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WORKSHOP
OSCILLOSCOPE**



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SUPPLEMENT**



**ALSO:
HIGH
IMPEDANCE
VOLTMETER**

ADCOLA Soldering Instruments add to your efficiency

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for Factory Bench Line Assembly

A precision instrument—supplied with standard 3/16" (4.75 mm) diameter, detachable copper chisel-face bit*.

Standard temp. 360°C at 23 watts.

Special temps. from 250°C—410°C.

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B 38 $\frac{1}{8}$ " — 3.2 mm CHISEL FACE

B 14 $\frac{3}{16}$ " — 2.4 mm CHISEL FACE

B 24 $\frac{3}{16}$ " — 4.75 mm SCREWDRIVER FACE

B 12 $\frac{3}{16}$ " — 4.75 mm EYELET BIT

B 58 $\frac{1}{2}$ " — 6.34 mm CHISEL FACE

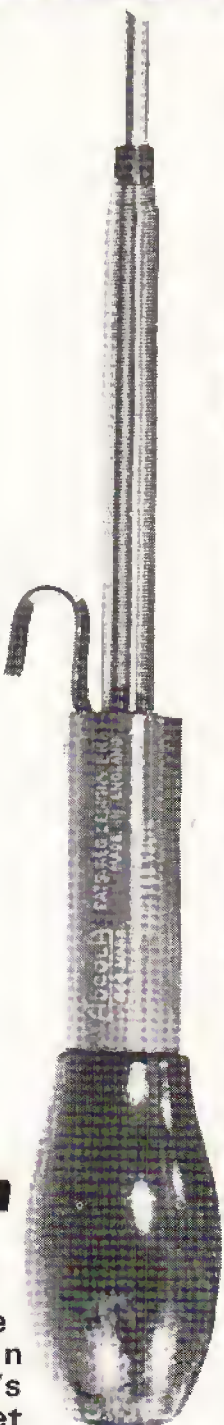
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B 44 LL $\frac{3}{16}$ " — 4.75 mm SCREWDRIVER FACE



Don't take chances. We don't. All our ADCOLA Soldering Instruments are of impeccable quality. You can depend on ADCOLA day after day. That's why they're so popular. You get consistent good service... reliability... from our famous thermally controlled ADCOLA Element and the tough steel construction of this ideal production tool.

ADCOLA
(Regd Trade Mark)

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price list
and
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Size 5 (illustrated) Savbit 18 15p *
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*Recommended Price



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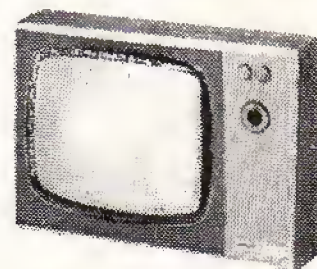
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Carriage and Insurance £1.50

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WIDE RANGE OF MODELS
DEMONSTRATIONS DAILY



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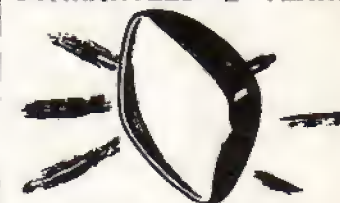
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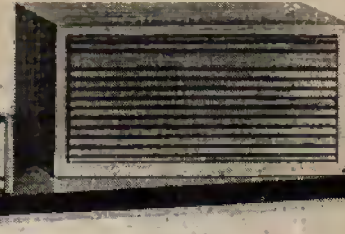
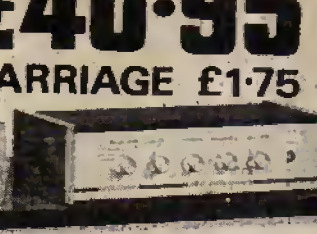
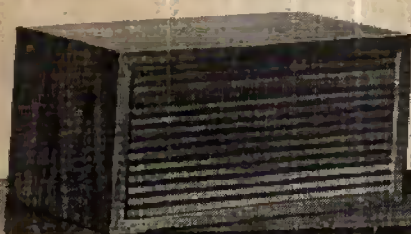
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COMPLETE STEREO SYSTEM

FOR ONLY

£40.95

CARRIAGE £1.75



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 x 5 1/2 x 3 1/2 in. high (Amplifier available separately if required £14.95 Carr. 40p.) **NOW AVAILABLE - MATCHING FM TUNER £22.05**

PREMIER STEREO SYSTEM "TWO"

As system "ONE" above but with Garrard SP25.

PREMIER PRICE £47 Carr. £1.75

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



MODEL 19-520



MODEL 19-542

Specifications

Semiconductors

Tuning range

Aerial

Frequency response

Power output

Inputs

Speaker impedance

Controls

Function selector

Size

PRICE

MODEL 19-520

19 transistors, 12 diodes, 2 varistors
FM 88-108 MHz
FM Stereo Multiplex
AM 535-1635 kHz
Internal AM and external FM
50-17,000 Hz
2 1/2 watts rms per channel (8 watts music power)
Ceramic phone

4-8 ohm
Power on/off, Volume, tone, balance, tuning, AFC, Stereo indicator

AM, FM, FM Stereo, Stereo indicator light
15" x 8 1/2" x 3 1/2"

£30.45

Carr. & Ins. 50p

MODEL 19-542

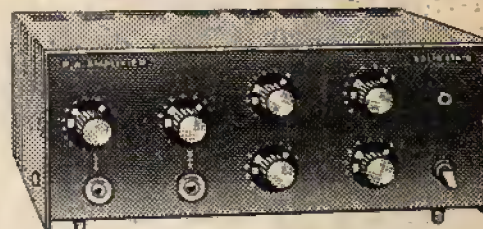
22 transistors, 12 diodes
FM 88-108 MHz
FM Stereo Multiplex
AM 535-1605 kHz
Internal AM and external FM
35-20,000 Hz
4 watts rms per channel (18 watts music power)
Magnetic/Ceramic phone and aux.
8 ohm
On/off, Volume, bass, treble, balance, tuning, AFC, Stereo indicator

AM, FM, FM Stereo, Ceramic, Magnetic, Aux.
16 1/2" x 9 1/2" x 3 1/2"

£44

Carr. & Ins. 50p

50 Watt Public Address Amplifier MODEL PA-5000



A top quality amplifier giving 50 watts rms power output (80 watts peak). Incorporates 8 transistors and 4 silicon diodes (silicon output transistors). Inputs for 2 microphones each with individual volume controls, plus radio/aux input. Master volume control and Bass and Treble Controls. Well presented front panel for ease of operation, on/off power flick switch and pilot light. Output impedance 4/8/16 ohms. Mike 1 & 2 sensitivity 2mV (50Kohms). Radio/Aux 300mV (100Kohms). Frequency response 50-20,000 Hz. Fused output and thermal overload protection. A.C. Mains 220-250v, 50/60 Hz. Size 13 1/2" x 9" x 5"

PREMIER PRICE £39 P. & P. 50p



E.M.I. 13x8in. HI-FI SPEAKERS

Fitted two 2 1/2 in tweeters and crossover network. Impedance 8 or 15 ohm. Handling capacity 10W. Brand new.

