through earpieces. The closer together the two vessels are supposed to be, the faster is the repetition rate. Means are provided whereby each player may obtain a "fix" on the position of the other.

ASDIC PRINTED CIRCUIT BOARD

The asdic circuit is mounted on Veroboard, and comprises nine transistors (Fig. 1). Transistors TR1 and TR2 together comprise a fast-running multivibrator giving a high frequency square wave output taken off through D31. The variable clock circuit is formed by TR3 and TR4. The base voltage of TR4 is varied through a series of resistors shown in Fig. 2 (R18 to R27). The output is taken through D30, which, together with D31 and R7 comprises the gate.

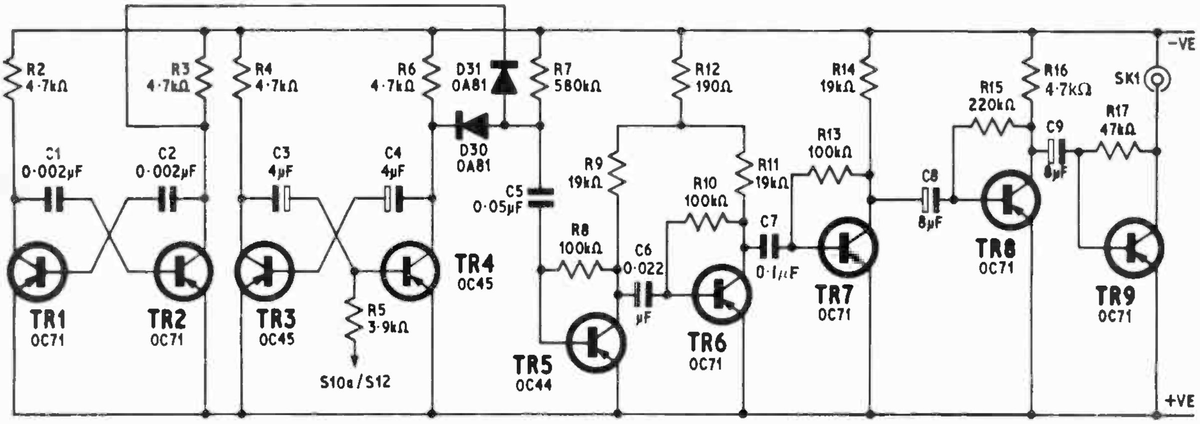
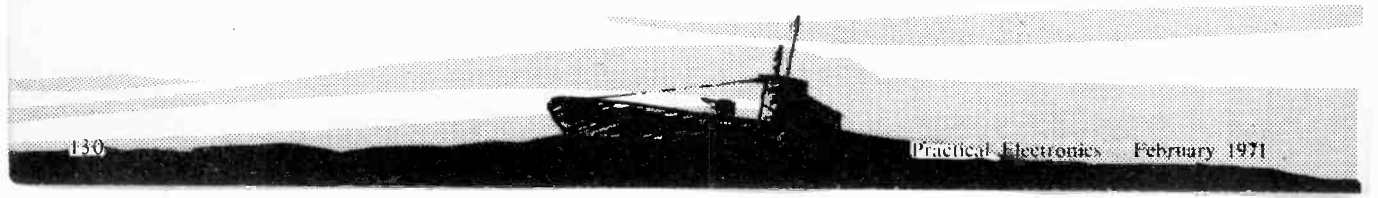


Fig. 1. Circuit diagram of the asdic board used in the Submarine Chaser game



The signal from TR2 will not pass forward unless a pulse is also present from TR4. Capacitor C5 is a d.c. de-coupler feeding the simple amplifier formed by TR5 to TR9. Final output from TR9 is fed to a miniature jack socket (SK1) into which a crystal ear-piece may be plugged. This is situated at the side of the unit, between the two players.

DIRECTION FINDING

Referring briefly to Operation Seasearch, switches S5 and S6 controlled the horizontal co-ordinates of the destroyer. Here they do so again, but whereas switches S7 and S8 controlled the cruiser, S7 must now control the depth of depthcharges and S8 becomes redundant. Therefore the connecting link between S7 and S8 must be disconnected at "X".

In a similar way, switches S3 and S4 originally controlled the position of the supply ship. Switch S3 must now control the submarine depth and S4 becomes redundant. The two depth control switches S3 and S7 therefore work together and since this is a third dimension, extra wiring is called for here as well as an extra wafer on each; Fig. 2 will establish the idea.

It will be realised that what is required for accurate direction finding of the opponent is a method of sampling the various co-ordinate lines. If this could be done, the one that gives the fastest repetition rate on the asdic will be the one which by-passes all the resistors and hence the one which corresponds with the position of the opponent's switch. If this is done with the North/South lines and the East/West lines, a very accurate "fix" can be achieved; Fig. 2 illustrates the method—the sampling switch is S14. As this switch passes through the left half of its sweep, it progressively by-passes resistors R18 to R22. When it coincides with the position of switch S1a (shown as position 5) the voltage applied to the asdic board will be at maximum, giving the fastest repetition rate. The player will therefore have detected the position of switch S1a.

In the right half of the sweep, the sampling switch will detect the position of switch S6, which is the player's own. This half of the sweep is therefore used by the

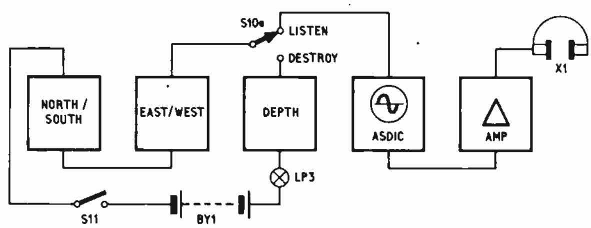
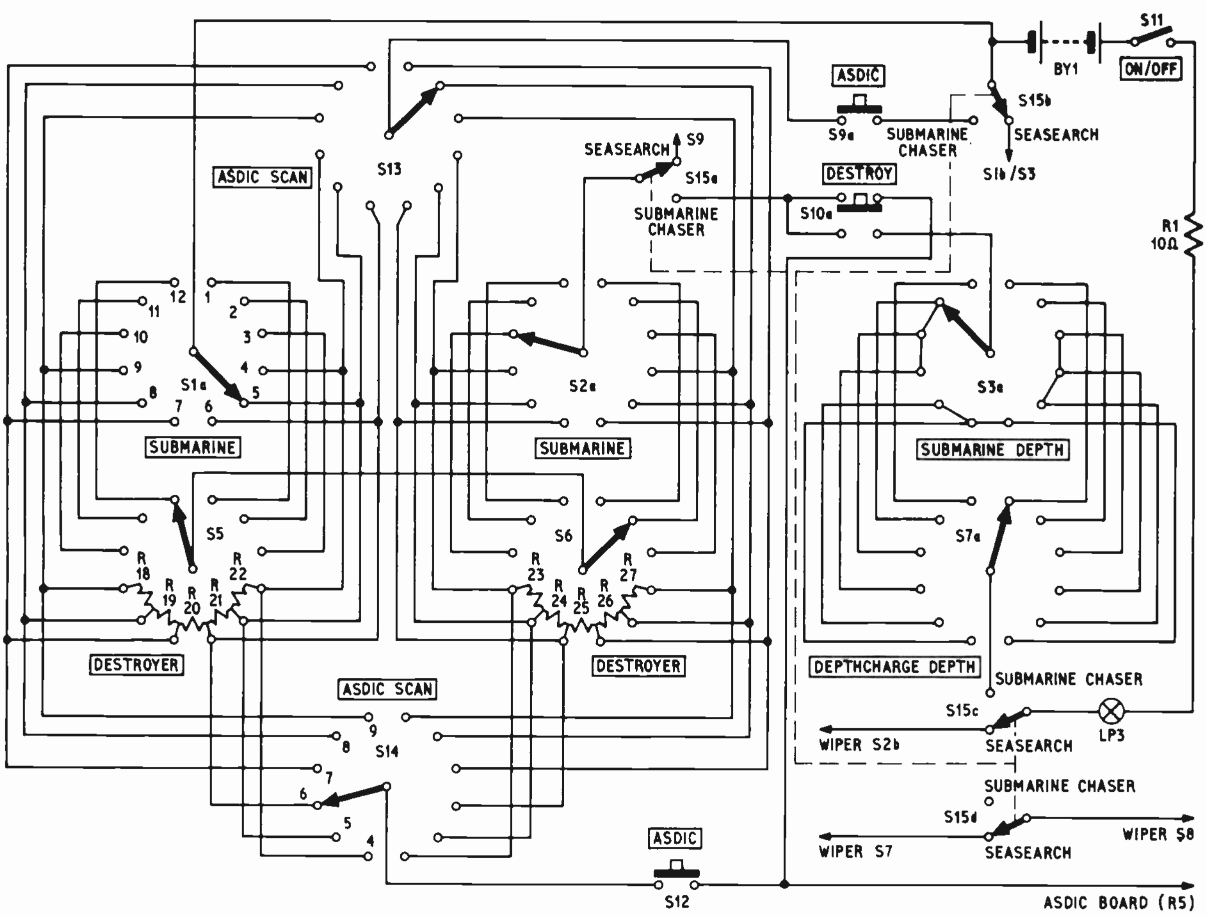


Fig. 2a. Block diagram of Submarine Chaser

Fig. 2b. Wiring diagram of the switching arrangements for Submarine Chaser. If only this game is to be built, switch S15 can be omitted and this diagram and Fig. 1 then give the complete circuit



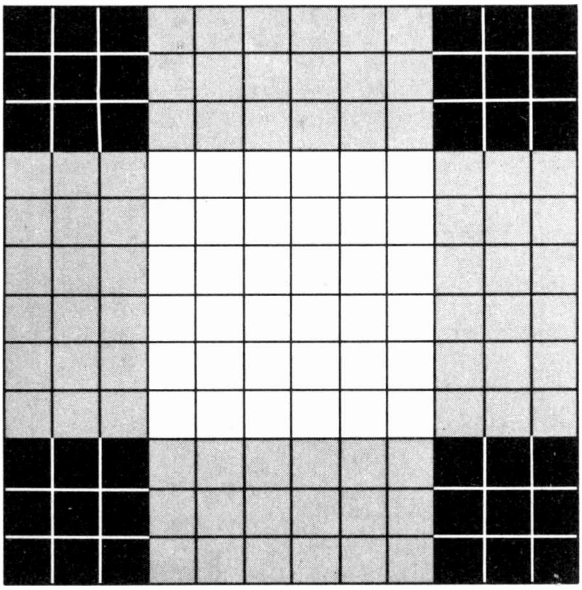


Fig. 3. Asdic detection pattern; white area—total detection; shaded area—partial detection; black area—no detection

opponent. It will be seen that two sampling switches are needed, the second is S13, which will detect switches S2a and S5. In use, the players in turn will use both switches but at opposite parts of the sweep. For convenience, the two halves of each sweep are given a dab of colour; red and blue corresponding to the Redland or Blueland player.

The sampling switches do not give a total fix, but only sample the centre six lines in each direction. This gives a detection pattern as in Fig. 3, where the white areas denote total detection, the shaded areas partial detection, and the black areas no detection at all. The game was designed in this way partly on the grounds of economy and partly because it was felt that total detection overall would not lead to such an interesting game. Readers who would prefer total detection will be able to adapt the circuit, but of course four sampling switches would be required instead of two.

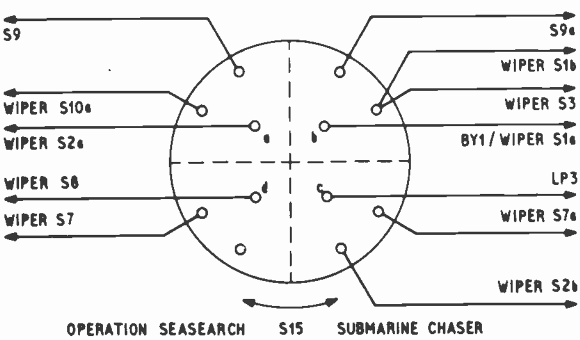


Fig. 4. Wiring of the game change switch S15

CONSTRUCTION

Readers who built Operation Seasearch will have no difficulty if they installed the recommended switches. All wires are severed at the points marked "X" in the Seasearch diagram and taken to the game-change switch, which is a four pole changeover switch—not three pole. Then the wiring to switches S13 and S14 (Fig. 2) is added, as well as the wiring to the second wafers of S3 and S7. Constructors interested in this game only will find a complete parts list in this article; Fig. 1 and Fig. 2 form the complete circuit, game change switch S15 may be omitted if one game only is built.

COMPONENTS . . .

Resistors

R1 10Ω (not required if Seasearch has been built)

R2	4·7kΩ	R10	100kΩ
R3	4·7kΩ	R11	19kΩ
R4	4·7kΩ	R12	190Ω
R5	3·9kΩ	R13	100kΩ
R6	4·7kΩ	R14	19kΩ
R7	580kΩ	R15	220kΩ
R8	100kΩ	R16	4·7kΩ
R9	19kΩ	R17	47kΩ
All $\frac{1}{4}$W, ±10% carbon		R18 to R27	2·2kΩ (10 off)

Capacitors

C1	0·002μF	C6	0·022μF
C2	0·002μF	C7	0·1μF
C3	4μF elect. 12V	C8	8μF elect. 12V
C4	4μF elect. 12V	C9	8μF elect. 12V
C5	0·05μF		

Switches

	For Submarine Chaser only	Additional to Operation Seasearch
S1	1p 12w	
S2	1p 12w	
S3	1p 12w	
S5	1p 12w	
S6	1p 12w	
S7	1p 12w	
S9	1p make push button	
S10	2p 2w push button	1p 2w
S11	S.P.S.T. toggle	
S12	1p make push button	1p make
S13	1p 12w	1p 12w
S14	1p 12w	1p 12w
S15		4p 2w

(S15 is a four pole two-way switch, not three pole as stated in Seasearch article)

All rotary wafer switches except where stated

Semiconductors

TR1, 2 OC71 (2 off)
TR3, 4 OC45 (2 off)
TR5 OC44
TR6–9 OC71 (4 off)
D30, 31 OA81 (2 off)

Miscellaneous

SK1 Miniature jack socket
LP3 6·3V 0·06A (MES bulb, clip-on holder—not required if Seasearch has been built)
BY1 9V battery type PP6 (not required if Seasearch has been built)
Case components (see list in Dec. 70 issue)
Three knobs with pointers
Crystal earpiece lead and jack plug
Veroboard
6B.A. fixings and spacers

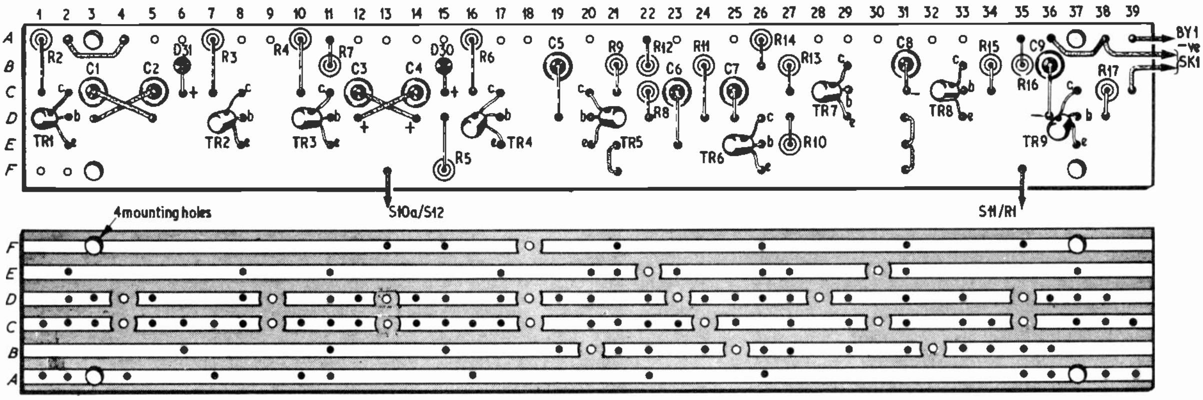
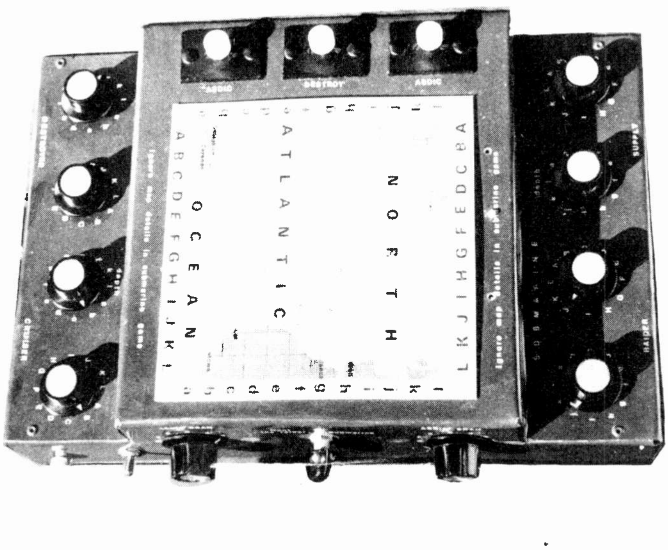


Fig. 5. Component layout and wiring of the asdic board

S10 is a two-pole change-over type, a d.p.d.t. switch may be used, but when playing, care must be taken to leave it in the off position; one pole is of course used for Operation Seasearch, and the other pole for this game. Switches S9 and S12 are labelled "Asdic" and S10 labelled "Destroy". In the off position S10 shunts the output from S2a to the asdic board. When depressed, the output goes to the depth wafers, switches S3a and S7a. If these are set at the correct depth lamp LP3 is lit and a hit registered. The asdic board is constructed as shown in Fig. 5 and fitted under the chassis near the lamps.

Switches S13, S14 and S15 are inserted through the three holes made in the side of the case described in the previous article. Push-button S12 is inserted in the spare hole on the top panel and SK1 can be sited in any position convenient to both players and the asdic board. The switches can be labelled as shown in Fig. 2.

Submarine Chaser is designed to be built in conjunction with Operation Seasearch but where the reader wishes to build Submarine Chaser alone it can be constructed in a case similar to that shown in the photographs. No map details are required for this game, the map—which is 7 inches square—is simply lettered to designate the co-ordinates. The case is constructed of aluminium and when bent to shape is pop rivited; the case shown measures 15 × 9½ × 3½ inches.



Lamps LP1, LP2 and LP3 are arranged under the map to illuminate corresponding numbers.

DEPTH

It will be seen that no Asdic detection is used for the destroyer player to determine depth. This is partly off-set by grouping the depth lines in the following way. The first position of the submarine switch (S3a) denotes that the sub is on the surface—this line is left on its own. The second line denotes periscope depth; the last denotes that the sub is sitting on the bottom; these two are also solo lines. The other nine positions are grouped in threes by shorting links on S3a (Fig. 2), which are optional and left to the constructor's discretion. It is felt that if the destroyer player has to guess the submarine depth it is asking too much for him to choose from 12 positions.

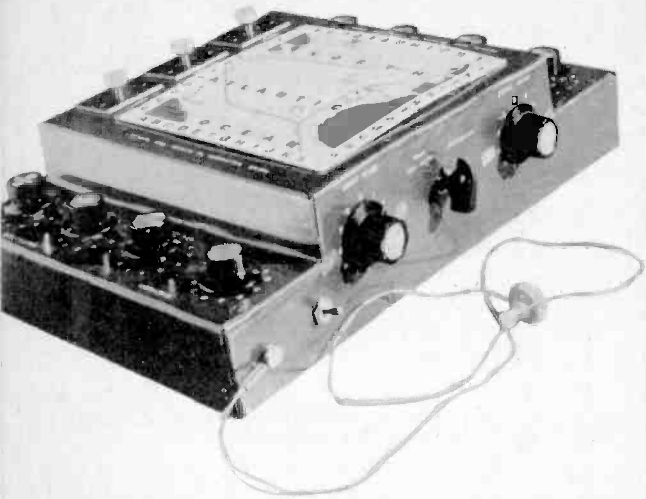
METHOD OF PLAY

The co-ordinates of the destroyer are adjusted so that he is at any peripheral square. Since the action is assumed to take place in a section of open sea, map details are totally ignored. A token is placed on the map to correspond with the destroyer's position. The submarine's position is adjusted to any one of the four central squares and at any depth he chooses. Only if he chooses to be on the surface must a token be placed because of course each ship can see the other. If he chooses depth two (periscope depth) the destroyer token remains but the submarine token is removed, whereas if he is any deeper both tokens are removed as neither can see the other. This simple rule of course applies throughout the game.