£3.47 P. & P. 40p

VERITAS V-149 MIXER

Battery operated 4-channel audio mixer providing four separate inputs. Size 6 x 3 x 2 in. suitable for crystal microphone low impedance microphone, with transformer, radio, tape, etc. Max. input 1.5v. Max. output 2.5v. Gain 6 dB. Standard jack plug socket inputs, phono plug output. Attractive teak wood grain finish case.



MONO MODEL £3 STEREO MODEL £3.47 P. & P. 12p



HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2 1/2 in speaker units with soft padded ear muffs. Adjustable headband. 8 ohms impedance. Complete with 6ft lead and stereo jack plug.

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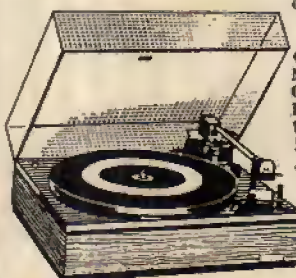
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Total list price over £24. **PREMIER PRICE**

£18.90

P. & P. 50p.



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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.

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P. & P. 5p.

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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 x 7in x 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 £40.50 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 $\pm$ 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 £49.50 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 indestructible. Allied to this is its very high power output (70W R.M.S.), a frequency response (30-20,000Hz $\pm$ 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: 15in x 5in x 6in.

PRICE £63.00 inc. P & P.

Also available DJ105S 30W PA Amplifier. Similar specification to above.

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1H5GT	-38	30C1	-32	DL94	-37	EM80	-41	PCL84	-87	UBF80	-34
1N5GT	-38	30C15	-83	DL96	-38	EM81	-41	PCL85	-45	UBF89	-33
1R5	-28	30C17	-80	DY86	-28	EM84	-33	PCL86	-41	UCC84	-35
1R5	-21	30C18	-87	DY87	-28	EM87	-37	PCL88	-72	UCC85	-36
1T4	-16	30F5	-76	EABC80	-32	EY61	-36	PCL800	-77	UCF80	-38
384	-28	30FL1	-63	EAF42	-50	EY86	-32	PEN44	-42	UCH42	-62
3V4	-37	30FL12	-72	EB91	-11	EZ40	-43	PEN36C	-70	UCH81	-32
5Y3GT	-30	30FL14	-72	EBC33	-40	EZ41	-43	PFL200	-58	UCL82	-35
5Z4G	-37	30L1	-32	EBC41	-52	EZ90	-23	PL36	-48	UCL83	-65
6/30L2	-58	30L15	-65	EBC90	-23	EZ81	-24	PL81	-46	UF41	-62
6AL5	-11	30L17	-73	EBF80	-33	GZ32	-48	PL81A	-61	UF89	-33
6AM6	-18	30P4	-85	EBF89	-31	GZ34	-48	PL82	-30	UL41	-60
6AQ5	-26	30P12	-77	ECC81	-18	KT41	-77	PL83	-35	UL44	£1.00
6AT6	-22	30P19	-85	ECC82	-23	KT61	-48	PL84	-32	UL84	-35
6AU6	-22	30PL1	-63	ECC83	-35	KT66	-63	PL600	-65	UM80	-25
6BA6	-22	30PL13	-88	ECC85	-23	LN819	-72	PL604	-67	UM84	-22
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6BJ6	-42	30PL15	-72	ECF80	-30	LN339	-63	PM34	-87	UY85	-23
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6F23	-78	807	-45	ECH81	-28	PC86	-51	PY81	-28	Transistors	
6F25	-82	6063	-62	ECH83	-41	PC88	-51	PY82	-28	AC107	-17
6K7G	-12	AC/VP2	-77	ECH84	-37	PC96	-42	PY83	-28	AC127	-18
6K8G	-17	AZ31	-47	ECL80	-35	PC97	-40	PY88	-34	AD140	-37
6SL7GT	-27	B249	-65	ECL82	-33	PC900	-37	PY800	-37	AF115	-20
6V6G	-17	B729	-62	ECL86	-40	PC84	-32	PY801	-37	AF116	-20
6V8GT	-32	COH35	-87	EF39	-23	PC85	-30	R19	-32	AF117	-20
6X4	-23	CL33	-82	EF41	-58	PC88	-45	R20	-65	AF118	-48
6X5GT	-23	CY31	-33	EF80	-24	PC89	-47	U25	-68	AF125	-17
10F18	-35	DAC32	-36	EF85	-31	PC189	-51	U26	-65	AF127	-17
10F13	-60	DAF91	-21	EF86	-31	PC806	-65	U47	-68	OC28	-25
12AH8	£2.25	DAF96	-36	EF89	-26	PCF80	-32	U49	-85	OC44	-12
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12AU6	-23	DF91	-16	EF183	-23	PCF86	-47	U191	-62	OC71	-12
12AU7	-23	DF96	-36	EF184	-32	PCF800	-67	U193	-42	OC72	-12
12AX7	-23	DH77	-22	EH90	-42	PCF801	-33	U251	-72	OC75	-12
19BG6G	-37	DK32	-37	EL33	-48	PCF802	-45	U301	-52	OC81	-12
20F2	-67	DK91	-28	EL34	-47	PCF803	-67	U329	-72	OC81D	-12
20P3	-85	DK92	-42	EL41	-55	PCF806	-60	U801	-98	OC82	-12
20P4	-82	DK96	-38	EL84	-24	PCF808	-72	UABC80	-32	OC82D	-12
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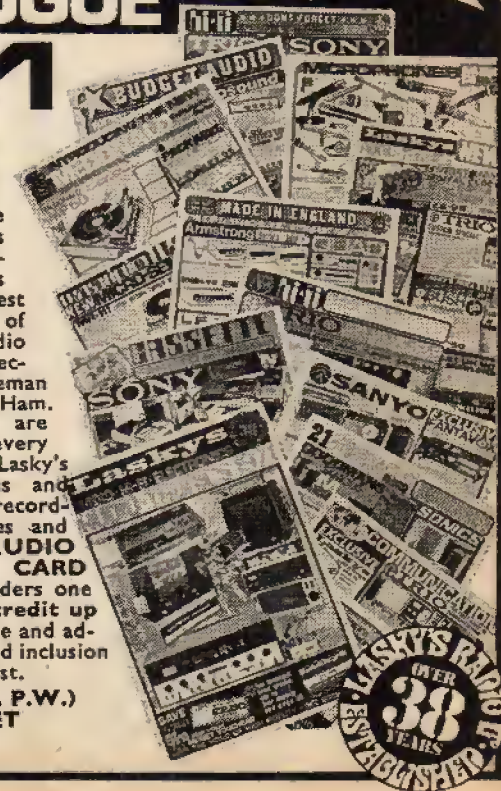
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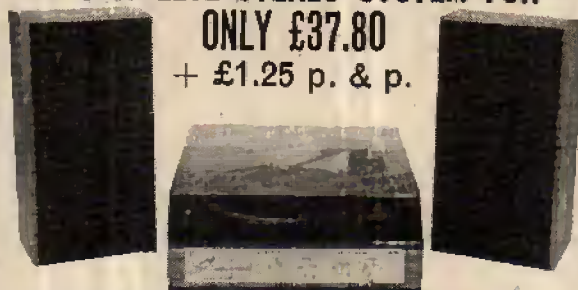
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A COMPLETE STEREO SYSTEM FOR ONLY £37.80 + £1.25 p. & p.