The destroyer moves first—or a coin is tossed. The destroyer moves a knight's move of two forward and one to the side, or one forward and two to the side. He may "drop" depth charges on each square through which he passes, he does this by pressing the "destroy" button. The depth charges may be adjusted for depth once each move.

The submarine moves minimum while submerged. That is, one square in any direction and one square up or down. Only while on the surface may he move two squares.

For the destroyer the game is thus quite simple—the destruction of the submarine, signalled as soon as the lamp is lit. For the submarine, life is a little more complicated. He can win the game either by escape or by sinking the destroyer. He escapes when he manages to reach the edge of the playing area, but with this one proviso—if the opponent can correctly guess the very first time to which edge he has gone, the game must continue for at least another ten moves.



TORPEDOES

The submarine can sink the destroyer by means of torpedoes. Only one is required. He may fire torpedoes only whilst on the surface or at periscope depth, but may not rise and fire in the same turn. A torpedo is fired when he is in line with the destroyer—a queen's move of any number of squares up, down, across, or diagonally. Here he simply claims the hit and reveals the positions of his controls.

VARIATIONS

For a really exciting game, try using a stopwatch or kitchen timer, allowing each player 30 seconds to listen and move. Better still, allow the first player one minute, but each succeeding move must be made in less time than the one preceding. Another variation would render it impossible for vessels to reverse direction in succeeding moves. The destroyer would then move in a series of loops, and the submarine would turn a maximum of 45 degrees on each move. The submarine might be allowed to sit on the bottom with engines off. Disconnect the Asdic and allow the destroyer three or four runs before giving up.

USING BOTH GAMES TOGETHER

The two games can be used together in a variety of ways. For example, the "Blue" player might run a convoy from Halifax to Britain, trying to avoid the submarine wolf-pack lying in wait. If contact is made the Red player scores one ship sunk before the destroyer escort is alerted. Play then transfers to the second game. If the sub escapes, play goes back to the first, and so on, until either the remnants of the convoy reaches Britain, or (say) five submarines are sunk. It might also be pointed out that the third dimension need not necessarily be depth. It might just as well be height. For submarines, read "bombers" and for asdic read radar. The two games together really have very wide scope, but perhaps enough has been said to get readers thinking for themselves.

Some readers might want to have their submarines rising to the surface in order to use deck guns as well as torpedoes, but here we are entering the very complicated world of naval gunnery. For this we really need the subject of a future article—a naval gunnery computer. ★

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.

I.C. POWER AMPLIFIER

We have recently received a comprehensive pamphlet describing four types of hybrid audio power amplifiers. These integrated circuit amplifiers require only the addition of a power supply, coupling capacitor and loudspeaker to form a high quality audio amplifier capable of giving 10, 20, 25 or 50 watts continuous output power, depending on the type.

Manufactured by Sanken Electric Co. Ltd. (Japan) and available through **Photain Controls Ltd.,** Randalls Road, Leatherhead, Surrey, the amplifiers have the following brief specification:

Harmonic Distortion at Full Power Level 0·8 per cent maximum.

for SI-1010A (10W) and SH020B (20W), 0·5 per cent maximum

for SI-1020A (25W) and SI-1050A (50W)

Frequency range at 1W output 20Hz to 100kHz for all types. Price SI-1010A—£5, SI-1020B—£7, SI-1020A—£8, SI-1050A—£11.

The amplifiers must be driven from a preamplifier or other source giving approximately 1V audio output to the amplifier. A feedback resistor is incorporated to give a voltage gain of about 30dB and the circuits will withstand an output short circuit for more than 5 seconds.

The modules are intended for use in hi-fi, public address and musical instrument applications, and should prove excellent due to their small size and high output power.

COMPONENT SPARES

Many readers like to carry out their own repairs to their television receivers but often find great difficulty in replacing components.

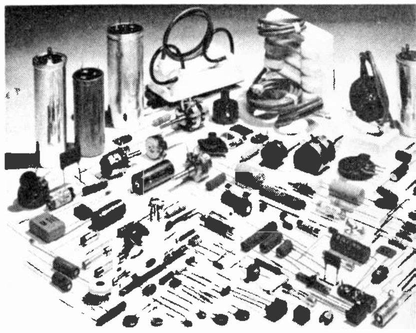
We have been informed that the firm of **Claygate Electronics** specialise in radio and television replacement components and as a result of recent expansion plans are now able to supply readers with any of their large range of components in small quantities.

As a result of the expansion they are now approved stockists for: Plessey, Hunts, ITT, Lemco, Egen Electric, Erie, Morganite, Newmarket, Multicore and Solderstat components. For small items like resistors and capacitors they can only supply a minimum number of five components. But for larger items they are prepared to supply "one off's".

At the time of going to press they were preparing to publish a catalogue and details and further information can be obtained from Claygate Electronics Ltd., 2, Stoke Newington High Street, London, N.18.

IRON ACCESSORIES

New from **Solderstat** (manufacturers of the Elremco-Wolf range of soldering tools) are a snap on iron transit cover and a universal iron stand. The transit cover is for use with the firm's MS and HMS series of miniature and heavy duty miniature soldering irons. This inexpensive accessory is particularly useful where soldering irons are used for servicing and maintenance work, since it allows the user to pack away the iron without waiting for it to cool down;



Group of television components available from Claygate Electronics

for this reason the transit cover has been included in the new Solderstat 12 volt motorist pack.

Suitable for the same range of irons as the transit cover, the universal stand is a die cast aluminium alloy stand that can either be fixed to a vertical or horizontal surface. The stand contains a bit cleaning pad, is finished in stove enamel and retails at around 27s (£1·35).

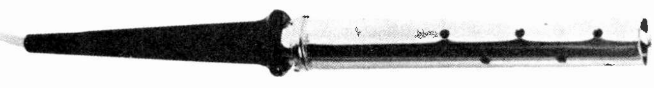
MULTI-PURPOSE PLIER

A useful tool for the workshop is the Hunter 55 multi-purpose plier that can cut, strip and crimp wires, now being marketed by **Henri Picard and Frere Ltd.**

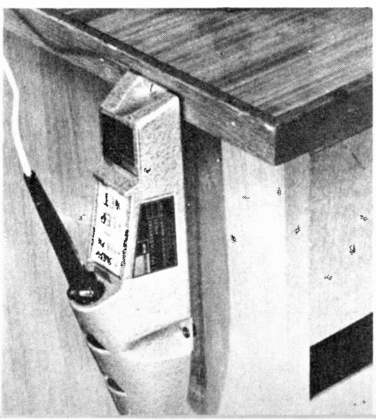
A serrated edge between the handles and the plier joint has six notches in graduated standard sizes to strip wires. Just between the serrated edge and the pivot joint the handles are sharpened to form a cutting edge for wire trimming.

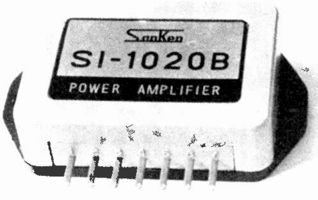
The standard corrugated plier snout is extra long and has, close to the joint, a pair of specially designed shapes for crimping wires together.

The price of the Hunter 55 is 21s (£1·05) and details of local stockists can be obtained from Henri Picard & Frere Ltd., 34 Furnival Street, London, E.C.4.



Solderstat snap-on transit cover and universal soldering iron stand





Sanken i.c. amplifier from Photain Controls (half size)

Hunter 55 multi-purpose plier marketed by Henri Picard and Frere

Meet the ladies...

WOMEN IN ELECTRONICS

By Dr. Elizabeth Laverick

PhD., F.I.E.E., F.Inst.P., S.M.I.E.E.E.

WHY are there not *more* women in the electronics industry? It is undoubtedly one of the most popular branches of engineering for women, partly because it is a profession which can be applied in many widely differing fields; partly because it is a relatively new science with little tradition attached; and partly because the Second World War introduced many women into the vagaries of electronics. Yet only one engineer in the U.K. out of every 500 is a woman.

Perhaps some may think that girls don't have the capability, but this is far from the truth. Girls in other countries take up engineering as a career in far greater numbers, so why not British girls. It can't be lack of opportunity. There is a strong need for good engineers today, and Universities and Colleges up and down the country, offer places to suitably qualified girl students.

It seems that, in too many cases, girls, parents and teachers don't even consider electronics as a possible career for a girl. How many girls are brought up in such a way that, any innate interest in what is considered as boys' games and hobbies, is discouraged from a very early age. At school, girls are encouraged to take domestic science and biology rather than maths or physics. But in spite of all this, women have shown that they can be just as good as the men in electronics, if given the training and the opportunity.

There are organisations that do try to further the aims and interests of women in engineering, and especially in the electronics field. More about this later, but first let us look quickly at some typical examples.

ELSIE: INDUSTRIAL AUTOMATION

Elsie's favourite subjects at school were maths and physics. After passing her G.C.E. "O" levels she took a post as Laboratory Assistant at a large local electronics factory, and studied electrical engineering on a part-time day release basis at the local technical college.

She worked first in the Test Department where she learned to use a wide variety of measuring and test instruments, and went on to designing and building special test equipment, under supervision of course. Later she worked as one of a team of engineers on the digital control system for a satellite communications station, and as her interest in digital work increased she started to specialise in digital data transmission systems. Later she became a Contracts Engineer, responsible for more than one project, and discussing customers' problems, finding the solutions, and evolving detailed system specifications.

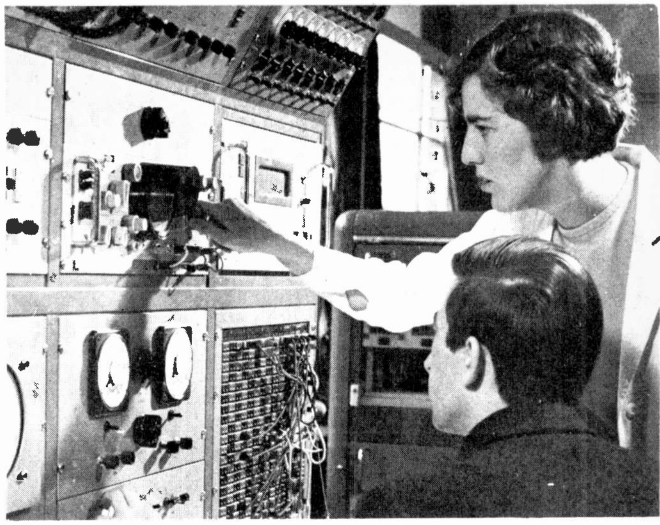
Now she has moved into industrial automation where she is Head of the Data Transmission Group, responsible for the profitability of all contracts within her Group and for the day-to-day supervision of 17 design and commissioning engineers.

ANNE: MICROWAVE ENGINEERING

Anne graduated in physics but now works as a microwave engineer in an industrial research laboratory. Although her physics course covered the fundamentals, Anne was very unfamiliar with the practical aspects of microwave engineering.

However, she soon gained experience of using microwave instruments and applying microwave measuring techniques, and after a year or so was given a small project of her own, to develop a microwave Colometer for measuring microwave power. She has been given increasing responsibility involving the direction of junior engineers, the planning and costing of her work and liaison with the customer.

Looking at the spectrum of a microwave solid state oscillator (Elliott Bros. (London) Ltd)



Setting up a problem on an analogue computer

PAT: PROGRAMMING

Another application of electronics very much to the fore nowadays is associated with computers, the design of computers and the use of computers in the business world, i.e. the scientific world, solving problems and in automation.

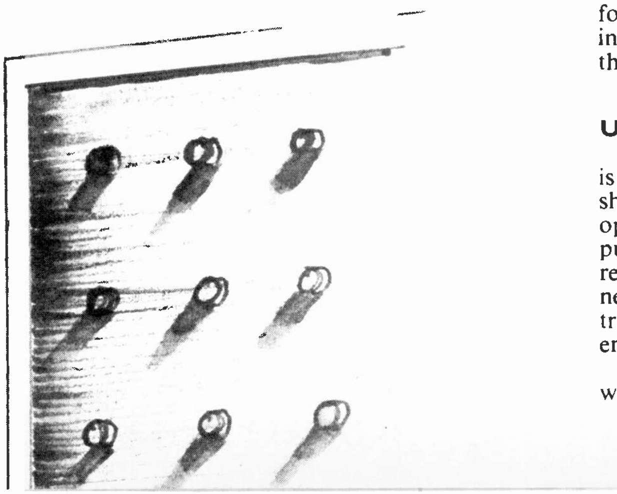
Pat joined an electronics firm at the age of 18 when they offered to sponsor her for a four year sandwich course in Applied Physics at City University. She worked for one year before her course started, and then spent alternate six month periods at College and at the firm, gaining practical experience in laboratory applications.

On graduating she decided to go in for programming, and she joined a project team in the Computing Research Laboratory, investigating the feasibility of computer aided design, in particular, the automatic production of a printed circuit master from a logic diagram.

SUSAN: COMPUTER AIDED DESIGN

Susan, too, works in computing. Unlike Pat she went for a full-time degree at Cambridge where she qualified as a physicist. Equipped with a degree, she moved into the computing industry. She became a project leader on computer aided design.

Women can also be found in production and in sales associated with electronics, the latter area involving much travel and liaison with customers.



THE WOMEN'S ENGINEERING SOCIETY

In the light of the success which these women have made as electronic engineers, what can be done to encourage more girls to take this up as a career?

The Women's Engineering Society (which celebrated its fiftieth anniversary last year) does a considerable amount of voluntary work in this direction. The Society is a group of women with a common interest in a profession which is still generally considered to be a male preserve, and with a desire to help other girls and women who would like to be engaged in engineering, including electronics.

The coverage of the membership of the Society is large including every branch of professional engineering and the allied fields of metallurgy, physics, chemistry, mathematics and even personnel work. It covers also the fields of technical and scientific teaching, of technical writing and information services, and of engineering factory inspection.

The two most important aims of the Society are

(i) To promote the study and practice of engineering among women, and

(ii) To enable technical women to meet and correspond and to facilitate the exchange of ideas respecting the interests, training and employment of technical women and the publication and communication of information on such subjects.

It has been responsible for launching in 1923 the Women's Electrical Association to "interest the non-technical woman in electrical development". The name was soon changed to the "Electrical Association for Women", and as the E.A.W. it has grown exceedingly, now having several thousands of members throughout the country.

UNIVERSITY SCHOLARSHIPS

This Society, the Caroline Haslett Memorial Trust, is a charitable body whose aims are to provide scholarships, travelling exhibitions and other educational opportunities for women who are seeking or already pursuing careers in the electrical industry or in other related fields requiring qualifications in science, engineering or domestic science. Among other things the trust awards university scholarships to girls in science, engineering and mathematics.

The Society maintains a list of engineering companies willing to train and employ women. A booklet on the training of women for engineering under the title "Training and Opportunities for Women in Engineering", is available from the Society's offices.

CAREERS ADVISORY COMMITTEE

The Society is actively engaged in careers work, taking part in conferences and exhibitions, contributing to careers conventions, giving talks at schools, answering careers enquiries, and giving advice and information on request to parents, careers teachers, Youth Employment Officers, and anyone who requires some guidance.

As a result of increasing government and public interest in women engineers, the Society has set up a Careers Advisory Committee as a Working Party to co-ordinate the Society's interests and activities in the fields of education, training and careers advice.

CAREER AND MARRIAGE

Why, you may ask, should girls train for a career when they will almost certainly marry, and have a family? Well, there are several reasons. Quite apart from the fact that all young people, irrespective of sex, should be encouraged to develop their capabilities to the full, it is worth knowing that already more than one third of the jobs in this country are held by women. Statistics show that the average young lady of the 1970's will have finished having her family by the time she is thirty, leaving another thirty years in which to fulfil herself in other directions. It is also worth remembering that many semi-skilled jobs are being taken over slowly but surely by automation.

All of the four girls described in this article married early in their careers, and have managed to find time for hobbies, home and husband (not necessarily in that order!) as well as their careers.

It is quite surprising how many women have entered electronic engineering through a maths or physics degree, or have graduated or otherwise qualified through alternative training schemes.

Electronics as a career can be hard work but the rewards are good in all senses. There are equal opportunities in the majority of firms today—*and* equal pay—so if you have a daughter who wants to help you when you're building that latest circuit, don't discourage her—you may have a budding electronics engineer in the family after all. ★

The following organisations may be approached for further information appropriate to this article:

- The Women's Engineering Society, and The Electrical Association for Women, 25 Foubert's Place, London, W.1.
- Central Office of Information, Hercules Road, London, S.E.1.
- Council of Engineering Institutions, 2 Little Smith Street, London, S.W.1.
- The Careers Centre, 42 Conduit Street, London, W.1
- Women's Employment Federation, 251 Brompton Road, London, S.W.3.
- Student Advisory Centre, 44 Albion Street, London, W.2.

NEWS BRIEFS

Radio Controlled Lunar Vehicle

The *Luna-17* automatic station soft landed on the moon in the area of the Sea of Rains on November 17. Installed on board was a self-propelled moon vehicle *Lunokhod-1*. This vehicle has made short excursions over the moon's surface under direct radio control from the Russian earth station, where a crew of six technicians "drive" the vehicle and monitor the data transmitted from the many scientific devices carried aboard.

A programme of scientific studies and tests is being carried out by this automatic station, including investigation of cosmic rays, panoramic survey of the terrain, analysis of the chemical and physical properties of the lunar surface soil and rock, and the measurement of different parameters inside the vehicle.

In December, following a 2-week hibernation during the lunar night, *Lunokhod-1* resumed exploration activities upon command from earth control.

100 Years of Telecommunications in the City

Sir Peter Studd, in entering his year as Lord Mayor of the City of London, has chosen Communications as a theme for his year of office. This is an appropriate choice, since 1970 marked the centenary of the Post Office responsibility for telecommunications. In 1870, the Post Office took over the inland telegraph system. Nine years later the first telephone exchange in Britain was opened in the City of London. There were 13 names in the first telephone directory.

Video Recording

Video recording is a fast moving business at the present time and we are constantly receiving news of new products, processes and business agreements. In our December issue we published an *Electronorama* feature on this subject and since then we have received news of a portable recorder from Akai—the VT100—and two new licence agreements made by the E.V.R. Partnership.

The V100 recorder is said to be the first fully portable record/playback video recorder and it uses ¼ inch tape. The Rank Organisation are marketing the complete Akai system consisting of the VT100 recorder, a camera with 4 : 1 zoom lens, clip on 3 inch monitor and batteries. The complete system costs £568 and a ¼ inch tape giving 20 minutes recording time costs £4. The VT100 is intended for non-domestic use and is shown below.

The E.V.R. Partnership have recently announced two licence agreements, one with Mitsubishi Electric of Japan for the manufacture and distribution of EVR teleplayers internationally (with the present exception of the USA and Canada), and a similar agreement with Hitachi Ltd. of Tokyo. The agreement with Hitachi was concluded first and preceded the Mitsubishi agreement by less than one week.

These new agreements with giants in the powerful Japanese electronics industry add immensely to the international strength of the EVR organisation. In Great Britain, Rank Bush Murphy has announced that it will bring its new colour teleplayer into full production early in 1971.