ITS PERFORMANCE CAN BE COMPARED WITH EQUIPMENT COSTING AT LEAST £130 THE APOLLO 100% MADE IN ENGLAND

This modern compact unit has been specially designed to give the maximum stereo performance in your home. Slenderly designed, the unit employs the latest Garrard 2025TC record deck which enables you to play your records manually or allow the machine to auto-change up to eight records automatically. The Garrard record deck is fitted with a cue and pause control which allows you to manoeuvre the arm of the deck to any chosen track of your record. Also used is a locking device to prevent the arm from moving whilst unit is in transit.

The amplifier used in this unit will give a true 5 watts (R.M.S.) per channel with maximum performance of base and treble. The controls are of a simple nature and allow you to adjust the balance of sound through each speaker, also the volume required, bass and treble.

The two speaker systems supplied with this audio unit are designed to give the best possible sound reproduction, the twin cone base unit will give a good bass response and the parasitic tweeter employed will clarify the high notes in your listening pleasure.

Finished in teak, this Hi-Fi compact unit will blend into any modern home and give you hours of listening pleasure in true stereo. 12 months guaranteed SPECIFICATION. Deck—Garrard 2025TC. Cartridge—Garrard G.C.538 with sapphire stylus. Output 5 watts (S.M.S.) per channel. Frequency: 40Hz to 20,000Hz. Speakers: Apollo 66 Three-way general purpose 15-16 ohms. 6" Twin cone base unit: 2 1/2" Parasitic Tweeter: LC Crossover; Suitable acoustic padding. Finish: Polished teak plynth and speaker cabinets: Charcoal tinted Perspex cover; Unit finished silver and black. Size: Unit 14 1/2" x 12 1/2" x 7 1/2". Speakers 14 1/2" x 8" x 6 1/2".

CARTRIDGES (p. & p. 12+p.)

GOLDRING G850	£4.20
GOLDRING G800	£6.09
GOLDRING G800E	£11.00
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SMC-101 MOVING MAGNET STEREO CARTRIDGE.
PRICE: £3.25.

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For complete specification on the above see our March Issue, Page 889.

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HL AUDIO SA 707	£27.00
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The **APOLLO 3-WAY SPEAKER SYSTEMS** are designed and built on the Infinite Baffle Principle and are completely Airtight and fully padded to damp out any Panel Resonance. Polished on all sides they can be used either vertically or horizontally and are ideal for Shelf or Wall Mounting.

Below are just a few from the **APOLLO** comprehensive range starting with:

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Impedance 8 ohms. Power Handling 15 watts. RMS (30 watts peak). Frequency Range: 35 to 18,000Hz. Colour: Teak. Size 21 x 15 x 7 1/2 in. **PRICE £18.50 each (p. & p. £1.00).**

THE APOLLO-10 3-WAY SPEAKER SYSTEM employs a specially designed 10in. Bass Unit which has a high efficiency Anisotropic Ferrite Magnet and two 4in. Treble Units and LC

Crossover Network. Specification: Impedance 4-8 ohms (15-16 ohms to order). Power Handling 10 watts RMS (20 watts peak). Frequency Range 50 Hz to 18,000 Hz. Size 21 x 11 1/2 x 9 1/2. Finish: Polished Teak.

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As above but 7 watts RMS (14 watts peak). F.R. 55 to 18,000 Hz. Size 20 x 12 x 8 in. **£10.12 each (50p p. & p.).**

APOLLO-66 3-WAY SPEAKER SYSTEM

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The Gern



Adler Story.

Once upon a time Gerry Adler worked a 25 hour day making and selling valve filament testers. And very efficient they were too.

But at that time the Japanese could make them for about half the price, and sent Gerry one to prove it. It was as good as the ones he was making, so he sold it. And every other one he could get into the country.

After a time Gerry decided to go one step further. He designed some electronic equipment and had it built to his specification in Japan. Then he sold it here under the brand name 'Eagle'. Nothing particularly remarkable about that. But Gerry couldn't stand the idea of a barrier between him and his manufacturers. So he went to Japan. He poked his nose into all the electronics factories to find out how the Japanese worked. And when he got back he started to learn Japanese, and to study their history, culture and way of life. That way he had fewer communication problems and could get what he wanted.

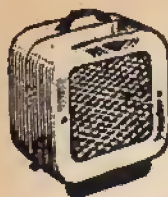
That's what matters to Gerry. He's very fussy about what goes out under the Eagle banner. Because Eagle aren't in the filament testing business any more. They make just about everything electronic: amplifiers, test equipment, PA systems, intercoms, old uncle substation and all. Eagle is now twelve years old, and has opened offices in New York, Tokyo and Brussels.

This isn't just so much chest expansion on Gerry's part. He puts his money where his mouth is. If you think one of his products is not as good as a rival's, or it's faulty, or it's not all it should be, Gerry wants to know.