BOOK REVIEWS

THE MUSIC LOVER'S ALL-IN-ONE GRAMOPHONE BOOK

By Vivian Capel
Published by Focal Press Ltd.
196 pages, 7in × 4¾in. Price 15s (75p)

WITH a title brief like this the author has had to bend over backwards to compound an embracing 'all' in one slim volume. Whether he succeeds depends on the degree of technical sophistication of the music lover; certainly for the man who is a prospective equipment purchaser and who wishes to be led painlessly through the edge of the hi-fi jungle, this is a good buy.

From an opening chapter on the price versus quality aspect of reproducing equipment, the author goes on to examine sound and what constitutes music.

The translation of sound to disc, or the recording process is dealt with briefly with a succeeding chapter on simple stereo technicalities.

A comprehensive chapter on pickups and gramophone mechanics is simple and instructive, as is the chapter on amplifiers which also clarifies the bogey of specifications.

Loudspeakers and enclosures have a chapter to themselves and the advantages of earphones are discussed.

The remaining half of the book covers choice of equipment, improvements to existing equipment, practical hints on wiring, record selection and equipment maintenance.

Apart from a chapter describing the instrument members of the orchestra, which seemed rather misplaced in the context, I found this book both interesting and instructive.

G.G.

RADIO AND AUDIO SERVICING HANDBOOK

By Gordon J. King
Published by Newnes-Butterworths
283 pages 10in × 6½in. Price 60s (£3.00)

THE second edition of this established work contains most of the original material published in the 1965 and 1967 editions, but includes up-dated information relevant to recent design techniques. These include field effect transistors, integrated circuits, stereo broadcasting and reception, stereo amplifiers, tuner amplifiers, compact music systems, cassette recorders.

A great deal of general information and advice is given in a straightforward manner. Some sections on valve equipment have been retained because of the large quantity still in everyday domestic use.

Although transistor equipment is usually very reliable, there are occasions when an understanding of principles goes a long way to avoid accidental damage during servicing, the most likely cases being during the insertion of semiconductors and testing. Several examples of different types of circuit are given to explain these principles and assist with fault location.

M.A.C.

TUNERS AND AMPLIFIERS

By John Earl
Published by Fountain Press Ltd.
184 pages 8½in × 5½in. Price 42s (£2.10)

THIS is the first of a new series in the Fountain "How to Choose and Use" range of books. The author of this one uses his extensive background in the testing and description of commercial hi fi equipment to bring home to the hi fi enthusiast recent trends in equipment design in a very readable manner.

Technical descriptions are given in very plain language, so that the reader can attempt to unravel the many expressions appropriate to the subject.

Circuit design has progressed quite considerably during the past five years or so. In fact, much of the criticism levelled at transistor tuners and amplifiers in the past can be answered in the newest designs to be made available. Examples are the improved performance and reliability from the use of integrated circuits, varicap diodes for tuning, field effect transistors for front end amplification, inter-station muting, ceramic "crystal" i.f. resonators, overload protection circuits.

The merits of these and alternative designs are described in some detail. For those readers who have some background in audio and radio techniques, this book will help to up-date the image of quality sound reproduction, where it may have previously become prejudiced by old well-established valve equipment.

M.A.C.

DICTIONARY OF TELECOMMUNICATIONS

By R. A. Bones
Published by Newnes-Butterworths
200 pages. 7½in × 5in. Price 45s (£2.25)

AS stated in the title, this dictionary is concerned basically with telecommunications and only relates to associated electronic fields such as radio broadcasting and television where these fields overlap. However, taking into account the specified field of the book, one gets the impression that there can be very few terms not listed or adequately described by Mr Bones. In his preface he states that he gives the most recent terminology and that at the time of going to press the dictionary was as up to date as possible, and this is evident from the text.

Terms consisting of two or more words are adequately cross referenced and the descriptions given are concise if a little basic in some cases. No lengthy descriptions on operation of components or instruments are given, simply a description of the item and its function. A comprehensive and useful book for students and engineers alike.

M.K.

RADIO AND TELEVISION YEAR BOOK 1970/71

Edited by Eric Ickinger
Published by IPC Electrical-Electronic Year Books Ltd.
226 pages 8¾in × 5½in. Price 20s (£1.00)

TELEVISION has been included in the title of this, the third edition, colour and monochrome receivers being listed. Special attention is given to the "unit audio" type of system up to about £150. An introductory article on this subject is given at the beginning of the book. These and other equipments are listed with specifications and prices on the same lines as in the Hi Fi Year Book, and include radio and television receivers, tape recorders and record players.

SONIC OBSTACLE

In this, the second and final article, the construction of the various sub-assemblies, setting up and final calibration of the locator will be dealt with.

TRANSMITTER CIRCUIT PANEL

The layout and underside connections of the transmitter panel is shown in Fig. 9. Here a 4·1in by 1·7in Veroboard is bolted to a 3in by 1·8in sheet of 16 s.w.g. aluminium, which acts as a heat sink for TR7, and a mount for the transformer T1.

The complete transmitter panel assembly is bolted to the baseplate of the aluminium box by means of screws and stand-off spacers; this method of mounting also applies to the receiver circuit panels.

Drill holes to accept mounting screws for T1, and TR7. The two holes, where the circuit board bolts to the heat sink, should be reinforced with a solder tag soldered to the copper strip.

TRANSFORMER ASSEMBLY

To prepare transformer T1, first remove the bobbin from inside the pot core by undoing the four clamp screws, taking care not to drop or otherwise damage the ferrite pot. Wind on by hand two layers (15 turns) of 20 s.w.g. enamelled copper wire for L2, and secure with a layer of plastics insulating tape. Slip red and blue sleeving onto the L2 leads, as shown in Fig. 10a.

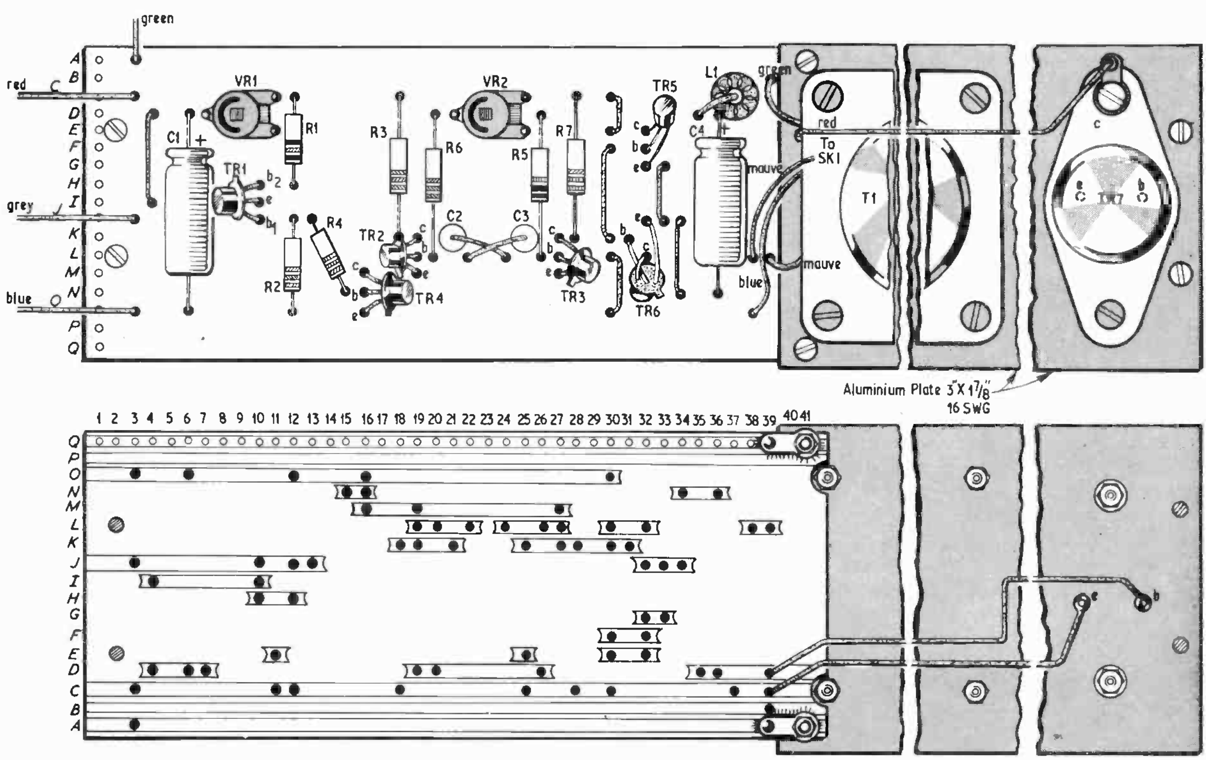
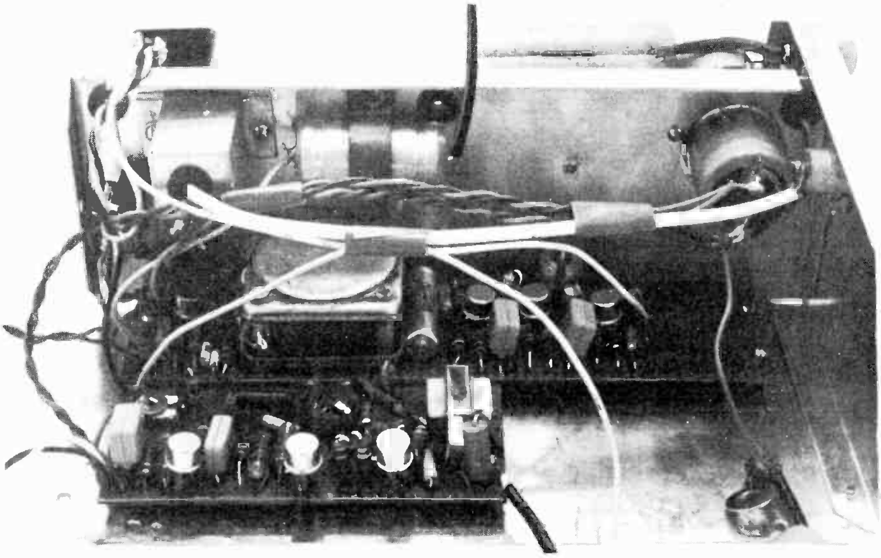


Fig. 9. Component layout and underside connections for transmitter panel

LOCATOR By D. Bollen



View of the sonic locator interior showing the tuned amplifier panel and the decoder, the latter in the foreground. The transmitter panel is screened by the metal partition and so prevents circuit interaction. This can be seen more clearly in Fig. 13

L3 consists of four layers of the same wire (30 turns) similarly secured with tape, and with mauve and green sleeving on the leads.

Bolt the assembled transformer to the heat sink, and mount TR7 complete with mica insulating washer, spacers, and collector solder tag.

When components have been assembled on the Veroboard, scrape the enamel off the ends of T1 leads, tin them, and insert in appropriate holes in the circuit board, then bolt the board to the heat sink and complete all wiring.

PRELIMINARY TRANSMITTER TESTS

Connect a small 3 ohm loudspeaker to the green wire from the transmitter circuit panel and the mauve wire from T1. Place a non-polarised capacitor of about 4μF in parallel with the loudspeaker.

Rotate VR1 and VR2 to the mid-track position, then join red and blue wires to a 12V battery. If the transmitter is working correctly, regular, loud clicks should come from the loudspeaker.

To check transmitter output, measure the peak to peak amplitude of the output at the loudspeaker with an oscilloscope, and convert the result to r.m.s.

If an oscilloscope is not available, temporarily short the collector and emitter of TR4. Connect an a.c. voltmeter across the speaker, and re-connect the battery leads briefly. If all is well, an output in the region of 10–15V r.m.s. will be obtained.

Bearing in mind that the circuit is intended for pulsed operation, do not leave the battery connected for more than a few seconds while TR4 is shorted, otherwise the loudspeaker and output transistor could overheat.

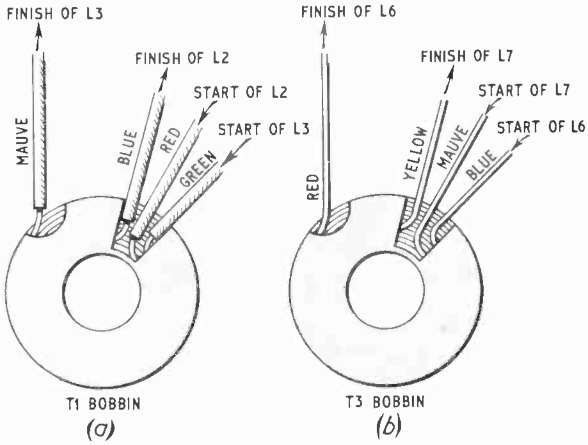


Fig. 10. (a) Coloured sleeves applied to T1 leads for identification; (b) sleeves applied to T3

TUNED AMPLIFIER CIRCUIT PANEL

Drill mounting holes in the 6·9in by 1·6in amplifier Veroboard panel, according to Fig. 11.

An easy method of winding transformer T3 bobbin is as follows. A mandrel to take the bobbin is made by cutting a short length of dowel and inserting a twist drill tightly in its centre. If the dowel is a sloppy fit in the bobbin hole, it can be built up with Selotape.

With the mandrel twist drill gripped in the chuck of a hand-drill, which is mounted horizontally in a vice, L6 and L7 turns can be wound on quickly.

The fine 40 s.w.g. enamelled wire used for the T3 windings needs to be terminated by soldering on leads of thin, multi-stranded (7/40) plastics covered wire; the joints thus made should be insulated with small pieces of plastics tape.

Starting with a mauve lead, wind on as evenly as possible 500 turns of 40 s.w.g. wire for L7. Finish off with a yellow lead, and secure the winding with tape.

L6 starts with a blue lead and consists of 100 turns of 40 s.w.g. wire wound *in the same direction* as L7, and is then terminated with a red lead. Bobbin details for T3 are given in Fig. 10b.

After gluing the completed transformer to the Veroboard, proceed with the assembly of the other components.

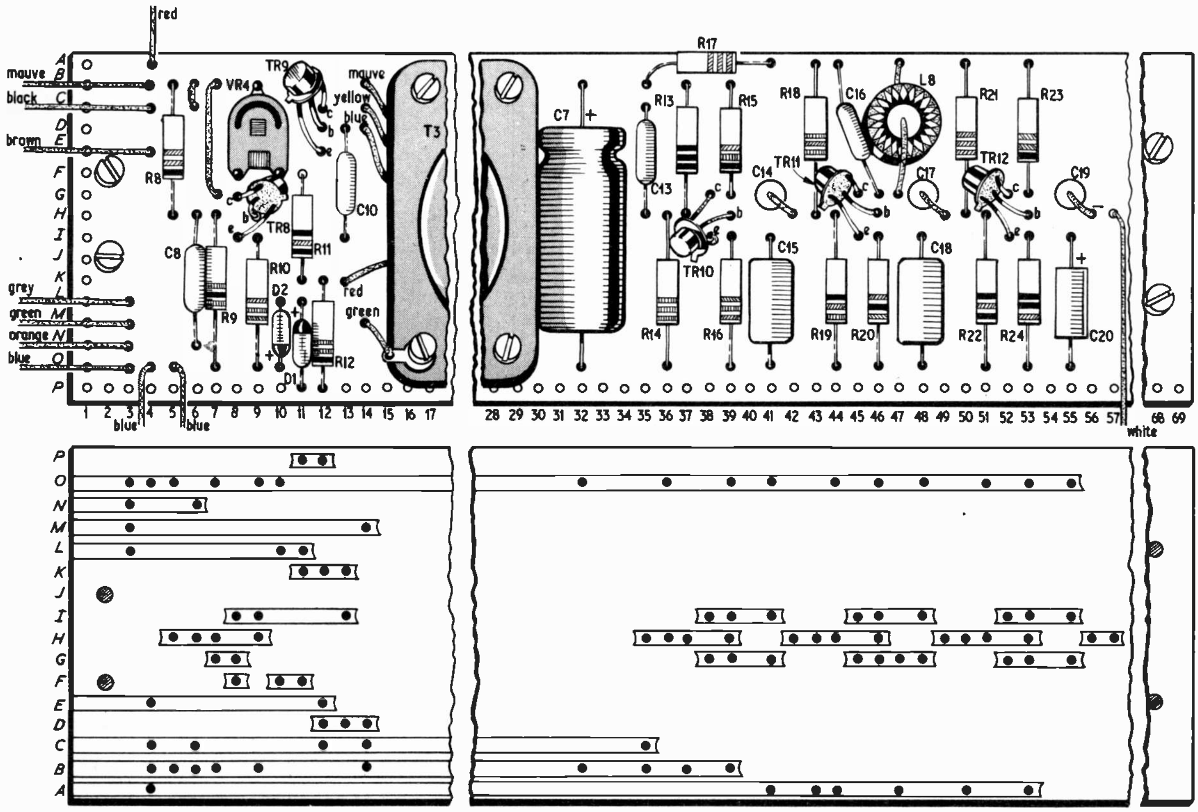


Fig. 11. Component layout and underside connections for tuned amplifier panel

PRELIMINARY TUNED AMPLIFIER TESTS

For the purposes of the following tests, the tuned amplifier circuit panel can be laid on a table top with the associated controls grouped around it.

Referring to Fig. 13, solder black and mauve circuit panel wires to TC1 and C12; blue and brown wires to VR5 and C11, and orange and blue wires to the screened cable of a 50 kilohm output impedance moving coil microphone. Note that the cable outer screen should connect to the blue wire.

Modifications to the microphone will be described later in the article.

Green and grey wires are left disconnected during the following tests. First, place a milliammeter in series with the red wire and the positive terminal of a 12V battery, then touch the remaining blue wire to the negative battery terminal. When assured that the amplifier current consumption is around 4mA, the milliammeter can be removed.

USING THE TELEVISION SET

Position the microphone close to a 405 line television set, first making sure that the amplifier panel is some distance away to prevent stray inductive pick up from the TV line transformer.

Clip an a.c. voltmeter onto the white amplifier output lead and to battery negative, and re-couple the red lead to battery positive. With VR5 at half-track the a.c. voltmeter should read zero.

If there is a steady meter reading this will be caused by tuned amplifier instability. To minimise unwanted stray feedback, rearrange the meter leads and microphone cable, and slightly reduce the VR5 setting.

Now switch on the TV set and, with the volume control at minimum, obtain a steady picture. A 10·125kHz sound signal, picked up from the line transformer by the microphone, should now cause the a.c. voltmeter to read somewhere in the region of 1–4V. Tune the amplifier by adjustment of TC1 for a peak in output voltage.

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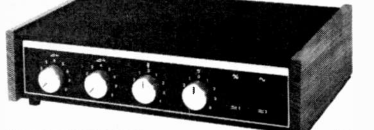
10 + 10 STEREO AMPLIFIER KIT



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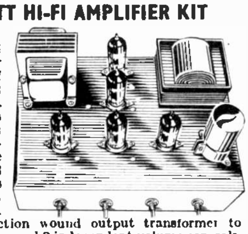

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 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 EZ80 rectifier. Simple instruction booklet 2/6 (Free with parts). All parts sold separately. ONLY £7.19.6. P. & P. 8/6. Also available ready built and tested complete with std. input sockets, £9.19.6. P. & P. 8/6.

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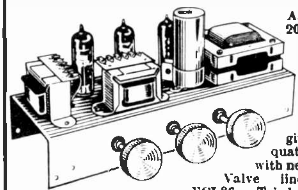

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HIGH GAIN 4 TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT
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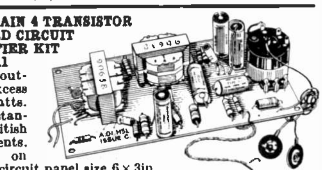

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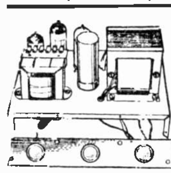

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4½in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only £4.15.0. P. & P. 6/-.