So write to him personally. He'll do something about it. He wants to make sure the Gerry Adler story has a happy ending.

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2kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2kW), switch down for half heat (1kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3.75. Post and ins. 38p.

12 VOLT BATTERY CHARGER

Made in Japan, this is very small and neat. Regular use will keep your car battery in good trip throughout the winter. Silly price £1.25 plus 23p postage and insurance.

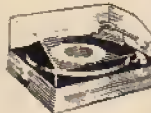
QUICK CUPPA

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. £1.25, post and insurance 14p. 12v. car model also available £1.



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Suitable for most auto changers, teak base with tinted perspex cover £4.25 plus 33p postage.



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Will dim incandescent lighting up to 600 watts from full brilliance to out. Assembled and wired ready to install £3.



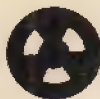
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With dash board control switch—fully extendable to 40" or fully retracted. Suitable for 12V positive or Neg. earth supplied complete with fitting instructions and ready wired dash board switch £5.95 plus 25p. p. & p.



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2,400 ft. of the best magnetic tape money can buy. Made by E.M.L., 1in. wide almost unbreakable and on a 10in metal computer spool. Users have claimed successful results with video as well as sound recordings £1 plus 33p post. Cassette to hold spool 50p extra.



HORSTMANN "TIME AND SET" SWITCH

(A 15 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 period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special sup price £1.50, p. & ins. 23p.



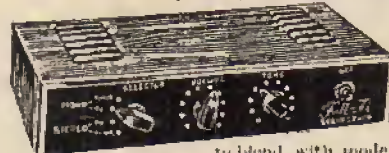
1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4 1/2 x 3 1/2, 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 mikro-switch £1.15.



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 in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6 watts B.M.B. 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.

UNREPEATABLE PRICE is £9 plus 38p post and insurance.

STANDARD WAFER SWITCHES



Standard Size 1 1/2 wafer—silver-plated 5 amp contact, standard 1/2" spindle 2", long—with locking washer and nut.

No. of Poles	2		3		4		5		6		8		9		10		12	
	way	way	way	way	way	way	way	way	way	way	way	way	way	way	way	way	way	way
1 pole	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
2 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
3 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
4 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
5 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
6 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
7 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
8 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
9 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
10 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
11 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p
12 poles	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p	33p

Where postage is not stated then orders over £5 are post free. Below £5 add 20p Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

SPARTAN Portable RADIO

Long and medium wave, 7 transistors, size 6in. x 4in. x 1 1/2in. with larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carry sling, earpiece and case £3.75 plus 25p post and ins.



MULTI-SPEED MOTOR

Replacement in many well known food mixers. Six speeds are available. 500, 850 and 1100 r.p.m. from either or both of the nylon sockets (Where the beaters of the food mixers normally go) and 8,000, 12,000 and 15,000 r.p.m. (Ideal polishing speeds) from the main drive shaft. Very powerful and useful motor size approx. 2in. diameter, 5in. long. Price 90p plus 23p, p. & ins. 12 or more post free.



MAINS OPERATED CONTACTOR

220/240v. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 amps. Extremely well made by a German Electrical Company. Overall size 2 1/2 x 2 x 2in. £1 each.



DOUBLE ENDED MAINS MOTOR

On feet with holes for screw-down fixing. To drive models, oven, blower heater, etc. 50p each, plus 18p post and insurance, 6 or more post free.



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Transistorised Stereophonic High Fidelity AM/FM Tuner Amplifier System.



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P. & P. 88p

Easily fitted no technical knowledge necessary.

Credit Terms available. First monthly payment of £5.83 followed by 9 monthly payments of £4.95. Total Credit Sale Price £49.50. Send £5.83 today.

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Transistorised Stereo Hi-Fi Record Player. Build your own Hi-Fi Record Player with the Serenade fully transistorised amplifier which comes complete with 2-10in. x 6in. speakers and the latest 4 Speed BSR Speed Stereo/Mono Record Changer.

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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 £2, less than the value of the clock alone—post and insurance 14p.



FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, 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. £1. Kit B—30-40 w. £1. Kit C—80 w. £1.20. Kit D—45 w. £1.20. Kit E for 8ft. 125 w. tube £1.75. Kit MF1 is for 6in., 9in. and 12in. miniature tubes £1. Kit MF2 for 21in. 13 w. miniature tube £1. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

BLANKET SWITCH

Double pole with neon light into side so luminous in dark. Ideal for dark room light or for use with waterproof element, new plastic case 30p each. 3 heat model 40p.



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 1 amp. Listed at £1.40 each we offer these while our stocks last at only 65p. each.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:

Miniature. 1in. long x approximately 1/4in. diameter. Will make and break up to 1A up to 300 volts. Price 13p each. £1.20 dozen.
Standard. 2in. long x 3/16in. diameter. This will break currents of up to 1A, voltages up to 250 volts. Price 10p each. 90p per dozen.
Flat. Flat type, 2in. long, just over 1/16in. thick, approximately 1/4in. wide. The Standard Type 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 30p each. 23p per dozen.
Small ceramic magnets to operate these reed switches 9p each. 90p per dozen.

HIGH CAPACITY ELECTROLYTICS

Brand new, not ex-equipment.
100 mfd. 25v., 6p each. 60p doz.
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500 mfd. 12v., 10p each. £1.05 doz.
500 mfd. 25v., 18p each. £1.80 doz.
500 mfd. 50v., 23p each. £2.40 doz.
500 mfd. 350v., 43p each. £4.50 doz.
1000 mfd. 12v., 15p each. £1.50 doz.
1000 mfd. 18v., 17p each. £1.70 doz.
1000 mfd. 64v., 37p each. £4 doz.
2000 mfd. 25v., 34p each. £3.95 doz.
5000 mfd. 12v., 24p each. £2.40 doz.
10,000 mfd. 6v., 29p each. £3 doz.
10,000 mfd. 15v., 43p each. £4.50 doz.
15,000 mfd. 10v., 53p each. £5 doz.
60,000 mfd. 8v., £1.10 each. £10 doz.
70,000 mfd. 18v., £2 each. £20 doz.

3 amp 12v Battery Charger Kit—comprising 230/40 mains transformer with 3 amp secondary and 3 amp rectifier £1.15 plus 23p post.

12 volt 1 1/2 amp Power Pack. This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 mfd/40 smoothing. Price £1.40.