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As a double check, to make sure that there is no spurious oscillation from the unscreened tuned amplifier, and that the amplifier is really responding to the signal, alter the timebase frequency by adjustment of the TV line hold control, whereupon the whistle note will change and the amplifier output voltage should drop.

The tuned amplifier is now ready for final assembly and the flexible, coloured leads can be unsoldered from the potentiometers and trimmer capacitor. Avoid altering the TC1 setting.

Make up the chassis and mark all panels for later identification, not forgetting the screen partition, then dismantle it completely.

Take the box baseplate and mark and drill mounting holes for the three circuit panels. Ensure that there will be sufficient clearance between the decoder panel and the crystal insert X2.

Fix the tuned amplifier and decoder circuit panels to the baseplate, with lockwashers under the mounting nuts, but leave the transmitter panel unmounted for the time being.

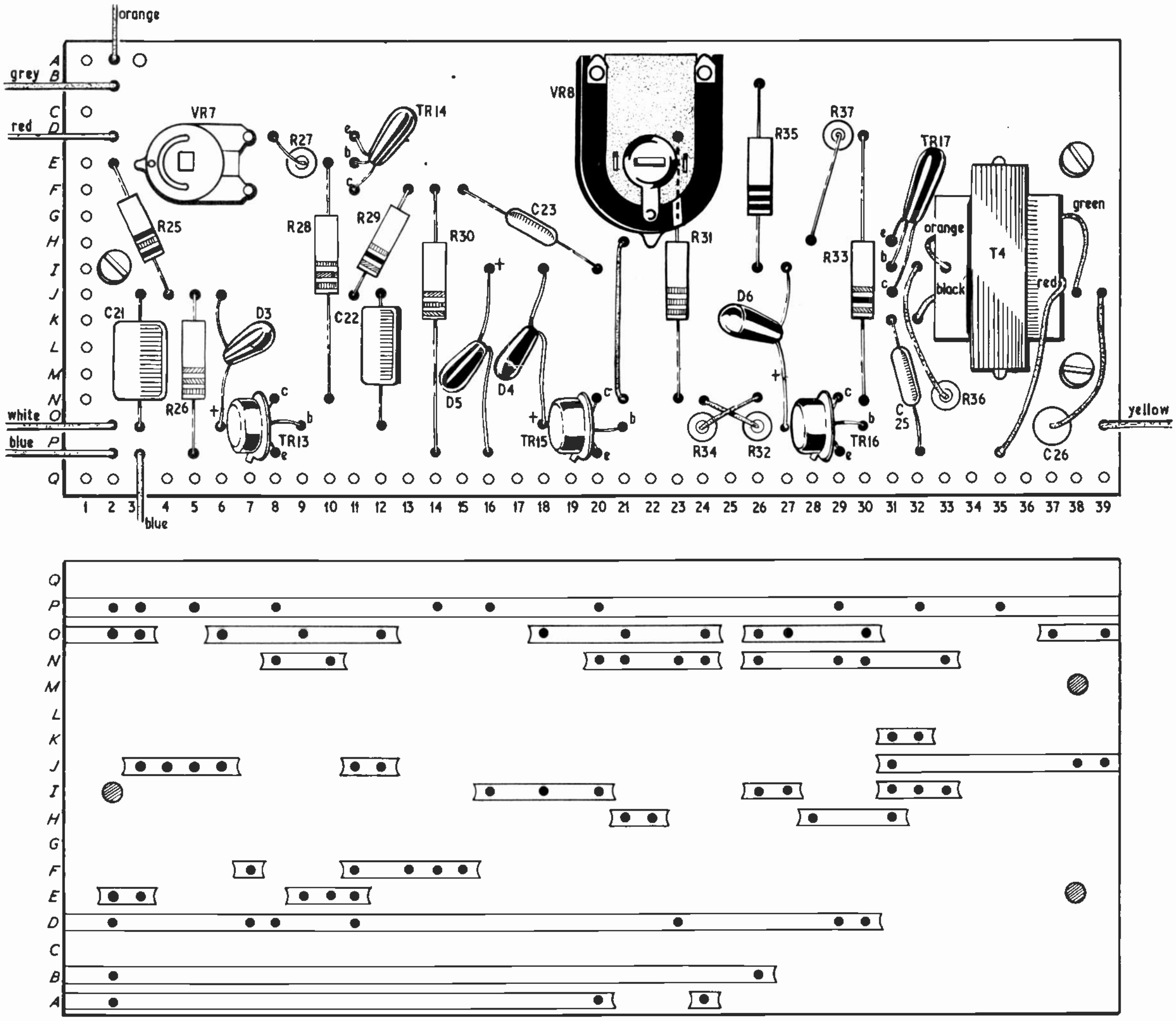

Fig. 12. Component layout and underboard wiring for decoder panel

DECODER CIRCUIT PANEL

The decoder panel layout appears in Fig. 12, and construction of this unit is quite straightforward. Holes are drilled to accept mounting screws, and existing holes are enlarged to take VR8 and T4 tabs.

The finished decoder can only be tested after final assembly.

FINAL ASSEMBLY

Details of the internal arrangement of the chassis housing, the circuit panels and other components are given in Fig. 13.

Drill the front panel according to Fig. 14; if desired, an identically drilled plastics laminate faceplate can be glued to the front panel to enhance the finished appearance. Mount VR3, VR5, and VR6, also the meter, on the front panel. Glue a small square of loudspeaker grille material to the inside of the crystal insert front panel aperture, then glue X2 to the grille.

SCREEN PARTITION

Drilling details will not be given for the screen partition as the size of components used for T2, C5, C6, and C9 may vary.

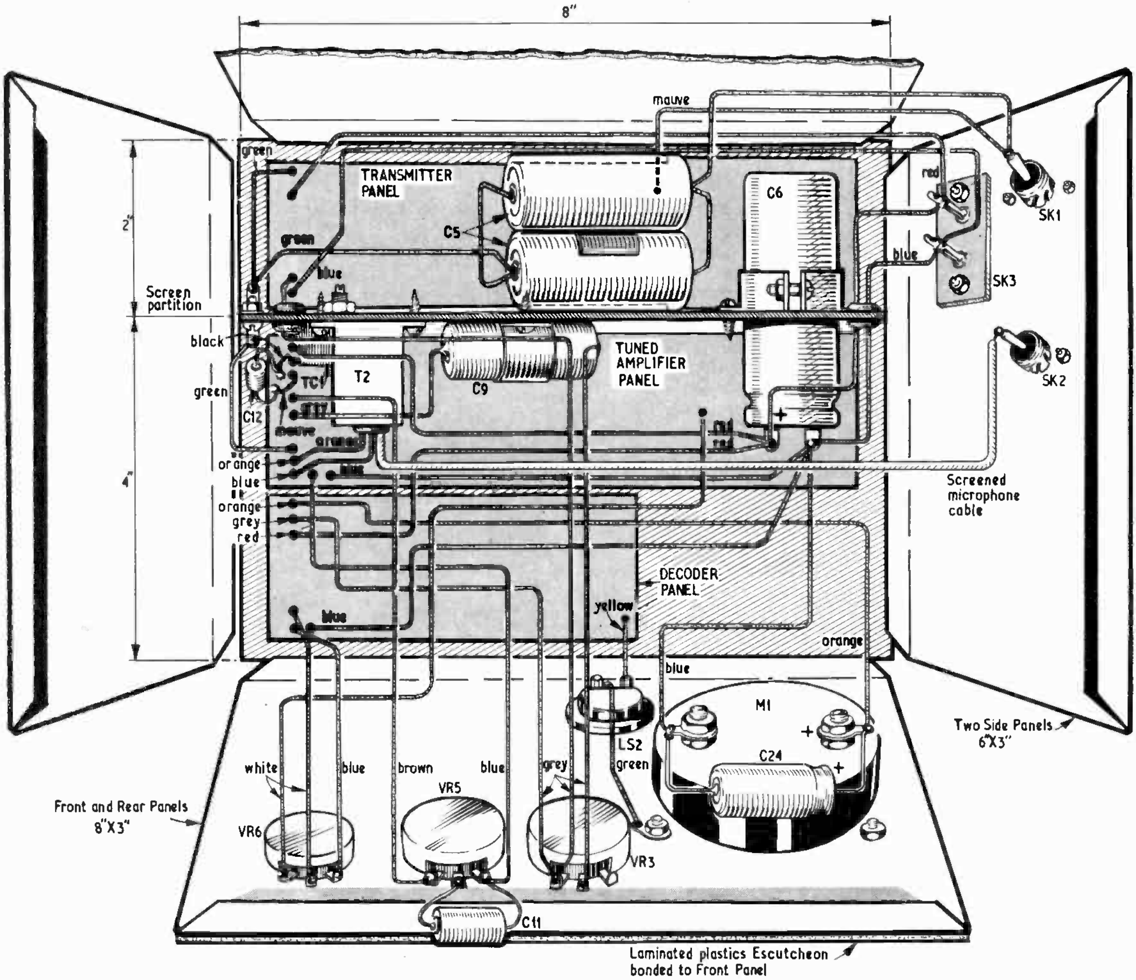

Fig. 13. Internal arrangement of plate mounted components and panel boards on chassis

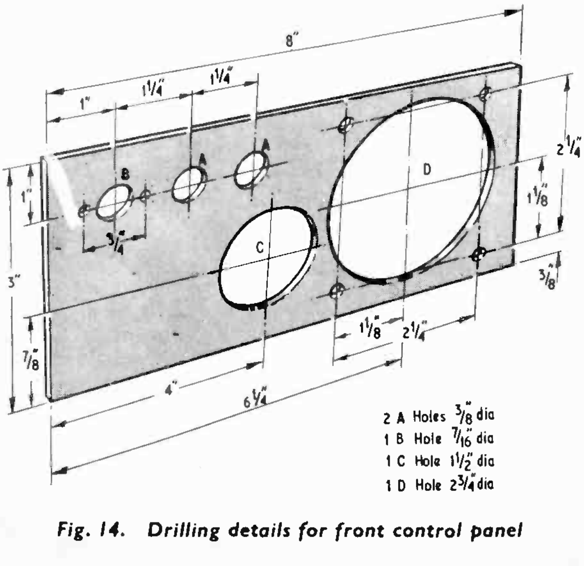

Fig. 14. Drilling details for front control panel

It is obviously a simple matter to find the best position for components on the partition when circuit panels and partition are in place on the baseplate; then the partition can be removed for drilling.

With the prototype, T2 was taken from inside a moving coil stick microphone (see Fig. 16), and was then enclosed in an old I.F. transformer can.

To obtain maximum transmitter output, C5 must be adjusted in value to suit individual loudspeaker resonances. A single 2μF capacitor can be mounted in the C5 position on the partition, and can be padded later by wiring another capacitor in parallel, as depicted in Fig. 13.

Mount the front panel, partition, transmitter circuit panel, and right-hand box side with sockets on the baseplate, then proceed with all interconnecting wiring. The remaining box side panels and top plate are left off until after the unit has been tested and calibrated.

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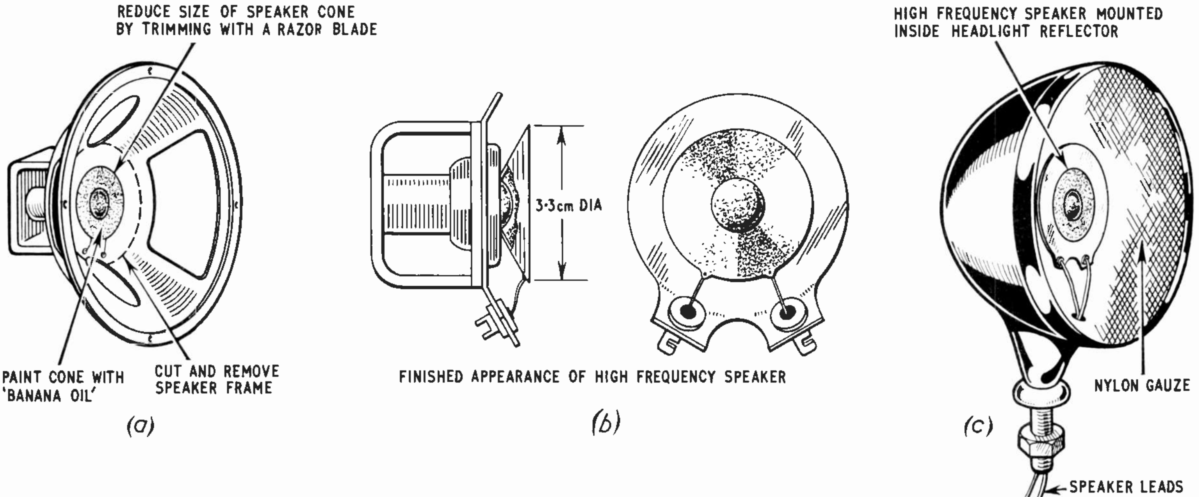


Fig. 15. (a) Cutting and preparing a small loudspeaker; (b) views of the finished 10kHz radiator; (c) the radiator mounted in a car headlight

TRANSMITTER LOUDSPEAKER

If there is a choice of small 3 ohm loudspeakers, select one that gives the loudest output when coupled to the sonic transmitter.

With a sharp razor blade or modelling knife, cut away the outer section of the loudspeaker cone (see Fig. 15a) taking care not to sever the pigtail leads leading to the voice coil. The remaining part of the cone, Fig. 15b, should be close to 3.3cm diameter—the wavelength of 10kHz sound—and is stiffened by applying two or three coats of modelmaker's banana oil.

The loudspeaker metal frame should also be cut away with tin snips or a hacksaw, but make sure that iron filings are not collected by the loudspeaker magnet.

A suitable mount for the high frequency loudspeaker is a car headlamp as shown in Fig. 15c. The headlamp reflector will not make a significant contribution to the loudspeaker directional characteristic but side and back radiation will be reduced if the headlamp interior is filled with acoustic wadding or felt.

Protection against small flying stones is afforded by nylon gauze across the front of the reflector, attached to the headlamp rim.

RECEIVER MICROPHONE

Fig. 16 shows how a conventional dynamic microphone can be converted for use with the Obstacle Locator. After completely dismantling the microphone, the rear of the "stick" is cut away. The microphone transformer is removed for use as T2.

Holes to take three screw eyes are drilled 120 degrees apart around the microphone casing, and a hole is also drilled to take the microphone cable.

Epoxy resin glue can be employed to retain the screw eyes, as well as the aluminium disc which is inserted to block off the opening in the end of the casing.

When re-assembling the microphone after soldering the screened cable to the insert terminals, fill the inside of the casing with plastic foam material.

HEADLAMP MOUNTING

The microphone is suspended at the focus of a parabolic headlamp reflector by rubber bands; facing inwards towards the back of the reflector as shown in Fig. 17. Other forms of mounting were tried, but the rubber band method gave better noise rejection.

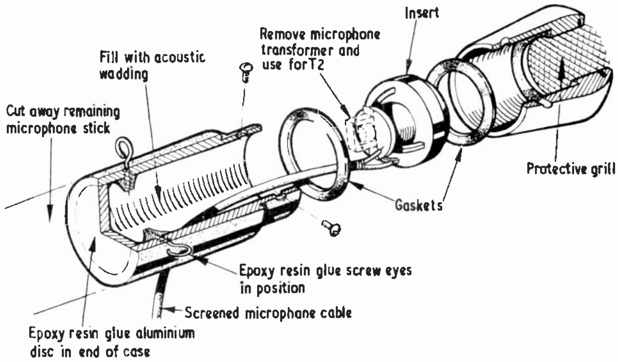


Fig. 16. Converting a dynamic stick microphone for use as a receiver

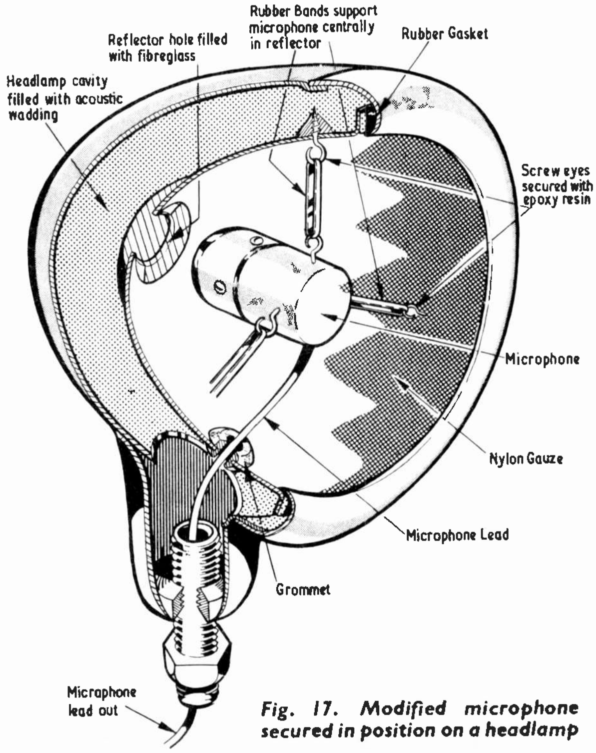


Fig. 17. Modified microphone secured in position on a headlamp

Before preparing the headlamp, measure the distance from the bulb filament to the back of the reflector, to find the focal point. Fill the hole in the back of the reflector with a fibreglass compound, and sandpaper when dry to conform with the reflector contour.

Position the microphone diaphragm at the focal point of the reflector and mark the location of holes for the reflector screw eyes, opposite those on the microphone casing, and in the same vertical plane.

Fix the screw eyes to the reflector and drill a hole to take the microphone cable, then attach the microphone to the reflector with rubber bands.

As with the loudspeaker, nylon gauze covers the opening in the headlamp to protect the microphone. Finally, fill the inside of the headlamp with acoustic wadding.

It is difficult to fully waterproof both headlamps without reducing efficiency, therefore, when the Obstacle Locator is not being used the headlamps should be covered with thick polythene bags.

SETTING UP

As a preliminary to setting up the Obstacle Locator, adjust VR1, VR2, and VR5 to a mid-track setting; VR3 to minimum resistance; VR4 and VR7 to maximum resistance; and rotate VR6 fully anti-clockwise.

Leaving loudspeaker and microphone plugs disconnected from SK1 and SK2, couple the power supply to SK3, making sure that the aluminium chassis is earthed either to the positive or negative supply rail, and switch on.

Set VR8 to give a full scale meter reading.

In the absence of a signal (VR6 fully anti-clockwise) full scale deflection of the meter needle indicates battery condition.

With VR5 and VR6 rotated fully clockwise, an almost continuous note should be heard from the crystal insert X2 and the meter reading will drop to almost zero. Back off VR5 to just beyond the point where the note ceases and the meter again reads full scale.

CALIBRATION

Find an open area of ground with a fairly flat surface, uncluttered by large stones and other objects. Position loudspeaker and microphone headlamps side by side, about 18in off the ground, and facing some large reflective object at exactly 20 feet distance.

Rotate VR6 fully anticlockwise, but do not alter any other settings. Connect up the loudspeaker cable to SK1, microphone cable to SK2, and power supply to SK3, and switch on.

Advance VR6 slowly until a regular bleep note is heard from X2, and the meter reading drops to somewhere near 20.

Calibrate by means of VR1 for an exact meter reading of 20.

No difficulty should be experienced in obtaining a response at 20 feet, even with the transmitter off tune. If an echo is not received, try connecting a pair of high impedance headphones across the track of VR6, to the tuned amplifier output. A regular click from the transmitter output will be clearly audible.

Now adjust tuning control VR2 and listen for additional echo clicks at a particular setting of VR2. If necessary, also trim TC1, VR7, and VR5 for a response.

SENSITIVITY ADJUSTMENT

The purpose of the next test is to establish optimum sensitivity. An oscilloscope can be coupled to the tuned amplifier output to display echo waveforms and noise levels, but failing this, the following procedure should be adopted.