Sonotone Stereo Cartridge. Turnover type, ref. No. 19 T1. This fits most British pick-ups and is a really excellent reproducer. Limited quantity, £1.50 each. 5 amp 3 pin Sockets. These are always good stock, you never know when you will need some. Famous make, brown bakelite, standard size, 12 for 65p plus 23p post.

Ditto but with switch. 12 for £1 plus 23p post.
13 amp sockets, flush mounting. Bakelite, cream-less switch. 6 for £1.

Bakelite Panels, many thicknesses. We have just taken delivery of approximately 10 tons of bakelite in varying thicknesses from 2in. to a few thou. If you have a need for any of this then we would be glad to supply. The thickest is very heavy and could be used, for instance, as a bed for a motorised unit. Medium thickness is useful for front panels of instrument, etc., etc. Cut to your size price is 30p per lb. plus 30p cutting charge plus carriage.
2 amp 3 pin Switched sockets for surface mounting, brown bakelite. Made by famous maker, 13p each or £1.20 dozen.

100 Assorted Silicon Rectifiers G.P. and switching diodes. Small and very small sizes. A real snip for experimenters, 65p per 100.

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 5 1/2 x 3 1/2 x 2 1/2 in. deep. Metal encased, glass fronted with chrome surround. Offered at £2.40 plus 23p postage and insurance.



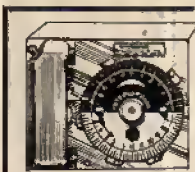
HI-FI SPEAKERS (15, 30, 40 & 100W)

FULL FI12 INCH LOUDSPEAKER. This 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 load and Rhythm Guitar and public address. Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone Moulded fibre—Freq. response 30-10,000 c.p.s.—Specify 3 or 15 ohms—Mains resonance 60 c.p.s.—Chassis Diam. 12in.—12 1/2in. over mounting lugs—Baffle hole 11in. Diam.—Mounting holes 4, holes—1in. diam. on pitch circle 11 1/2in. diam.—Overall height 5 1/2in. A 26 speaker offered for only £4 plus 37p p. & p. 12in. 40 watt £7 carr. 43p. 15in. 25 watt £3 carr. 53p. 18in. 100 watt £19.50 carr. £1.50.



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A parcel of integrated circuits made by the famous Plessey Company. A once-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 24-HOUR ELECTRIC TIME SWITCH

Made by Smith's, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp changeover contacts will switch circuit on or off during these periods. £2.50 post and ins. 23p. Additional time contacts 60p pair

DISTRIBUTION PANELS

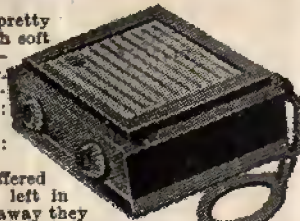
Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, £2 less plug £2.25 with fitted 13 amp plug; £2.40 with fitted 15 amp plug, plus 23p P. & L.



BARGAIN OF THE YEAR

MICROSONIC KEYCHAIN RADIO

7 transistor Keychain Radio in very pretty case, size 2 1/2 x 2 1/2 x 1 1/2 in.—complete with soft leather zipped bag. Specification:—Circuit: 7 transistor superheterodyne. Frequency range: 530 to 1600 Kc/s. Sensitivity: 5 mv/m. Intermediate frequency: 465 Kc/s or 455 Kc/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 £1.25 less batteries plus 13p. post 6 for £7 post free. Pair of rechargeable batteries and charger 85p.



4 AMP VARIAC CONTROLLERS

With this you can vary the voltage applied to your circuit from zero to full mains without generating undue heat. One obvious application therefore is to dim lighting. Ex equipment but little used—as good as new offered at approx. half price. £5 plus 75p. post and ins.



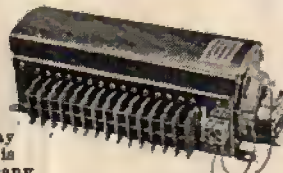
19 PIECE SOCKET SETS

Complete with wall or bench rack. Most useful sizes from 1/4" to 1 1/2" 80p plus 23p post and insurance.



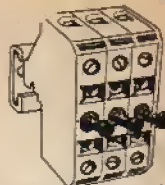
HONEYWELL PROGRAMMER

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 £5.75 plus 23p post and insurance. Don't miss this terrific bargain.



Mains Connector

A quick way to connect equipment to the mains safely and firmly—L, N, and E, coded to new colour scheme; 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, 65p each.



DRILL CONTROL

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. £1.50 plus 13p post and insurance. Made up model also available, £1.90 plus 13p post & p.



BALANCED ARMATURE UNIT

500 ohm. operates speaker or microphone, so useful in intercom or similar circuits. 33p ea. 25.30 doz.



PROTECT VALUABLE DEVICES FROM THERMAL RUNAWAY OR OVER-HEATING

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 190 deg. F. or with the dial removed range setting is between 80 to 800deg. F. Price 50p.



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 63p each. Postage and insurance 14p.



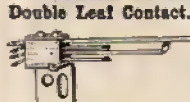
MAINS MOTOR

Precision made—as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 50p. Postage 15p for first one then 5p for each one ordered.



NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. 6p each. 60p doz. Plastic push-rod suitable for operating, 5p each, 45p 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 13p each, £1.80 dozen, your assortment.



WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. 60p post free.

MICRO SWITCH

5 amp. changeover contacts, 9p each, £1 doz. 15 amp. Model 10p each or £1.05 doz.

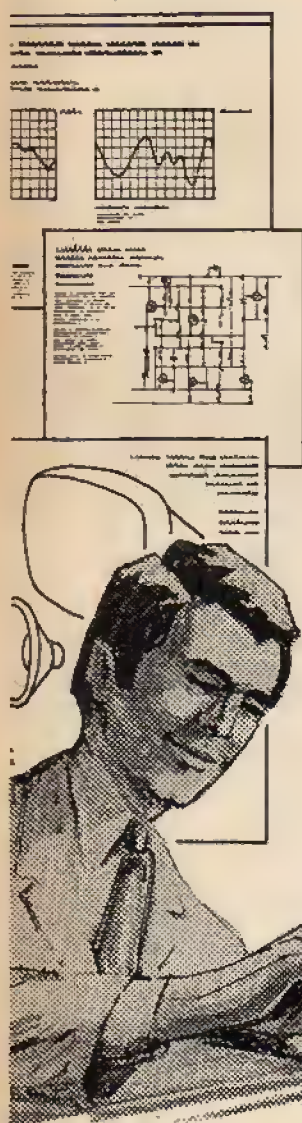


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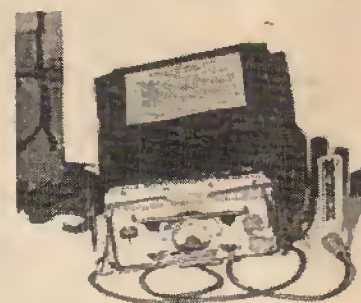
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Well-known contamination meter comprised of main unit fitted with meter marked in 'Milli Rontgens/Hour', probe, lead and carrying case. A very sensitive set which will give a good reading from most pocket watches. Very low battery consumption. Audio output available from socket on front panel. Supplied in new or as new condition.



Model 1. Supplied with internal vibrator power supply unit, enabling set to work from 4 pen cell batteries £4.47 plus 37p p.p.

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TRANSISTOR MODULATOR FRONT END 4 transistor modulator pre-amp panel 2 1/2" x 4 1/2". Fitted with preset microphone gain control and mod. filter. Originally used to drive an NKT404 which drove a pair of NKT404s. Supplied brand new with circuit of complete modulator £1.12 plus 7p p.p.

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VHF RECEIVER UNIT TYPE R1933A. 18 miniature valve vhf receiver ideal for 2 metres, 4 metres or aircraft band. Requires p.s.u. and oscillator. £2.25 plus 30p p.p.

300 UNTESTED UNMARKED TRANSISTORS. £1.00 plus 10p p.p.

600 UNTESTED UNMARKED DIODES. £1.00 plus 10p p.p.

ELECTRO MAGNETIC COUNTERS. 4 digit GPO type counters. Used but tested. Six for £1.30 plus 3/6d. p.p.

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CONSTRUCTOR'S PARCEL NO. 1. Contains one 455Kc/s transistor FM IF panel, new but faulty; 60 untested unmarked diodes; 3 audio osc and timer 1/Cs with circuits; 6 miniature 12 vdc 100pF capacitors; 4 matched diodes; 5 2S3010 and 5 DT1602s. £1.87 post free.

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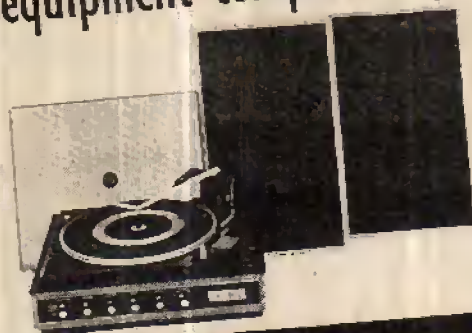
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LEWIS AUDIO SYSTEMS comprise ready built equipment designed and built to advanced technical standards of efficiency and styling. Their prices make true hi-fi available to a wider public than ever. Based on the excellent **Lewis Audio SA. 55** stereo amplifier in which FETS are used in the pre-amp to ensure better quality throughout, the range offers choice of free-standing amplifier with separate playing unit in plinth with plastic hard top or the **Compact** assembly in which the amplifier is built into the base of the plinth and motor assembly. Separate matched speakers are available for either system. Illustrated above is the **Lewis S.55 Mk. II Compact System**.

LEWIS AUDIO SYSTEMS

SA.55 STEREO AMPLIFIER—8 watts RMS output per ch. into 15 ohm speakers. Controls— Input selector/Vol/Bass/Treble/Balance/ On-Off. Tape Record and replay facilities. DIN socket connections. Modern leak finished cabinet. R.R.P. **£18.90**

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SC.55 Mk. II 'Compact' with Garrard 2025TC and SA.55 amplifier built into plinth R.R.P. **£40.32**

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LS.16 'Major'—13" x 8" three way system in American Walnut finished cabinet. 8 ohms R.R.P. **£11.70**

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● **TRADE ENQUIRIES WELCOME**

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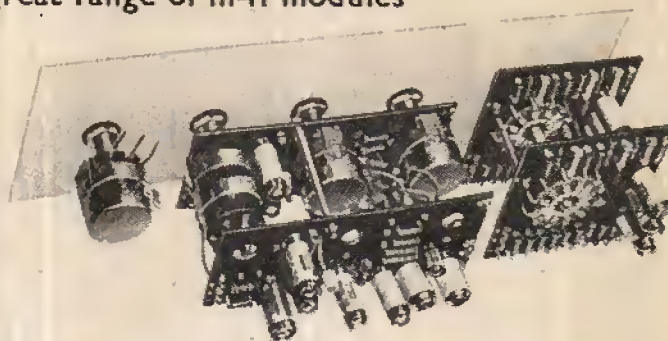
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MARTIN AUDIOKITS were first to make modular unit construction available to the hi-fi enthusiast keen to save by building his own assembly. **AUDIOKITS** were first to feature "add-on-ability" by which a simple system could be expanded to high performance stereo equipment by the addition of easily added on units. Many who built with **MARTIN AUDIOKITS** years ago continue to enjoy unsurpassed quality and reliability from them to this day. **NOW YOU CAN BUY AUDIOKITS AGAIN** to allow you to build a high fidelity system to your personal choice and which will satisfy completely on performance, simplicity of assembly, robustness and reliability. These units are beautifully engineered and solidly built for a lifetime of trouble-free service. You can start with mono and add on units to make stereo, or build with stereo throughout.

TYPICAL MARTIN ASSEMBLIES

1478E Five stage matched input selector unit; controls and pre-amp; power amp. (10 watts RMS into 15 ohms) power supply; front escutcheon plate (mono) Total price **£17.50**

1478SE Similar to above but for stereo. Total price **£29.95**

9748SE Stereo assembly for use with high grade ceramic and low power mag. pick-ups. Total price **£32.95**

All units are obtainable separately. State pick-up when ordering.



● **EACH MARTIN AUDIOKIT MODULE IS COMPLETE IN ITSELF AND REQUIRES THE ADDITION OF NO FURTHER COMPONENTS TO IT.**

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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—anytime, 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 x 1.4V Mercury battery. Mallory type RM625 or equivalent. Mallory battery is not rechargeable.

COMPLETE WITH EARPIECE ONLY POST
RECHARGEABLE BATTERY £1.48 18p
POCKET CARRYING CASE

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

BARGAIN PACKAGE

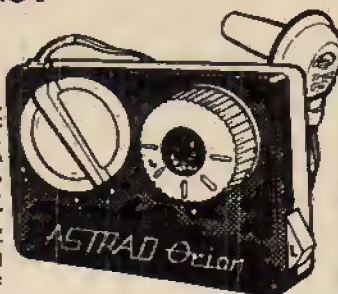
COMPRISING—1 ORION RADIO
1 RECHARGEABLE BATTERY AND
BATTERY CHARGER **£2 POST 20p**

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.