Set up loudspeaker and microphone 50 feet away from a large wall, in an area free from other echo producing objects.

Switch on, then, with VR6 set fully clockwise, rotate VR7 until a response is obtained. The meter should now read 50 and the mark-space ratio of the bleep from X2 will be equal.

Back off VR6 to the point where the signal ceases. Now adjust VR2, VR7, and VR5 for maximum response at the lowest possible setting of VR6. Also try placing various capacitors in parallel with C5 to bring up the transmitter sonic output.

It will be found that, when the loudspeaker and microphone are close to the ground, back-scatter echoes will be received, if the surface is at all rough, when VR3 is turned anti-clockwise. The range of back-scatter control presented by VR3 is fixed later by suitable adjustment of VR4.

Finally, see if a strong signal can be received from a large wall or a building at 95 feet distance; in this case the note from X2 will be of such short duration that it sounds like a click.

USING THE LOCATOR

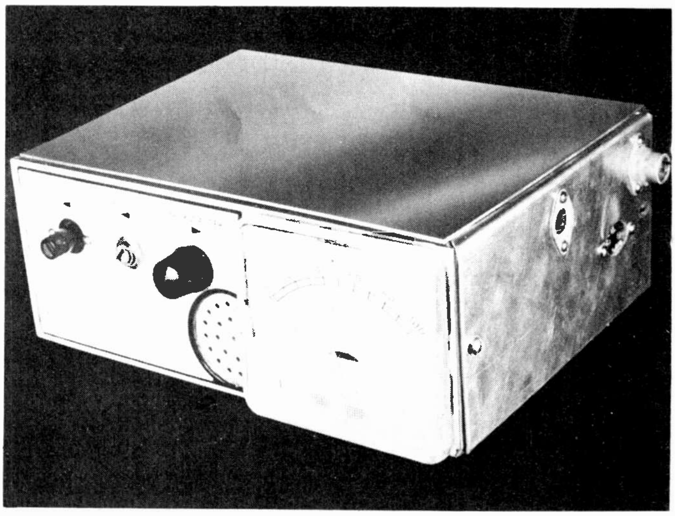
In uncluttered conditions, where the equipment is working over a smooth area of water or tarmac, and the best possible response to small objects at near distances is desired, set VR4 to mid-track and advance VR3 until a suitable response is achieved.

Where there are numerous small objects in front of the loudspeaker transducer, VR3 should be left at minimum resistance.

The only control likely to need adjustment under operating conditions is VR6. In difficult, built-up areas for example, VR6 will be set low, to avoid spurious echoes, but in more open situations a high setting of VR6 will give long range working.

When visibility is constantly changing, the equipment can be left ready on stand-by with VR6 rotated fully anticlockwise.

If the Sonic Obstacle Locator is to be used at sea, adequate precautions must be taken to thoroughly moisture proof all aluminium parts against corrosion, including the interior of the microphone unit; this can be done with a varnish. ★



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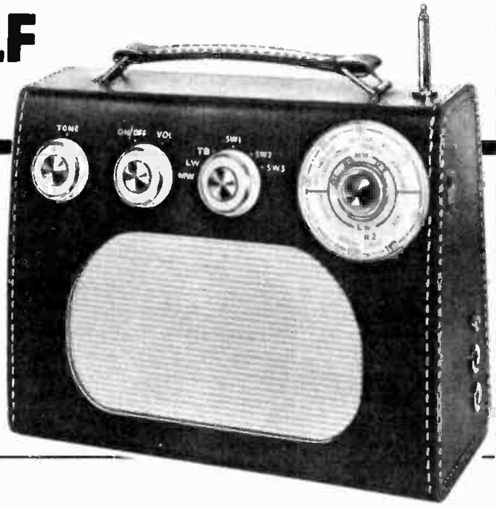

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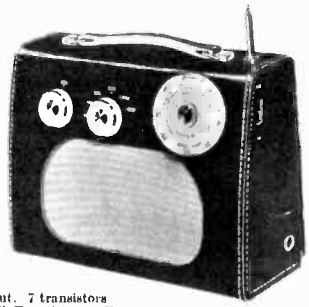
Total building costs £6.19.6 P. & P. 7/6 Overseas P. & P. 17/-

roamer seven mk IV



7 FULLY TUNABLE WAVEBANDS—M.W.1, M.W.2, L.W., S.W.1, S.W.2, S.W.3 and Trawler Band. Extra Medium waveband provides easier tuning of Radio Luxembourg, etc. Built in ferrite rod aerial for Medium and Long Waves. Retractable 4 section 24in chrome plated telescopic aerial for peak Short Wave listening. Socket for Car Aerial. Powerful push-pull output. 7 transistors and two diodes including Micro-Alloy R.F. Transistors. Famous make 7 × 4in P.M. speaker. Air spaced ganged tuning condenser. Volume/on/off control, wave change switches and tuning control. Attractive case with carrying handle. Size 9 × 7 × 4in approx. Easy to follow instructions and diagrams make the Roamer 7 a pleasure to build. Parts price list and easy build plans 3/- (FREE with parts).

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Personal Earpiece with switched socket for private listening, 5/- extra.

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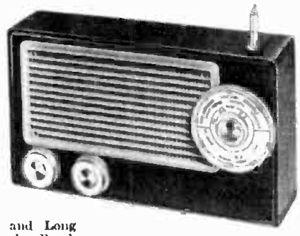

SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive case in black with red grille and black knobs and dial with spun brass inserts. Size 9 × 5½ × 2¾in. approx. Tunable on Medium and Long Waves, 3 Short Waves and Trawler Band. Sensitive ferrite rod aerial for M.W. and L.W. Telescopic aerial for Short Waves. 8 improved type transistors plus 3 diodes. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 5/- (FREE with parts).

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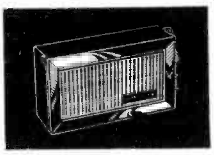
pocket five



MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive black and gold case. Size 5½ × 1½ × 3½in. Tunable over both Medium and Long Waves with extended M.W. band for easier tuning of Luxembourg, etc. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).

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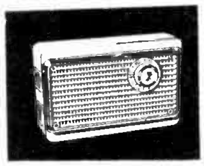
transona five



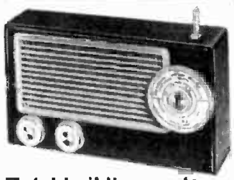
MEDIUM WAVE, LONG WAVE AND TRAWLER BAND PORTABLE WITH SPEAKER

Attractive case with red speaker grille. Size 6¾ × 4½in × 1½in. 7 stages—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone moving coil speaker. Easy build plans and parts price list 1/6 (FREE with parts).

Total building costs 47/6 P. & P. 3/9

Overseas P. & P. 10/-

IMPROVED MODEL! roamer six



SIX WAVEBAND PORTABLE WITH 3in. SPEAKER

Attractive black case with red grille and black knobs and dial with spun brass inserts. Size 9 × 5½ × 2¾in. approx. Tunable on Medium and Long Waves, two Short Waves, Trawler Band plus an extra M.W. band for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and latest telescopic aerial for Short Waves. Improved circuit. 8 stages—6 transistors and 2 diodes including Micro-Alloy R.F. Transistors, etc. Easy build plans and parts price list 2/- (FREE with parts).

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DIGI-CLOCK

By R. W. Coles **Part 3**

THIS month we give details of the alarm board construction, discuss the power supplies, and give the high voltage regulator board details.

CONSTRUCTION OF BOARD "B"

The wiring of the alarm board follows the same general principle as that employed with the clock board described last month. In this case there are a large number of discrete components and it must be admitted that wiring up is quite tricky because of this.

It is best to construct the regulator first and test its operation before attempting the alarm circuit; the connection diagram for this circuit is given in Fig. 13. Note that there are three breaks to be made in the printed copper power supply strips, so that these tracks can be used for other connections, and also that the wire to the 200V supply does not pass through the edge contacts.

In all there are two wires which leave the board in this way, due to the shortage of edge contacts on the 22-way version used in the prototype. If desired the DL109/44 type of "Dualine" card could be used to prevent this.

REGULATOR TESTS

To test the regulator it is desirable to have the power supplies already built, but any power supply providing the correct voltages can be used. It is also possible to drive the 12V bias line from a 20V supply if a 680 ohm resistor is used instead of the 15 kilohm R14 required when a 200V supply is employed.

The MJE521 power transistor is mounted on the chassis near the regulator, and is insulated with a mica washer which should be supplied with the device. A smear of silicon grease on either side of this washer helps heat transfer and should be used if available.

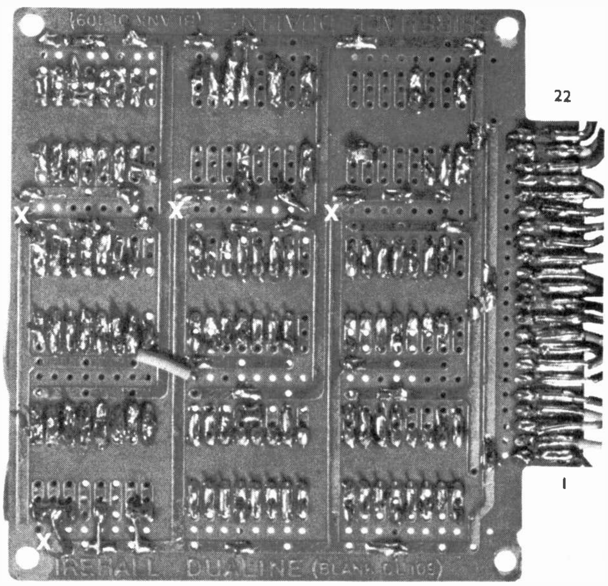
This transistor is much easier to mount compared with the traditional TO-3 packaged devices, only a single hole being required, facilitating its attachment to a temporary heat sink if desired for testing purposes —remember to bolt the transistor down with the brass collector tab next to the heat sink, and do not forget the washer.

When the test arrangement is wired up, connect the power supplies and monitor the output voltage, which should be somewhere between 3 and 8V. Adjust VR1 to obtain the required 5V, preferably with a load of about 20 ohms connected.

If all is well, decrease the load to about 4 ohms; the output voltage should drop under the control of the current limiter. As the final test, short out the output while monitoring the current. The output voltage will drop to zero, and with any luck the current will drop to about 400mA. If it does not, there is probably something wrong with the wiring, and you may need a new output transistor.

ALARM CIRCUIT WIRING

When the regulator is tested and performs satisfactorily, the wiring of the alarm circuit can be carried out, first the package interconnections, then the discrete components and finally the wiring to the edge connector. The wiring on the plain side is shown in Fig. 13 with the edge connector wiring. Testing this circuit is difficult to achieve in isolation, and in this case it is better to wait until the clock is nearing completion. There is no reason why the alarm oscillator should not be checked with an oscilloscope or even an earphone.



Underside view of the Alarm Board B showing positions of cuts in copper strips at four places marked X

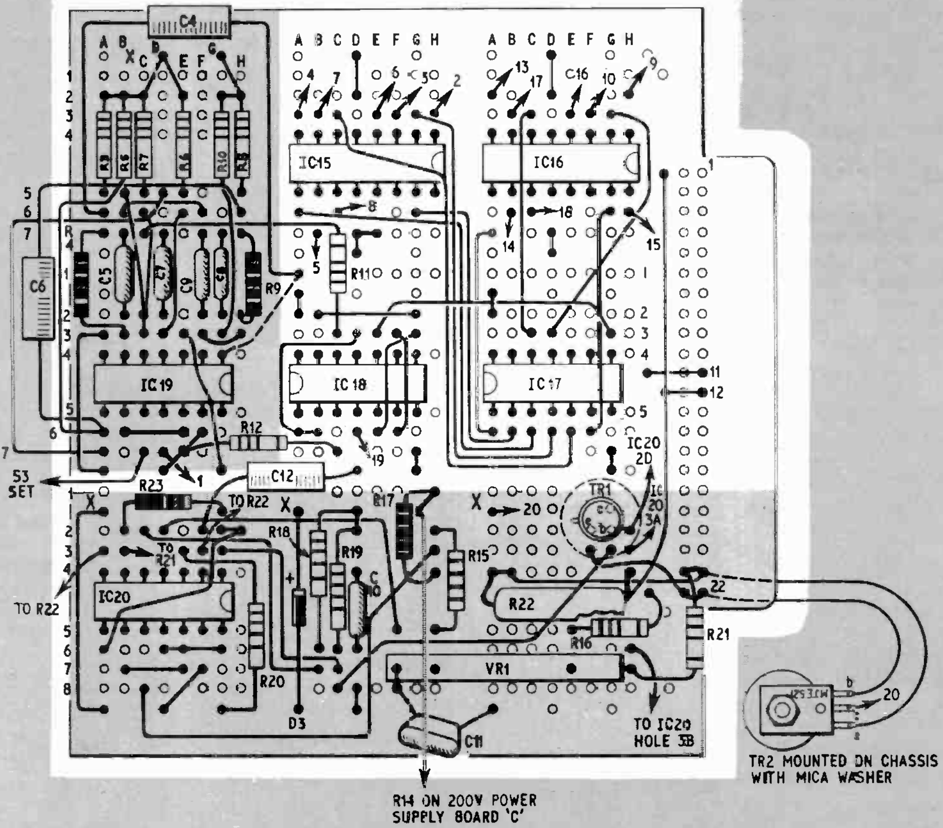


Fig. 13. Layout and wiring of the complete Board "B" incorporating the alarm circuit and 5V regulator

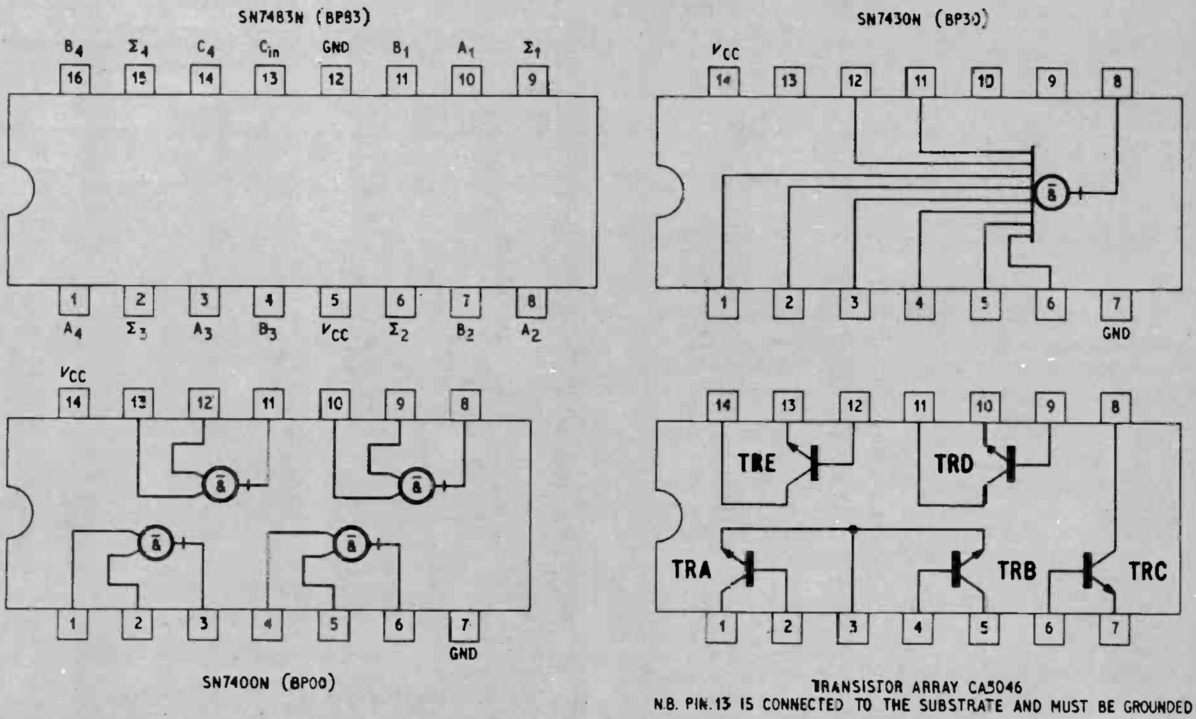


Fig. 14. Integrated circuit diagrams and pin connections for Board "B"

ELECTRIC CLOCK WITH 25 AMP SWITCH

Made by Smith's, these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only **39/6**, less than the value of the clock alone—post and insurance 2/9.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. **19/6**. Kit B—30-40 w. **19/6**. Kit C—80 w. **23/6**. Kit E—65 w. **23/6**. Kit F for 8ft. 125 w. tube **35/-**. Kit MF1 is for 6 in., 9in. and 12in. miniature tubes, **19/6**. Kit MF2 for 21in. 13 w. miniature tube, **20/-**. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit F 6/6 then 4/6 for each kit ordered. Kit MF1 3/6 on first kit then 3/6 on each two kits ordered.

BLANKET SWITCH

Double pole with neon let into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. **5/6** each. 3 heat model **7/6**.

BLANKET SIMMERSTAT

Although looking like, and fitted as an ordinary blanket switch, this is in fact a device for switching on for varying time periods, thus giving a complete control from off to full heat. Although suitable for controlling the temperature of any other appliances using up to 1A. Listed at **27/6** each we offer these while our stocks last at only **12/6** each.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature. 1in long × approximately ⅛in diameter. Will make and break up to ½A up to 300 volts. Price **2/6** each, **24/-** dozen.
Standard. 2in long × $\frac{3}{16}$in diameter. This will break currents of up to 1A, voltages up to 250 volts. Price **2/-** each, **18/-** per dozen.
Flat. Flat type, 2in long, just over $\frac{1}{16}$in thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1 amp 200 volts. Price **6/-** each. **£3** per dozen.
Small ceramic magnets to operate these reed switches **1/9** each. **18/-** dozen.

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500 mfd. 12V, **2/-** each **£1.1.0** doz.
500 mfd. 25V, **3/6** each **36/-** doz.
500 mfd. 50V, **4/6** each **48/-** doz.
500 mfd. 350V, **8/6** each **£4.10.0** doz.
1000 mfd. 12V, **3/-** each **£1.10.0** doz.
1000 mfd. 18V, **3/4** each **34/-** doz.
1000 mfd. 64V, **7/4** each **80/-** doz.
2000 mfd. 25V, **6/8** each **79/-** doz.
5000 mfd. 12V, **4/9** each **£2.8.0** doz.
10,000 mfd. 6V, **5/9** each **£3.0.0** doz.
10,000 mfd. 15V, **8/6** each **£4.10.0** doz.
15,000 mfd. 10V, **10/6** each **£5.0.0** doz.
60,000 mfd. 8V, **22/-** each **£10.0.0** doz.
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3 AMP 12V BATTERY CHARGER KIT—comprising 230/40 mains transformer with 3 amp secondary and 3 amp rectifier **22/6** + 4/6 post.
12V 1½ AMP POWER PACK. This comprises double-wound 230/240V. mains transformer with full wave rectifier and 2,000 m.f.d. smoothing. Price **27/6**.
SONOTONE STEREO CARTRIDGE. Turnover type, ref. No. 19 T1. This fits most British pick-ups and is a really excellent reproducer. Limited quantity, **19/6**.
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DITTO WITH SWITCH. 12 for £1 plus 4/6 post.
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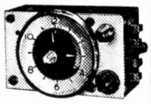
100 ASSORTED SILICON RECTIFIERS G.P. AND SWITCHING DIODES. Small and very small sizes. A real snip for experimenters, **12/6** per 100.
MAINS SUPPRESSION ADAPTOR for preventing mains interference caused by vacuum cleaners, razors, sewing machines, etc, rated at 4 amps, simply plug this into your 5 amp 3 pin socket, **6/-** each.

20 AMP ELECTRICAL PROGRAMMER



Learn in your sleep: Have Radio playing and kettle boiling as you awake—switch-on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Made by the famous Smiths Instrument Company.
This is essentially a 230/240 volt mains operated Clock and a 20 amp Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarly the switch-on time can be delayed. This is a beautiful unit, size 5¾ × 3¾ × 2¼in. deep. Metal encased, glass fronted with chrome surround. Offered at **47/6** plus postage and insurance.

40 WATT 12in. HI-FI SPEAKER

Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 40 watts R.M.S.—Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms. Chassis diam. 12in.—12¾in. over mounting lugs. Overall height 5½in. A £10 speaker offered this month for **£6.19.6** plus 7/6 post and ins.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A one-in-a-lifetime offer of Micro-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic NPN matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices **5/-** upwards with circuits and technical data of each. Complete parcel only **£1** post paid. *DON'T MISS THIS TERRIFIC BARGAIN.*

THIS MONTH'S SNIP

HONEYWELL PROGRAMMER

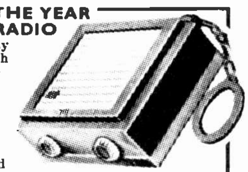
This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 revs per min. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from Makers probably over £10 each. Special snip price **£5.15.0.** plus 5/- post and insurance. Don't miss this terrific bargain.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **39/6** less plug; **45/-** with fitted 13 amp plug; **47/6** with fitted 15 amp plug, plus 4/6 P. & I.

BARGAIN OF THE YEAR

MICROSONIC KEYCHAIN RADIO

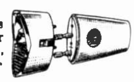


7 transistor Key chain Radio in very pretty case, size 2¼ × 2½ × 1¼in—complete with soft leather zipped bag. Specification:—
Circuit: 7 transistor superheterodyne.
Frequency range: 530 to 1,600 Kc/s.
Sensitivity: 5 mv/m. Intermediate frequency: 465Kc/s or 455Kc/s. Power output: 40mW. Antenna: ferrite rod.
Loudspeaker: Permanent magnet type.
In transit from the East these sets suffered slight corrosion as the batteries were left in them but when this corrosion is cleared away they should work perfectly—offered without guarantee except that they are new. Price only **24/6** plus 2/6 post and insurance, less batteries. 6 for **£7**, post free Rechargeable batteries **8/6** pair. Charger **8/6**.

TANGENTIAL HEATER UNITS

These heater units are the very latest type, most efficient, and quiet running. As fitted in Hoover and blower heaters costing £15 and more. Comprises motor, impeller, and two elements allowing variable heat switching and with thermal safety cut out. Can be fitted into any metalline case or cabinet. Only need control switch. 1½ K.W. model **39/6**, 2½ K.W. **69/6** and 3 K.W. model **79/6**. Postage and insurance 6/6. Control switch **8/6**.

RE-CHARGEABLE TORCH



Neat flat torch, fits unobtrusively in your pocket, contains 2 Nicad cells and built-in charger. Plugs into shaver adaptor and charges from our standard 200/240 volt mains. American made; sold originally at over 4 dollars. Our price only **19/6** each.

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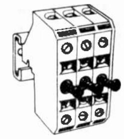
Complete with wall or bench rack. An ideal gift for the motorist. **15/6** + 4/6 post and insurance.

PLINTH AND COVER

Suitable for most auto-changers, teak base with tinted perspex cover. Specially made for Balfour. **85/-** plus 6/6 postage.

MAINS CONNECTOR



A quick way to connect equipment to the mains safely and firmly; disconnection by plugs prevents accidental switching on; has sockets which allow insertion of meter without disconnection; cable inlets firmly hold one hair wire on up to four 7,029 cables. **12/6** each.

DRILL CONTROLLER

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions **29/6**, plus 2/6 post and insurance.

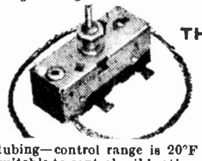
BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, **6/6** each, **£3.10.0** doz.

PROTECT VALUABLE DEVICES

FROM THERMAL RUN-AWAY OR OVERHEATING: Thyristors, rectifiers, transistors, etc., which use heat-sinks can easily be protected. Simply make the contact thermostat part of the heat-sink. Motors and equipment generally, can also be adequately protected by having thermostats in strategic spots on the casing. Our contact thermostat has a calibrated dial for setting between 90deg. to 190deg.F. or with the dial removed range setting is between 80 to 800deg. F. Price **10/-**.

THERMOSTAT WITH PROBE



This has a sensor attached to a 15A switch by a 14in length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be raised out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at **12/6** each. Postage and insurance 2/9.

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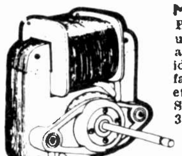

Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at **9/6**. Postage 3/- for first one then 1/- for each one ordered.

NEED A SPECIAL SWITCH?

Double Leaf Contact

Very slight pressure closes both contacts, **1/3** each, **12/-** doz. Plastic push-rod suitable for operating, **1/-** each, **9/-** doz.

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **3/6** each. **36/-** dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. **10/-** post free.

MICRO SWITCH

5 amp. changeover contacts, **1/9** each, **18/-** doz. 15 amp Model **2/-** each or **21/-** doz.

Where postage is not stated then orders over £5 are post free. Below £5 add 2/9. Semiconductors add 1/- post. Over £1 post free. S.A.E. with enquiries please.

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Many items at new reduced prices. All power types supplied with free insulating sets

1N914	1/3	2N3706	2/6	40512	39/-	BC147	3/-	BFY51	4/-
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2N1131	6/3	2N3819	7/-	ACY40	4/-	BC167	2/6	MPF102	7/6
2N1132	6/6	2N3820	12/-	ACY41	5/-	BC168	2/3	NKT403	15/6
2N1302	4/-	2N3904	7/6	AD142	14/3	BC169	2/6	NKT405	15/-
2N1303	4/-	2N3906	7/6	AD149	12/-	BC177	6/3	OA47	1/9
2N1304	4/6	2N4058	4/-	AD161/AD162 (matched)	14/- pr.	BC178	5/8	OA90	1/3
2N1305	4/6	2N4059	4/-	AF114	7/-	BC179	6/-	OA91	1/3
2N1613	6/-	2N4060	4/-	AF115	7/-	BC182L	2/6	OA99	3/-
2N1711	7/-	2N4061	4/-	AF116	6/6	BC183L	2/3	OA200	1/11
2N2147	19/-	2N4062	4/-	AF117	6/6	BC184L	2/6	OA202	2/-
2N2218	9/3	2N4284	3/-	AF124	7/6	BC186	8/6	OC71	7/6
2N2219A	16/6	2N4286	3/-	AF127	7/-	BC212L	5/-	TIP31A	16/-
2N2483	6/3	2N4289	3/-	AF139	9/6	BC213L	5/-	TIP32A	20/-
2N2484	9/6	2N4291	3/-	AF180	18/6	BC214L	5/3	TI843	10/6
2N2646	10/9	2N4292	3/-	AF239	9/9	BCY70	4/-	ZTX300	3/6
2N2904	11/-	2N4410	4/9	ASY26	8/6	BD121	21/-	ZTX301	3/6
2N2924	4/-	2N5062	12/3	ASY27	8/3	BD123	21/-	ZTX302	4/6
2N2925	4/6	2N5163	5/-	ASY28	6/6	BD124	20/-	ZTX303	4/6
2N2926	2/3	2N5192	25/-	B5041	15/-	BF167	8/6	ZTX304	6/9
2N3053	5/6	2N5195	28/3	BA102	6/-	BF178	10/6	ZTX500	5/-
2N3054	14/3	2N5457	9/9	BA156	4/-	BF180	12/-	ZTX501	5/-
2N3055	15/-	2N5458	9/9	BA130	4/6	BF194	7/-	ZTX502	6/-
2N3325	10/9	2N5459	9/9	BA145	5/6	BF195	7/6	ZTX503	5/-
2N3663	11/6	40250	14/3	BC107	2/9	BFX29	6/3	ZTX504	12/-
2N3702	2/6	40361	12/6	BC108	2/6	BFX84	5/9	ZTX530	5/5
2N3703	2/6	40362	16/-	BC109	2/9	BFX85	7/-	ZTX531	6/9
2N3704	2/6	40406	16/3	BC125	11/-	BFX87	5/9		
2N3705	2/6	40408	14/6	BC126	11/-	BFX88	5/3		
		40430	37/-			BFY50	4/6		

RESISTORS

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82Ω–220kΩ	E12	18d	16d	15d
C	⅛W	5%	4·7Ω–330kΩ	E24	2·5d	2d	1·75d
C	¼W	10%	4·7Ω–10MΩ	E12	2·5d	2d	1·75d
C	½W	5%	4·7Ω–10MΩ	E24	3d	2·5d	2·25d
C	1W	10%	4·7Ω–10MΩ	E12	6d	5d	4·5d
MO	½W	2%	10Ω–1MΩ	E24	9d	8d	7d
WW	1W	10% ± 1/20Ω	0·22Ω–3·9Ω	E12	1/6d all quantities		
WW	3W	5%	12Ω–10kΩ	E12	1/6d all quantities		
WW	7W	5%	12Ω–10kΩ	E12	1/9d all quantities		

CODES: C = carbon film high stability low noise. MO = metal oxide Electrosil TR5 ultra low noise. WW = wire wound Plessey.

VALUES: E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades. E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51, 62, 75, 91 and their decades.

Prices are in pence each for same ohmic value and power rating, NOT mixed values. (Ignore fractions of 1d on total resistor order.)

INTEGRATED CIRCUIT AMPLIFIERS

SINCLAIR IC.10 complete with instruction book giving amplifier circuit details and range of applications. **59/6** nett. Components pack for stereo inc. mains transformer, controls, etc., **£4.15.0** nett.

PLESSEY SL403A. Only **42/6** each nett. 3W into 7·5Ω for 18V supply. Application data **2/-**: free with two or more.

WAVECHANGE SWITCHES LONG SPINDLES

1P 12W; 2P 6W; 3P 4W; 4P 3W .. .. **4/9** each

SLIDER SWITCHES D.P.D.T. .. .. .. **3/-** each

NEON INDICATOR LAMPS all 200/250V

Square bezel, red only **3/9**
Round chrome bezel red, amber, clear .. .. **4/9** each
Toggle switches, 250V a.c. 1·5A. Chrome dolly and chrome milled nut S.P.S.T. **3/9**; S.P.D.T. **4/6**; D.P.D.T. **5/9**; S.P.D.T. centre off **5/-**.

S-DeC's put an end to "birdsnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC (70 points) only **20/-**. Compact T-DeC, increased capacity, may be temperature-cycled. T-DeC (208 points) only **50/-**. Full range stocked.

MULLARD POLYESTER C280 series

250V 20%: 0·01, 0·022, 0·033, 0·047, **8d** ea.; 0·068, 0·1, **9d** ea.; 0·15, **11d**; 0·22, **1/-**. 10%: 0·33, **1/5**; 0·47, **1/8**; 0·68, **2/3**; 1μF, **2/9**; 1·5μF, **4/2**; 2·2μF, **4/9**.

MULLARD SUB-MIN ELECTROLYTIC

C426 range axial lead **1/3** each
Values (μF/V): 0·64/64, 1/40, 1·6/25, 2·5/16, 2·5/64, 4/10, 4/40, 5/64, 6·4/6·4, 6·4/25, 8/4, 8/40, 10/2·5, 10/16, 10/64, 12·5/25, 16/40, 20/16, 20/16, 20/64, 25/6·4, 25/25, 32/4, 32/10, 32/40, 32/64, 40/16, 40/2·5, 50/6·4, 50/25, 50/40, 64/4, 64/10, 80/2·5, 80/16, 80/25, 100/6·4, 125/4, 125/10, 125/16, 160/2·5, 200/6·4, 200/10, 250/4, 320/2·5, 320/6·4, 400/4, 500/2·5.

LARGE CAPACITORS

High ripple current types: 1000/25 **5/6**; 1000/50 **8/2**; 1000/100 **16/3**; 2000/25 **7/4**; 2000/50 **11/4**; 2000/100 **28/9**; 2500/64 **15/5**; 2500/70 **19/6**; 5000/25 **12/6**; 5000/50 **21/11**; 5000/100 **58/3**; 10000/15 **17/-**; 10000/25 **24/6**; 10000/50 **44/-**; 10000/70 **61/-**.

MEDIUM RANGE ELECTROLYTICS

Axial leads: 50/50 **1/9**; 100/25 **1/9**; 100/50 **2/6**; 250/25 **2/6**; 330/25 **2/6**; 250/50 **3/9**; 500/25 **3/9**; 500/50 **4/6**; 1000/25 **4/-**; 1000/50 **6/-**; 2000/25 **6/-**.

SMALL ELECTROLYTICS

Axial leads: 4·7/10, 4·7/25, 5/50, **1/-** ea. 10/10, 10/25, 10/50, 33/10, 50/10, **1/-** ea. 25/25, 25/50, 47/25, 100/10, 220/10, **1/3** ea.

ENAMELLED COPPER WIRE even No. SWG.

only: 2 oz. reels: 16–22 SWG **4/3**; 24–30 SWG **5/-**; 32, 34 SWG, **5/6**; 36, 38 SWG, **6/3**. 4 oz. reels: 16–22 SWG only **7/6**.

PEAK SOUND PRODUCTS ENGLEFIELD AMPLIFIER

12 + 12 watts RMS per channel

Stereo amplifier in modular kit form (including cabinet) 12 watts per channel **£38.9.0.** Cabinet kit only **£6**. These prices nett.

BAXANDALL SPEAKER SYSTEM

Designed by Peter Baxandall. Superb reproduction for its size. Handles 10 watts with ease. Uses ELAC 15Ω 59RM109 speaker unit. Kit **£13.12.0** nett.; built **£19.8.6** nett.

MAINLINE AMPLIFIER KITS

RCA/SGS designed main amplifier kits. Input sensitivity 500–700mV for full output into 8Ω.

Power	Kit price including components	Suitable unreg. power supply kit
12W	168/- nett	92/-
25W	190/- nett	N/A
40W	210/- nett	115/1
70W	252/- nett	138/10

30 WATT BAILEY AMPLIFIER KIT

Sensitivity 1·2V for full output into 8Ω. Transistors and PCB for one channel **£7.5.6.** Transistors and PCBs for two channels **£14.11.0.** Capacitors and resistors (metal oxide) 40/- per channel.
Complete unregulated power supply kit **£4.15.0.**

ZENER DIODES

5% full range E24 values: 400mW: 2·7V to 30V **3/9** ea. 1W: 6·8V to 82V **9/-** ea. 1·5W: 4·7V to 75V **12/-** ea. Clip to increase 1·5W rating to 3 watts (type 266F) **9d.**

CARBON TRACK POTENTIOMETERS, long spindles.

Double wiper ensures minimum noise level.

Single gang linear	220Ω to 2·2MΩ	2/6
Single gang log	4·7KΩ to 2·2MΩ	2/6
Dual gang linear	4·7KΩ to 2·2MΩ	8/6
Dual gang log	4·7KΩ to 2·2MΩ	8/6
Log/antilog	10K, 47K, 1MΩ only	8/6
Dual antilog	10K only	8/6

Any type with ½A D.P. mains switch, extra **2/3.** Please note: only decades of 10, 22 and 47 are available within ranges quoted.

CARBON SKELETON PRE-SETS

Small high quality, type PR, linear only 100Ω, 220Ω, 470Ω, 1K, 2K2, 4K7, 10K, 22K, 47K, 100K, 220K, 470K, 1M, 2M2, 5M, 10MΩ. Vertical or horizontal mounting **1/-** each.

COMPONENT DISCOUNTS

10% on orders for components for £5 or more. 15% on orders for components for £15 or more (No discount on nett items).

POSTAGE AND PACKING

Free on orders over **£2**. Please add 1/6 if under. Overseas orders welcome: carriage charged at cost.

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POWER SUPPLIES AND CONSTRUCTION

The power supplies that provide the various d.c. voltages required by the Digi-Clock circuitry are quite conventional in design, as can be seen from Fig. 15. Outputs required from the supplies are:

(a) 10 volts (nominal) at 1A (max), from which the regulated 5 volt supply is derived.
(b) 180 volts at 10mA (nominal), which is used to drive the anodes of the "Nixie" tubes and decimal-point indicator.
(c) 200 volts (nominal) at 25mA (max), which is used to supply the 180 volt regulator, and to drive the 12 volt bias line of the 5 volt regulator.

In addition a 6·3V r.m.s. (50Hz) low current supply is required to provide the clock timing waveform.

No on/off switch was fitted to the prototype, as permanent use when plugged into the 230/250V a.c. mains supply makes it unnecessary. A mains switched socket with fused plug or a fused spur outlet is recommended for installation. A clock will normally be left on permanently, only being switched off at holiday times or other occasions when the house is vacated for long periods.

If the constructor's house wiring uses the non-fused type of plug then it is vital that a separate fuseholder be incorporated in the clock design to provide protection of the transformer primaries. While on the subject of fuses, remember that all fuses used in this design are necessary for safety, the clock is intended to run continuously, often unattended, and the only way safety can be assured is by proper fusing.

LOW VOLTAGE SUPPLY

Two power transformers were used in the prototype to provide the necessary a.c. supplies (Fig. 15). This proved to be necessary because of the difficulty of finding a single transformer with suitable ratings and of the correct physical size.

The transformer selected for the low voltage supply not only provides the required 10V at 2A, but also has the highly desirable feature of an interwinding screen, which reduces the coupling of mains-borne r.f. interference into the logic supply lines.

Constructors who may prefer to use a different case design from that used in the prototype, may like to know that West Hyde Developments make a single transformer that will supply all the voltages required by the clock. This is type TRA which is too large to fit into the specified Case "C".

An encapsulated bridge rectifier (D4 to D7 in Fig. 15) with a current rating of 1A (continuous) is used as the low voltage full wave rectifier, and this is followed by a 5,000μF smoothing capacitor C10 in the usual way. Two "protection" components are included in this circuit.

When switching on, a very large surge current flows for a short period as the capacitor is charged. This current would be limited only by the internal impedance of the transformer, and might exceed the 8A surge rating of the bridge, were it not for the inclusion of R24 between it and C10. The resistor, of course, imposes a large voltage drop under surge conditions, and ensures that the current cannot exceed 8A, whereas during normal operation the voltage drop across it will only be an insignificant half-volt or so.