MP.60 McDONALD PROFESSIONAL SERIES FOUR SPEED SINGLE PLAY UNIT

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



LASKY'S PRICE
£12.50 post 35p

complete with plinth and cover **LASKY'S PRICE £15.75** Post 40p

610 AUTOMATIC TURNTABLE

Same specifications as the MP60 but with synchronous four pole motor and full automatic change facilities.

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510 AUTOMATIC TURNTABLE

Counterbalanced pick-up arm, pressed steel turntable, bias compensator, viscous cueing and synchronous four pole motor.

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WITH PLINTH AND COVER £16.95 POST 40p

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Low-mass square section pick-up arm, cue and pause lever, visual stylus pressure indicator, slide-in cartridge carrier, four pole motor.

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BSR McDONALD PACKAGES

PACKAGE No. 1

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AUDIO DEVELOPMENT AD76K Magnetic Cartridge £ 4.50
BSR Afrosmosia Plinth with black mounting board..... £ 5.00
BSR Smoked Perspex Dust Cover £ 3.50
Recommended retail price £30.00

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ADD £6.50 if Shure M44/5 is preferred

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BSR McDONALD 310 4 Speed Autochanger £14.00
AD76K Magnetic Cartridge £ 4.50
BSR Afrosmosia Plinth with black mounting board..... £ 5.00
BSR Smoked Perspex Dust Cover £ 3.50
Recommended retail price £27.00

LASKY'S PRICE £23.50
ADD 50p if BSR Ceramic Cartridge is preferred

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LASKY-McDONALD
plinth and cover **£4.75** POST 25p
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WAFER TYPE ELECTRO DYNAMIC

This revolutionary idea in sound reproduction functions in a similar manner to the cone loudspeaker system. In place of the conventional paper cone is a flat, rigid plastic panel only a fraction of the depth of the equivalent cone structure. With a flat rectangular panel a larger piston area is also available thereby reducing the size compared with an equivalent cone loudspeaker.
Power capacity: 20 watts (peak). Freq. range, 40Hz-20,000 Hz. Input imp.: 8 ohms. Size: 11 1/2in x 14 1/2in x 1 1/2in. Weight: 9oz.



LASKY'S PRICE £5.75 each **£11** for two: Post 20p each

EXCLUSIVE TMI & TM5

MODEL TM-1 1000 ohms/v MINI-TESTER

The first of Lasky's new-look top value meters, the TM-1 is a really tiny pocket multimeter providing "big" meter accuracy and performance. Precision movement calibrated to $\pm 3\%$ of full scale. Click stop range selection switch. Beautifully designed and made impact resistant black case—with white and metallic red/green figuring. Ohms zero.

- DC/V: 0-10-50-250-1,000 at 1K/OPV.
- AC/V: 0-10-50-250-1,000 at 1K/OPV.
- DC CURRENT: 0-1mA, 100mA.
- Resistance: 0-150k Ω .
- Decibels: -10dB to +22dB.
- Complete with test leads, battery and instructions.

LASKY'S PRICE £1.95 POST 13p



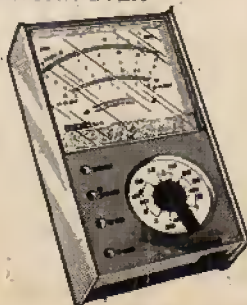
Size
Only
3 1/2in. x 2 1/2in.
1 1/2in.

MODEL TM-5 5k OHMS/V POCKET MULTIMETER

Another new look pocket multimeter from Lasky's providing top quality and value. The "slimline" impact resistant case—size: 4 1/2in. x 2 1/2in x 1 1/2in, fitted with extra large 2 1/2in square meter. Readability is superior on all low ranges; making this an excellent instrument for servicing transistorised equipment. Recessed click stop selection switch. Ohms zero adjustment. Buff finish with crystal clear meter cover.

- DC/V: 3-15-150-300-1,200 at 5K/OPV.
- AC/V: 6-30-300-600 at 2.5K/OPV.
- DC Current: 0-330 μ A, 0-300mA.
- Resistance: 0-10k Ω , 0-1M Ω .
- Decibels: -10dB to +16dB.
- Complete with test leads, battery and instructions.

LASKY'S PRICE £2.95 POST 13p



SONY TFM 8030L

BARGAIN SCOOP

HIGH PERFORMANCE 11 TRANSISTOR THREE WAVEBAND PORTABLE BATTERY/MAINS RADIO

This is a really top performance, top quality solid state receiver packed with SONY know-how and backed by the outstanding reliability for which SONY are renowned. Now this outstanding set is available from Lasky's at over 27% below the manufacturer's list price making it without a doubt the NUMBER ONE SCOOP of 1971! Just look at these outstanding features. Covers MW, LW and FM (VHF). 11 transistor circuit for high sensitivity and stability. Powerful output to 5" P.M. Dynamic speaker with rich clear tone quality. AFC for drift free VHF reception. Push-button wavechange selectors and tone control.

Choice of three power sources—9V battery, household mains or car battery with suitable adaptors. Dial light for use in the dark. External jacks for earphone, tape recording, external power input and car aerial. Ultra modern styling and superb finish with padded leatherette covered cabinet for superior sound damping with chrome trim, strong carrying handle.

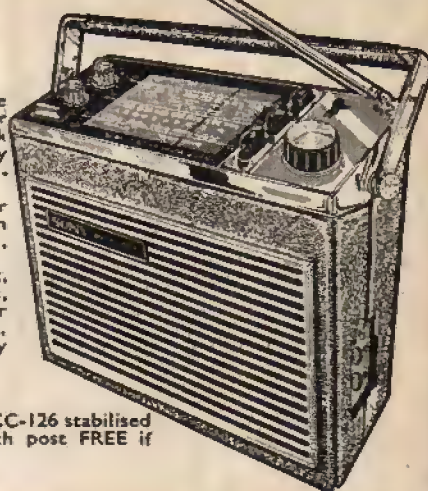
The SONY TFM 8030L will enliven your leisure hours anywhere, anytime with exciting sound, news, sport, music, etc. Technical specification: Freq. range, FM 87-108MHz, LW150-Z85kHz, MW530-1,605kHz. Circuit: 11 transistors, 7 diodes and 2 thermistors. Aerial System: Directional telescopic for FM, internal ferrite bar for LW/MW. Power Output: 1.85W max. Speaker PM Dynamic—4Ωimp. Power Source: 9v power pack battery (Ever-Ready PP9 or equiv.), AC mains with adaptor, Car battery with adaptor. Size: 9½(W) x 8½(H) x 3½(D). Complete with earphone and battery and full instruction manual.