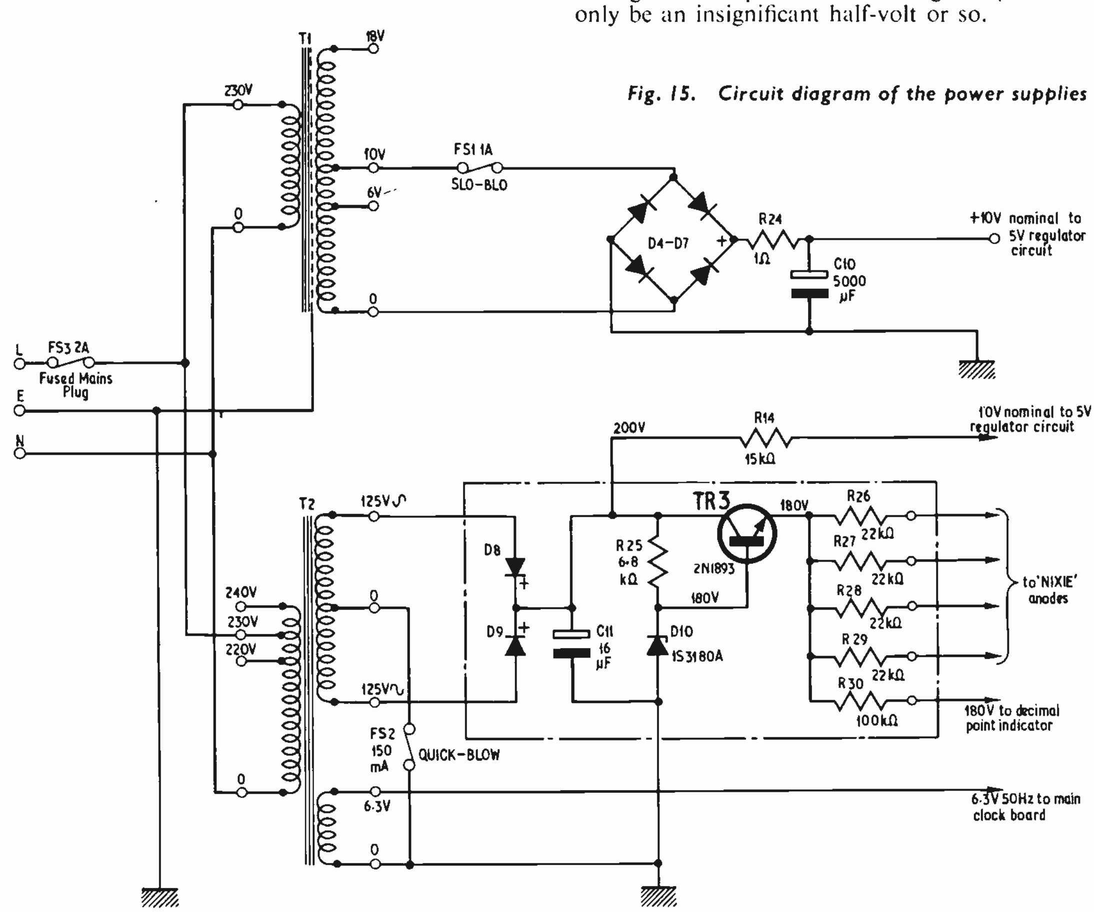
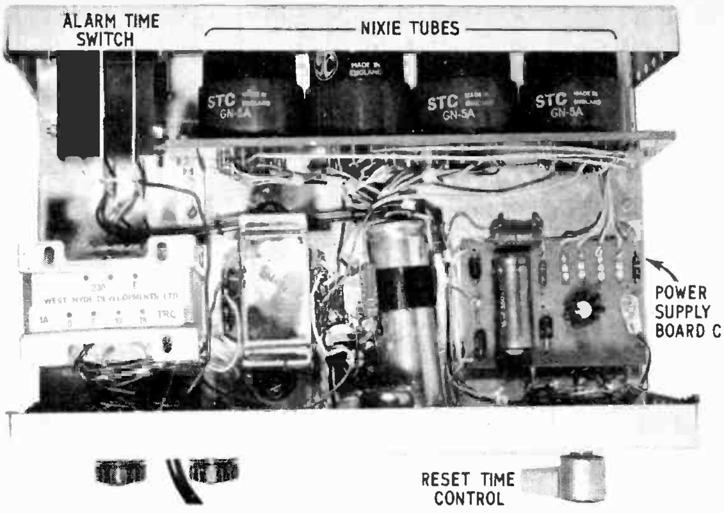


Fig. 15. Circuit diagram of the power supplies



Top view of the chassis showing power supply components

The increase in the impedance of the supply caused by its inclusion does not pose a problem because the final 5V output is provided by a feedback regulator, which as we have already seen, reduces the supply impedance to a fraction of an ohm.

The use of an anti-surge fuse in this supply allows very close protection of the bridge and transformer, without having to increase the fuse rating to accommodate surge currents, as would be the case with quick-blow devices. Fuse FS1 ignores short duration current transients, but will blow within a few tens of milliseconds should its rating be continuously exceeded.

The smoothing capacitor C10 should be a good quality type with a high ripple-current rating. Components inadequate in this respect will have a reduced life in this type of circuit.

HIGH VOLTAGE SUPPLY

Transformer T2 is used to provide the high voltage supply for the display and 6·3V a.c. for the timing circuits. The two diodes (D8 and D9) and the smoothing capacitor C11 complete the full-wave rectification circuit as shown in Fig. 15.

The nominal 200V supply developed across C1 is fed to the 5V regulator via R14. This resistor should be mounted as close to the board as possible to reduce the risk of direct short circuits, but it cannot be mounted on the board because of the amount of heat it dissipates. Although not used in the prototype, a small tag-strip could be employed to support it, and allow air circulation.

The 180V regulator is simply an emitter follower circuit with the base voltage of transistor TR3 set by the breakdown voltage of a 180V Zener diode D10.

COMPONENTS . . .

POWER SUPPLIES

Resistors

R24 1Ω 3W wirewound
R25 6·8kΩ R28 22kΩ
R26 22kΩ R29 22kΩ
R27 22kΩ R30 100kΩ
All ±5%, ½W high stab. except R24

Capacitors

C10 5,000μF elect. 15V
C11 16μF elect. 350V

Diodes

D4 to D7 Bridge rectifier 1B10J10 100 p.i.v. 1A (Texas)
D8, D9 PL4004 (General Instruments) or any 400 p.i.v., >50mA
D10 1S3180A (Texas) *or* ZX180. Zener 180V, >2mA

Transistor

TR3 2N1893

Transformers

T1 Mains primary; 10V 1A secondary with inter-winding screen (e.g. Type TRC by West Hyde Developments Ltd., Ryefield Crescent, Northwood Hills, Northwood, Middlesex).
T2 Mains primary; 250V c.t. 25mA and 6·3V 1A secondary (e.g. "Midget Mains 250V" type by Radiospares).

Loudspeaker

LS1 80Ω 2¼in diameter

Display Tubes

V1 to V4 GN-5A (S.T.C.) "Nixie" numerical indicators or similar (Electroniques (S.T.C). Ltd., Edinburgh Way, Harlow, Essex)
LP1 Neon indicator lamp miniature (e.g. type 1MH)

Switches

S1 3-pole, 3-way rotary wafer switch.
S2 Decade thumbwheel switch, 2 banks with 2 side plates. (Type SB10N1248, Birch Stolec Ltd.). Alternatively 2 wafer thumbwheel switches, 4-pole, 10 way
S3 Single-pole changeover miniature toggle

Fuses

FS1 1A Slo-Blo cartridge with fuseholder
FS2 150mA cartridge with fuseholder
"Behind-panel" depth not more than 1in

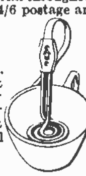
Miscellaneous

Case Contil Mod-2 Type C (West Hyde Developments)
Display panel, s.r.b.p. 8in × 2¼in × ⅛in
Printed circuit Board "C" copper clad 3in × 2in
Aluminium brackets for display panel 2¼in × 1in × ½in wide
Capacitor clip for C10
Perspex sheet orange translucent 7⅛in × 2⅜in
Heatsinks, clip-on for TR1 and TR3 (see photos)
Thin flexible connecting wire different colours
Nuts and bolts 4 B.A. and 6 B.A. × 1in
Grommets and soldering tags. Lettering transfers

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit **£3.15.0.** Post and ins. 7/6.

12 volt Car Battery Trickle Charger. Made in Japan, this is very small and neat. Regular use will keep your car battery in good trim throughout the winter. Silly price, **25/-** plus 4/6 postage and insurance.



QUICK CUPPA

Mini Immersion Heater, 350w. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **24/6,** post and insurance 2/9. **12v. car model also available 19/6.**

PLINTH AND COVER

Suitable for most auto changers, teak base with tinted perspex cover. **85/-** plus 6/6 postage. Special set for Balfour autochanger **85/-** plus 6/6 postage.

THYRISTOR LIGHT DIMMERS

Will dim incandescent lighting up to 600 w. from full brilliance to out. Assembled and wired ready to install. **59/6.**

AUTO-ELECTRIC CAR AERIAL

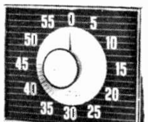
with dashboard control switch—fully extendable to 40in. or fully retractable. Suitable for 12v positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£5.18.6** plus 5/- post and ins.

COMPUTER TAPE

2,400 ft of the best magnetic tape money can buy. Made by E.M.I., 1in. wide almost unbreakable and on a 10½in. metal computer spool. Users have claimed successful results with video as well as sound recordings. **19/6** plus 6/6 post. Cassette to hold spool **10/-** extra.

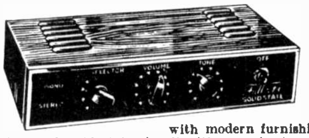
HORSTMANN "TIME & SET" SWITCH

(A 30 Amp Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price **29/6.** Post and ins. 4/6.



1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4½in. × 3½in., which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch, **22/6.**

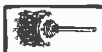


THE FULL-FI STEREO SIX

The amplifier sensation of the year

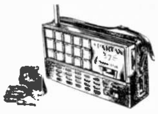
You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled and teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. Other controls include "treble lift and cut", "balance" and separate mains on/off switch. Price is **£8.19.6** plus 7/6 post and insurance.

STANDARD WAFER SWITCHES



Standard size 1½ wafer—silver-plated 5-amp contact, standard ¼in spindle 2in long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6	6/6
2 poles	6/6	6/6	6/6	6/6	6/6	6/6	6/6	10/6	10/6
3 poles	6/6	6/6	6/6	6/6	10/6	10/6	10/6	14/6	14/6
4 poles	6/6	6/6	6/6	10/6	10/6	10/6	10/6	18/6	18/6
5 poles	6/6	6/6	10/6	10/6	14/6	14/6	14/6	22/6	22/6
6 poles	6/6	10/6	10/6	10/6	14/6	14/6	14/6	26/6	26/6
7 poles	10/6	10/6	10/6	14/6	18/6	18/6	18/6	30/6	30/6
8 poles	10/6	10/6	10/6	14/6	18/6	18/6	18/6	34/6	34/6
9 poles	10/6	10/6	14/6	14/6	22/6	22/6	22/6	38/6	38/6
10 poles	10/6	10/6	14/6	18/6	22/6	22/6	22/6	42/6	42/6
11 poles	10/6	14/6	14/6	18/6	26/6	26/6	26/6	46/6	46/6
12 poles	10/6	14/6	14/6	18/6	26/6	26/6	26/6	50/6	50/6



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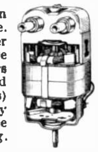

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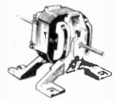

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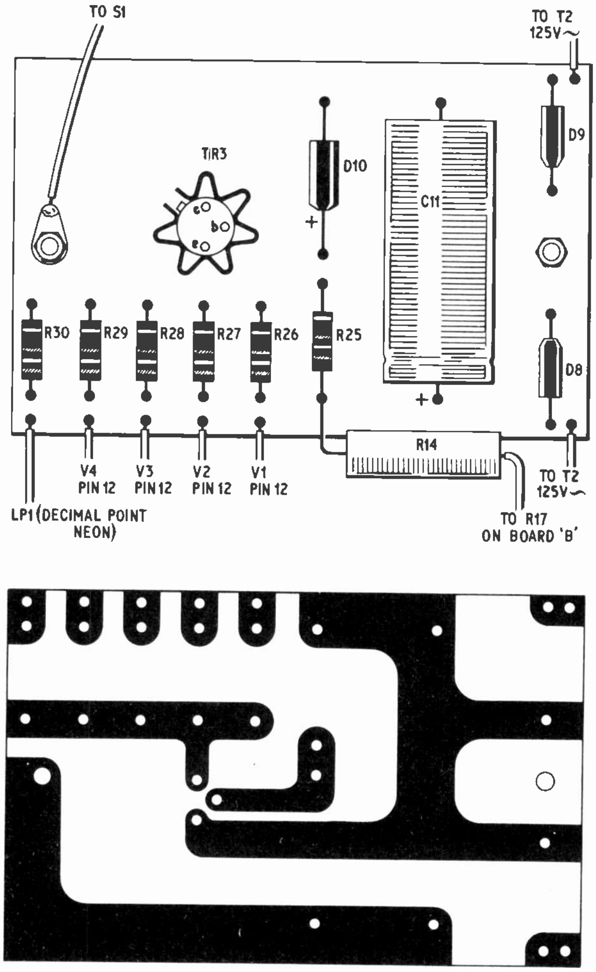

Fig. 16. Layout of components on Board "C", the high voltage regulator—shown full size

The transistor used in this position must have a high V_{cb} rating to allow for the difference between the unregulated input and the regulated output voltage, even under transient conditions. The regulator may be called on to provide up to 10mA at 180V.

If the nominal 200V supply rises to more than 220V, the transistor would get quite hot; hence the clip-on heat sink used in the prototype. The anode resistors R26 to R30 for the four "Nixie" tubes and the decimal-point indicator are mounted alongside the regulator on the same printed circuit board to give a neat appearance and to reduce the risk of a damaging short circuit.

Shorting the individual anode outputs to earth will not harm the regulator, because these resistors limit the current to a safe value. However, if the 180V output is shorted, the transistor will be instantly destroyed. In fact, in this design, the series pass transistor is used as a "fuse", it being impossible to use a conventional fuse link to afford any protection to a device operated under these conditions.

The 150mA fuse FS2 in the "earthy" line of the transformer will only be able to act fast enough to protect the diodes and the transformer itself, and the only way the transistor can be protected is by using a current limiter similar to that used in the 5V regulator, a course considered unnecessarily expensive in the prototype.

PRINTED CIRCUIT

The printed circuit used for the 180V regulator is of a simple design which lends itself to home production using the "paint and etch" system of printed circuit board construction which many readers will have used before.

The layout is shown in Fig. 16, which also gives component mounting details. It is recommended that the holes be drilled before the printed pattern is painted on, as this gives a good guide, and enables more accurate painting to be achieved.

If the constructor does not have facilities for producing printed circuits there is no reason why a tagboard of similar dimensions should not be used to support the regulator components, though the appearance would not be as neat in this case.

NIXIE DISPLAY

The drivers and power supplies used in the Digi-Clock are capable of handling any type, or make, of gas filled numerical indicator tubes currently available, and alternatives may be directly substituted for the STC GN5A used in the prototype, with appropriate wiring changes according to the pin connections.

Manufacturer's data on "Nixie" tubes usually states that the highest anode voltage available should be used to drive these devices, and readers may be a little puzzled by the choice of 180V for this design, as this is very close to the minimum voltage allowable.

The reason for the choice of such a low voltage is that the SN7441AN decoder driver is only guaranteed to "hold off" 55V; a Zener diode connected to each output breaks down if this voltage is exceeded. This means that the maximum voltage differential which can be achieved across the tube is 55V.

In our case, the voltage across the tube when it is supposed to be off is 180–55V which means that 125V can still be applied in these circumstances. Obviously, if the anode supply is raised too far, the 55V differential will be insufficient to ensure that the cathodes, which are supposed to be off, do not conduct.

COLOUR FILTER

If these cathodes do conduct, an unpleasant background haze is produced which impairs the readability of the display, and in extreme cases more than one numeral could become lit within the same tube. For a clear "Nixie" display with the view of the unlit numerals completely suppressed, it is important that a red or orange coloured filter be employed between the tubes and the observer.

Although tubes are available with this filter applied as a lacquered coating on the outside of the glass envelope, by far the best system is to use clear tubes with a common external filter sheet. In this design the filter is produced from a sheet of ordinary orange tinted Perspex, which performs admirably in this role, mounted on the front of the clock to form the viewing window.

The decimal point separating the two "minutes" indicators from the "hours" section has to be provided separately when using the GN5A "Nixies", as these devices do not have integral points as do some other types. In the prototype a Hivac type 1MH "Minicator", miniature neon, performed well in this role, and was driven from the 180V supply via a 100K resistor. Any small neon lamp, such as used for mains indicators, could be used with the correct value of series resistor R30.

Next month: Final wiring and testing

Readout—
A SELECTION FROM OUR POSTBAG

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

Time expense

Sir—I have been a faithful reader of Practical Electronics for a good many years now, and I have not until this month's issue (December 1970), come across a Digital Clock.

But I would like to express my disappointment when I saw the circuit, and found the cost of it was in the region of twenty-five to thirty pounds to produce. This puts the clock well beyond my, and I should imagine many other readers' grasp, and even then with a little too much heat on one of the pins the complete project could be destroyed.

I have also seen on the market a digital clock using a cold cathode display, costing under twenty pounds, so I was naturally assuming that your project would cost much less, —but it doesn't.

I'm sure many other readers must feel the same way about the high cost, and I cannot see many readers attempting the project.

C. Honeyands,
Cosford,
Wolverhampton.

The estimated cost of making the complete "Digi-Clock" using the components specified is in the region of £40. No doubt many readers will be able to find ways of reducing this cost, but in order to build an all-electronic digital clock the degree of circuit complexity involved, whether using integrated circuits or discrete components, is bound to make this an expensive project. However, one must consider the accuracy and reliability together with long life in comparing the cost with any clock using electro-mechanical devices.—M.A.C.

Not for Fun?

Sir—Congratulations! You are now printing some really worth while designs in P.E. I am specifically thinking of the "Digital Clock" and the "P.E. Gemini Amplifier", and the forthcoming Sound/Light Controller. We want far more articles of this calibre, not designs for radios, metal detectors, electronic dice, war games, etc. You should take a poll of readers' wants—I am sure that the majority of them, like me, want to build *useful* things, not toys!

M. J. Clarke,
London, S.E.1.

I am pleased to learn that you have reacted favourably to some of our recent designs. On the other hand, I cannot agree with you so far as your comments relating to metal detectors, war games, etc. Electronics is a servant to all, and we must be very broad-minded concerning the applications of this technology.

I certainly see no reason why amusements such as "War Games" should not be described. After all, the electronic circuitry involved can be as technically fascinating as that used for more prosaic projects, i.e. commercial computers.—Ed.

Biased view

Sir—I have been a regular reader of your magazine for many years, and find it very enjoyable to read, and the circuits are really up-to-date. I also attend day-release Technical College and have an Intermediate Certificate in City and Guilds Radio and T.V. Servicing.

Nevertheless, I have come across a problem which no-one can explain, and I can find no book in the whole of Cambridgeshire which can give me an answer, so I am writing to you in the hope that you can help me before I go mad!

In the latest circuits, for example, audio amplifiers, which are d.c. coupled, it often appears that the a.c. signal input is fed straight to the base of the first transistor, without the transistor having any d.c. base bias on it (from resistors, potential dividers, etc.). Therefore is it possible for a transistor to amplify the input a.c. signal without having any base bias?

Also, in a transistor configuration such as the "Super-Alpha pair", the first transistor usually has a base bias resistor, but the second transistor's base is connected straight to the first transistor's emitter.

Even in Practical Electronics the text usually just states that the emitter current of the first transistor is the base current of the second transistor; but how can that be—if there is no base bias resistor on the second transistor, there can be no voltage on the base, hence no current (Ohm's Law).

I must apologise if my query has a very simple explanation, which I should know, but technical college lecturers tend to show you a circuit of a transistor amplifier, and just say, "The signal goes in there, and comes out here," and expect you to accept it!

J. Hammond,
Great Abington.

When an alternating voltage is present at the collector of a transistor, this consists of an alternating direct voltage. If this is passed to a succeeding stage by way of a capacitor, only the alternating component is passed. If this component is passed to an unbiased transistor, this signal will be rectified and amplified; an audio signal so treated would be distorted.

With d.c. coupled linear amplifier, the d.c. component from the previous stage is so arranged to correctly bias the succeeding transistor so that an exact reproduction of the a.c. component is made.

A "Super-Alpha" pair is a compound of two transistors, d.c. coupled to form, in effect, a high gain transistor. This gain, ideally, approaches the product of the individual transistor gains, hence "Super-Alpha" as a description.

For pulse amplification, such combinations do not need a second transistor base resistor. In a.f. amplifier applications, this resistor is required.—G.G.

DECIMAL CURRENCY AND P.E.

Readers in the U.K. are probably aware that British currency will be decimalised with effect from February 15, 1971. The following notes are issued for their guidance when writing to Practical Electronics.

1. Cheques and postal orders should show amounts payable in decimal currency.

2. Readers' cheques and postal orders written in £ s d will not be accepted by the banks or Post Office after February 15, 1971.

3. Handwritten cheques of more than £1, which include new pence, should use a hyphen in place of the decimal point (e.g. £7-80, £30-06).

4. Postage rates on and after February 15 will be 2½p second class and 3p first class for up to 4 ounces. Old £ s d stamps used on and after this date must be at the new rate of 6d second class, 7d first class for up to 4 ounces. Readers requiring a reply to correspondence are asked to use the correct postage rate on s.a.e.

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6U4	12/6	ECH83	8/6	U801	20/-
6V6G	5/-	ECL80	9/-	UABC80	6/9
6V6GT	6/6	ECL82	6/6	UAF42	10/6
6X4	5/-	ECL83	12/6	UBC41	9/6
6X5G	5/6	ECL86	8/6	UBC81	8/-
6X5GT	5/6	EF37A	8/-	UBF80	7/3
10C2	10/-	EF39	8/-		
10F1	18/-	EF40	10/-	UBF89	7/-
10P13	11/-	EF41	12/6	UCC84	9/9
10P14	20/-	EF42	14/-	UCC85	8/-
12AT6	5/-	EF80	5/-	UCF80	10/6
12AT7	4/-	EF85	7/-	UCH21	11/-
12AU7	5/-	EF86	6/6	UCH42	13/-
12AX7	6/-	EF89	5/6	UCH81	6/6
12AV6	6/-	EF91	4/6	UCL82	7/-
12BA6	6/6	EF92	7/6	UCL83	12/-
12BE6	6/6	EF183	6/6	UF41	10/-
12BH7	6/6	EF184	7/-	UF80	7/6
19AQ5	6/6	EH90	8/-	UF85	8/-
20D1	9/-	EL34	10/6	UF89	7/-
20F2	15/-	EL33	17/6	UL41	12/-
20L1	20/-	EL41	11/-	UL84	6/6
20P1	10/-	EL42	11/6	UY41	8/-
20P3	12/-	EL81	10/-	UY85	6/-
20P4	20/-	EL84	5/-	VR105/30	5/6
20P5	20/-	EL85	8/3	VR150/30	5/-

ZENER DIODES

400mw. (3.3 to 33v) 3/-
1.5 watt (2.4 to 200v) 4/-
10 watt (3.9 to 100v) 5/-

INTEGRATED CIRCUITS

L900 9/9; L914 9/9; L923 12/6; 1C-10 50/-; SL403 42/6; MC1303 52/6; MC1304 55/-; PA246 52/6; CA3005 25/6; CA3011 16/6; CA3052 36/6; FCH131 10/-; FCH 161 10/; FJH141 10/-; FJH171 10/-; FJH181 10/-; FJH221 10/-; FJH231 10/-; FJH241 10/-; FJH251 10/-; FJJ121 17/6; FJJ131 17/6; FJJ211 25/-; FJY101 10/-.

SEND SAE FOR FULL LISTS!

DISCOUNTS
10% on 12+ any one type. 15% on 25+ any one type. Large quantity discounts on application
Postage—Semi Conductors 1/6; Valves 3/-.

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

SEND S.A.E. FOR DISCOUNT PRICE LISTS AND PACKAGE OFFERS!

GARRARD

FULL CURRENT RANGE OFFERED, BRAND NEW AT FANTASTIC SAVINGS

2025T/C stereo	£8.17.6	SL72B	£24.19.6
40 MKII stereo	£8.8.0	AP76	£22.10.0
3000 stereo	£9.19.6	SL75	£25.19.6
SP25 MKIII	£11.15.0	SL75B	£27.19.6
SL55	£11.12.6	SL95B	£37.10.0
SL65B	£14.19.6	A70/11	£11.19.6
		401	£25. 0.0

Carriage 7/6 extra each item.

TEAK PLINTHS AND PERSPEX COVERS
1. For SP25, SL65, SL55, 3000, 2025T/C, 2025, 1000. £3.19.6
2. For AP75, SL75, SL95. £5.19.6
3. For SP25 etc. to operate with lid in place £5.19.6
Carriage 7/6 extra each type. Full range of Garrard accessories available.

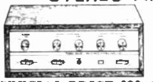
TELETON SPECIAL OFFER!

CR10T AM/FM STEREO TUNER AMPLIFIER WITH MATCHING PAIR SA1003 SPEAKER SYSTEMS

Output 4 watts per channel. Excellent reception AFC, built-in MPX. Cer/XTAL Input. Total List £50.5.0. OUR PRICE £29.19.0, Carr. 12/6.

Also available with Garrard 2025T/C Record Changer, Plinth, cover and stereo cartridge. Ready wired. £45. Carr. 20/-.

TELETON SAQ203E STEREO AMPLIFIER



Solid state, 10W per channel music power. 6W r.m.s. Inputs for mag, ceramic, tuner, aux.
SPECIAL PRICE £20. Carr. 7/6.

HOSIDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable head-band. 8 ohm impedance. 20–12,000 cps. Complete with lead and stereo jack plug. ONLY 47/6. P. & P. 2/6.

HOSIDEN DH-08S DE LUXE STEREO HEADPHONES

Features unique mechanical 2-way units and fitted adjustable level controls. 8 ohm impedence. 20-20,000cps. Complete with spring lead & stereo jack plug £7.19.6. P. & P. 2/6.

AMERICAN TAPE

First grade quality American tapes. Brand new Discount on quantities.

3in. 225ft. L.P. acetate	3/6
3¼in. 600ft. T.P. mylar	10/-
5in. 600ft. std. plastic	8/6
5in. 900ft. L.P. acetate	10/-
5in. 1,200ft. D.P. mylar	15/-
5¾in. 1,200ft. L.P. acetate	12/6
5¾in. 1,200ft. L.P. mylar	16/-
5¾in. 1,800ft. D.P. mylar	22/6
5¾in. 2,400ft. L.P. mylar	39/6
7in. 1,200ft. std. acetate	12/6
7in. 1,800ft. L.P. acetate	15/-
7in. 1,800ft. L.P. mylar	20/-
7in. 2,400ft. D.P. mylar	25/-
7in. 3,600ft. T.P. mylar	45/-

Postage 2/-. Over £3 post paid.

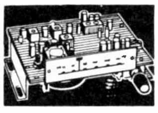
SPECIAL OFFERS!

Garrard SP25/III fitted Goldring G800 cartridge and wooden plinth and plastic cover. Ready wired. Total list price £35. OUR PRICE £22.10.0. Carr. 10/-.
GOLDRING GL69/2 fitted Goldring G800 cartridge complete with de luxe base and cover. Total list price £50.16.0. OUR PRICE £39. Carr. 20/-.

SINCLAIR EQUIPMENT

Project 60. Package offers. 2 × Z30 amplifier, stereo 60 pre-amp. PZ5 power supply. £19.0.0, Carr. 7/6. Or with PZ6 power supply, £21, Carr. 7/6. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. £21.10.0, Carr. 7/6. Transformer for PZ8, 59/6 extra. Add to any of the above £4.17.6. for active filter unit and £16 for a pair of Q16 speakers. Project 60 FM Tuner £20.19.6. Carr. 7/6.
All other Sinclair products in stock. 2,000 amplifier, £23, Carr. 7/6. 3000 Amplifier £36. Carr. 7/6. Neoteric amplifier £46, Carr. 7/6.

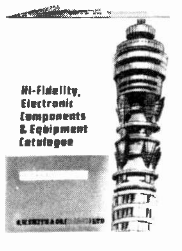
★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108 MHz. Ready built ready for use. Fantastic value for money. £6.7.6. P. & P. 2/6. Stereo multiplex adaptors 99/6.

Latest Catalogue

Our latest edition giving full details of a comprehensive range of HI-FI EQUIPMENT COMPONENTS, TEST EQUIPMENT and COMMUNICATIONS EQUIPMENT. FREE DISCOUNT COUPONS VALUE 10/-. 248 pages, fully illustrated and detailing thousands of items at bargain prices.



SEND NOW—ONLY 7/6 P. & P. 1/6

← See previous page ● G. W. SMITH & CO. (RADIO) LTD. ● See opposite page →

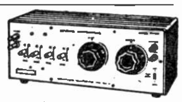
MULTIMETERS *for EVERY purpose!*

RUSSIAN C1-16 DOUBLE BEAM OSCILLOSCOPES

5MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated triggered sweep from 0·2μsec to 100msec/cm. Supplied complete with all accessories and instructions. £37, Carr. paid.

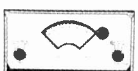
MARCONI CT44/ TF956 AF ABSORPTION WATTMETER

1 μ/watt to 6 watts. £20. Carr. 20/-.



TE111. DECADE RESISTANCE ATTENUATOR Variable range 0–111dB. Connections. Unbalanced T and Bridge T. Impedance 600 Ω range (0·1dB × 10) + (1dB × 10) + 10 + 20 + 30 + 40dB. Frequency: d.c. to 200kHz (−3dB). Accuracy: 0·05dB. + indication dB × 0·01. Maximum input less than 4W (50V). Built in 600 Ω load resistance with internal/external switch. Brand new £27.10.0. P. & P. 5/-.

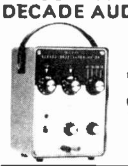
BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR



Sine 18–200,000Hz; Square 18–50,000Hz. Output max +10dB (10k Ω). Operation internal batteries. Attractive two-tone case 7½in × 5in × 2in. Price £17.10.0 Carr. 3/6.

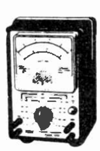
TE-15A Transistorised Signal Generator. 5 ranges 400 kHz–30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5¼ × 5¼ × 3¼. Complete with instructions and leads. £7.19.6. P.&P. 4/-.

BELCO DA-20 SOLID STATE DECADE AUDIO OSCILLATOR



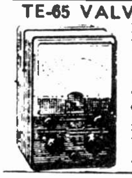
New high quality portable instrument. Sine 1Hz to 100kHz. Square 20Hz to 20kHz. Output max. +10dB (10k Ω). Operation 220/240V a.c. Size 215mm × 150mm × 120mm. Price £27.10.0. Carr. 5/-.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER



10 meg. input 10 ranges: ·01 / ·003 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.–1·2Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. £17.10.0. Carr. 5/-.

TE-65 VALVE VOLTMETER



High quality instrument with 28 ranges. D.c. volts 1·5–1,500V. A.c. volts 1·5–1,500V. Resistance up to 1,000 megohms. 220/240V a.c. operation. Complete with probe and instructions. £17.10.0. P. & P. 6/-. Additional Probes available: R.F. 42/6. H.V. 50/-.

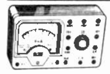
AUTO TRANSFORMERS

0/115/230v. Step up or step down. Fully shrouded.

150 W.	£2.7.6.	P. & P. 3/6
300 W.	£3.5.0.	P. & P. 4/6
500 W.	£4.19.6.	P. & P. 6/6
1,000 W.	£7.5.0.	P. & P. 7/6
1,500 W.	£8.19.6.	P. & P. 8/6

SOLID STATE VARIABLE A.C. VOLTAGE REGULATORS

Compact and panel mounting. Ideal for control of lamps, drills, electrical appliances, etc. Input 230/240V a.c. Output continuously variable from 20V to 230V. Model MR2305 5A 68 × 46 × 43mm, £8.7.6. Model MR2310 10A 90 × 68 × 60mm, £11.19.6 Postage 2/6.



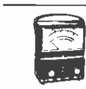
TECH PT-34. 1,000 O.P.V. 0/10/50/250/500/1,000V a.c. and d.c. 0/1/100/500mA. d.c. 0/100K. 39/6. P. & P. 2/6.

MODEL TE-200. 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50μA/250MA. 0/60K/6 meg. −20 to +62dB. 75/-. P. & P. 3/-.

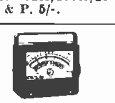
MODEL 500. 30,000 O.P.V. with overload protection, mirror scale 0/·5/2·5/10/25/100/250/500/1,000 V d.c. 0/2·5/10/25/100/250/500/1,000 V. a.c. 0/50 μA/5/50/500 mA. 12 amp. d.c. 0/60K/6 Meg./60 Meg Ω. £8.17.6. Post paid.

MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA/3/30/300mA. 0/16K/160K/1·6M/16 meg. £5.10.0. P. & P. 3/-.

TMK MODEL TW-50K. 46 ranges, mirror scale. 50K/Volt d.c. 5K/Volt a.c. D.c. volts: 0·125, 0·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 10K, 100K, 1 meg., 10 meg. Decibels: −20 to +81·5dB. £8.17.6. P. & P. 3/6.



TE-900 20,000 Ω/VOLT GIANT MULTIMETER. Mirror scale and overload protection. 6in full view meter. 2 colour scale. 0/2·5 / 10 / 250 / 1,000 / 5,000V a.c. 0/25/12·5/10/50/250/1,000/5,000V d.c. 0/50μA/110/100/500mA/10A d.c. 02K/200K/20 meg. ohm. £15.0.0. P. & P. 5/-.



MODEL 5025. 57 ranges, giant 5¼in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0·125, 0·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 2K, 10K, 100K, 1 meg, 10 meg. Decibels: −20 to +85dB. £12.10.0. P. & P. 3/6.

HONOR TE.10A. 20k Ω/Volt 5/25/50/250/500/2,500V d.c. 10/50/100/500/1,000V a.c. 0/50μA/2·5mA 250mA d.c. 0/6K/6 meg. ohm. −20 to +22dB. 10–0, 100 mfd. 0·100–0·1 mfd. 69/6. P. & P. 3/-.

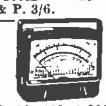
MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA / 6mA / 60mA / 300mA/600mA. 0/8K/80K/800K/8 meg. −20 to +63dB. £5.19.6. P. & P. 3/-.

MODEL TE 80. 20,000 O.P.V. 0 / 10 / 50 / 100 / 500 / 1,000V. a.c. 0/5/25/50/250 / 500 / 1,000V d.c. 0·5μA. 5/50/500mA./0/6K/60/K/600K/6 Meg. £4.17.6. P. & P. 3/-.

MODEL TE-90. 50,000 O.P.V. Mirror scale, overload protection. 003/13/60/300/600/1,200V d.c. 0/6/30/120/300/1,200V d.c. 0·03/6/60/600mA. 16K/160K/1·6/16 meg. −20 to +63dB. £7.10.0. P. & P. 3/-.

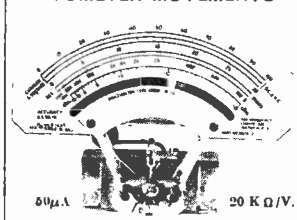
TMK MODEL TW-20CB. Features Resettable Overload Button. Sensitivity: 20K Ω/Volt d.c. 5K Ω/Volt a.c. D.c. volts: 0–0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 0–2·5, 10, 50, 250, 1,000V. D.c. currents: 0–0·05, 0·5, 5, 50, 500mA. Resistance: 0–5K, 50K, 0–500K, 5 meg. Decibels: −20 to +52dB. £11.10.0. P. & P. 3/6.

MODEL AS-100D. 100K Ω/Volt. 5in, mirror scale. Built-in meter protection 0/3/12/60/120/300/600/1,200V d.c. 0/6/30/120/300/600V a.c. 0/10μA/6/60/300mA/12A. 0/2K/200K/2M/200M. −20 to +17dB. £12.10.0. P. & P. 3/6.



TMK LAB TESTER. 100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100μA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: −10 to +49dB. Plastic case with carrying handle, size 7½in × 6¾in × 3½in. £18.18.0. P. & P. 5/-.

AVOMETER MOVEMENTS



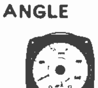
50μA 20 K Ω/V.

Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multi-meter. Brand New Boxed 69/6. P. & P. 3/6.

SKYWOOD SW-500

50 K Ω/Volt. Mirror scale DC Volts 0.6/3/12/30/300/600. AC Volts 3/30/300/600. DC Current 20uA/6/60/600mA. Resistance 10K/100K/1Meg/10 Meg. Decibels −20 to +57db £7.10.0. P & P 3/-.

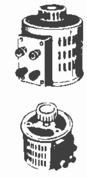
270° WIDE ANGLE 1mA METERS



MW1-6 60mm square £3.19.6. MW1-8 80mm square £4.19.6. P. & P. extra.

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality . Low price . Immediate delivery



MODEL S-260 General Purpose Bench Mounting

1A	£5.10.0
2·5A	£6.15.0
5A	£9.15.0
8A	£14.10.0
10A	£18.10.0
12A	£21. 0.0
20A	£37. 0.0

MODEL S-260 B Panel Mounting

1A	£5.10.0
2·5A	£6.12.6

Please add postage

ALL MODELS INPUT 230 VOLTS, 50/60 CYCLES, OUTPUT VARIABLE 0–260 VOLTS Special discounts for quantity

UNR-30 RECEIVER

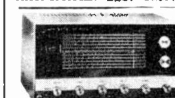
4 Bands covering 550KHz–30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. £15.15.0. Carr. 7/6.

WS62 TRANSCEIVERS

Large quantity available for EXPORT! Excellent condition. Enquiries invited.

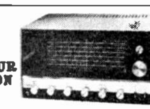
UR-1A SOLID STATE COMMUNICATION RECEIVER

4 Bands covering 55KHz–30MHz. FET, S Meter, Variable BFO for SSB. Built in Speaker, Telescopic Aerial, Bandspread, Sensitivity Control. 220/240V a.c. or 12V d.c. 12⅞in × 4½in × 7in. Brand new with instructions. £25. Carr. 7/6.



LAFAYETTE HA-600 RECEIVER

General coverage 150–400KHz, 550KHz–30MHz. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter, Bandspread. RF Gain. 15in × 9¼in × 8¼in. 18lb. 220/240V a.c. or 12V d.c. Brand new with instructions. £45. Carr. 10/-.



LAFAYETTE HA-800 SOLID STATE AMATEUR COMMUNICATION RECEIVER

3·5–4, 7–7·3, 14–14·35, 21–21·45, 28–29·7, 50–54MHz. Dual conversion, 2 mech. filters, product detector, variable BFO, S Meter, 100KHz calibrator. 220/240V a.c. or 12V d.c. 15in × 9¼in × 8¼in. 18lb. Brand new with instructions. £57.10.0. Carr. paid (100KHz Crystal 39/6 extra).

LAFAYETTE PF60 VHF FM RECEIVER

Solid State. 152–174MHz. Fully tuneable or crystal controlled (not supplied). Built in Speaker, Squelch and Volume Controls. 220/240V a.c. or 12V d.c. Brand new with instructions. £37.10.0. Carr. 10/-.

FULL RANGE OF TRIO EQUIPMENT

VOLTAGE STABILISER TRANSFORMERS

180–260V input. Output 230V. Available 150W or 225W. £12.10.0. Carr. 5/-.

EDDYSTONE VHF RECEIVERS MODEL 770R. 19–165 Mc/s. Excellent condition. £150.

INTERCOM/BABY SITTER

Transistorised Incoms, Ideal for home / office / workshop, etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions, 2 station 59/6. P. & P. 2/6. 4 station £6.12.6. P. & P. 5/-.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

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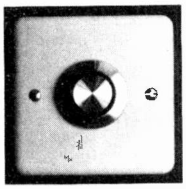

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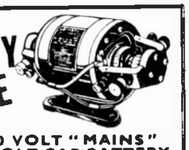

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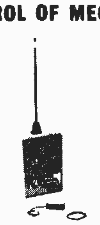

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200μF	6V	125μF	10V	50μF	12V	25μF	25V	2·5μF	64V
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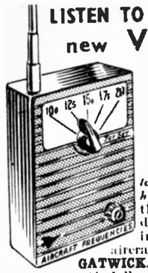

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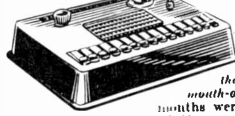

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