MANUFACTURER'S LIST PRICE £29.75

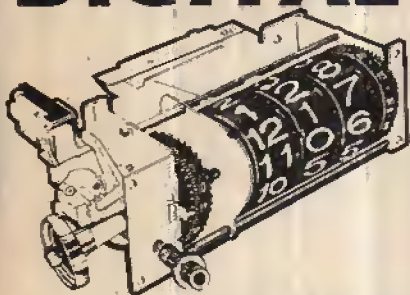
LASKY'S SPECIAL OFFER PRICE **£21.50**

Optional Extras. SONY AC-90e AC adaptor £4.00 DCC-126 stabilised car battery £6.00. Both post FREE if purchased with radio.

Post 35p



EXCLUSIVE DIGITAL CLOCK SCOOP!



- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
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- 12 HOUR ALARM
- AUTO "SLEEP" SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACK-WARD TIME ADJUSTMENT
- SILENT OPERATION
- SYNCHRONOUS MOTOR

- SHOCK AND VIBRATION PROOF
- BUILT IN ALARM BUZZER

SPECIAL QUOTATIONS FOR QUANTITIES

This unique DIGITAL CLOCK is now available EXCLUSIVELY FROM LASKY'S in chassis form for you to mount in any housing that you choose.

All settings are achieved by two dual-concentric controls at the front including: ON-OFF-AUTO and AUTO ALARM, "sleep" switch, 10 minute division "click" set alarm (up to 12-hour delay), time adjustment. Ultra simple mechanism and high quality manufacture guarantee reliable operation and long life.

The sleep switch will automatically turn off any appliance—radio, TV, light etc. at any pre-set time up to 60 min. and in conjunction with the AUTO setting will switch on the appliance again next morning.

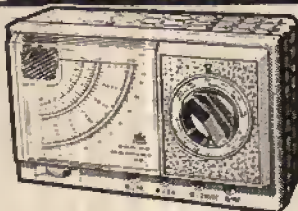
The clock measures 4½W x 1½H x 3½D (overall from front of drum to back of switch) SPEC: 210/240V AC, 50Hz operation; switch rating 250V, 3A. Complete with instructions. HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS

LASKY'S PRICE **£6.95** Post 18p

SPECIAL QUOTATIONS FOR QUANTITIES

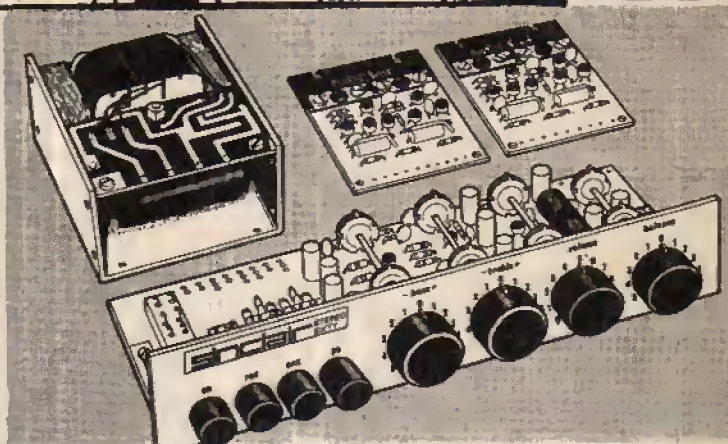
TTC C-1051 METER

A completely new design 20,000 O.P.V. pocket multimeter with mirror scale and built-in thermal protection. Exceptionally large easy to read meter with D'Arsonval movement. Colour coded scales. Single positive click-in, recessed selection switch for all ranges. Ohms zero adjustment. Range spec. a.c. volts: 0-6-30-300-1,200V at 10K/ohms/V. DC volts: 0-3-15-150-300-1.2KV at 20K/ohms/V. Resistance: 0-60K-6megs. DC current: 0-60μA—300 mA. Decibels: -20dB to +17 dB. Extremely high standard of accuracy on all ranges. Uses one 1½ penlight battery. Strong impact resistant plastic cabinet—size only 4½ x 3½ x 1½ in. Two colour buff/green finish. Complete with test leads and battery.



LASKY'S PRICE **£4.25** Post 13p

sinclair Project 60



Project 60 is a range of modules which connect together to form a complete stereo amplifier. The modules are: 1. Z-30 high gain power amp. 2. Stereo-60 pre-amp, control unit. 3. The PZ-5 unbalanced and PZ-6 stabilised power supplies. A complete system comprises two Z-30's, one Stereo-60 and a PZ-5 or PZ-6.

STEREO 60 SPECIFICATION

Input sensitivities: Radio up to 3mV. Magnetic Pick-up 3mV: correct to R.I.A.A. curve ±1dB; 20 to 25,000Hz. Ceramic Pick-up to 3mV:

Auxiliary up to 3mV • Output: 1 volt • Signal to noise better than 70dB • Front panel: brushed aluminium with black knobs and controls • Size: 5½ x 1½ x 4½ in.

£8.95 Post 18p

Z-30 SPECIFICATION

• Power output: 15 w. R.M.S. into 5 ohms using a 35 volt supply • Frequency response: 30 to 300,000Hz ±1dB • Distortion: 0.02% • Signal to noise: better than 70dB • Input sensitivity: 250mV into 100 K ohms • Loudspeaker Imp: 3 to 15 ohms • Power requirements: from 8 to 35V DC (The Z30 will operate from batteries if required)—Size: 3½ x 2½ x 4½ in.

£4.25 Post 18p

30V unbalanced—sufficient to drive two Z-30's and a Stereo 60 for domestic applications.

35V stabilised—ideal for driving two Z-30's and a Stereo 60 for low efficiency speakers.

PZ5 £4.50 Post 13p

PZ6 £7.50 Post 13p

PACKAGE PRICE For Stereo 60, two Z-30's and one PZ-5 **£19.25** Post 50p

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1H5GT .35	6F24 .68	12AD6 .40	30L1 .32	DK92 .43	ECC810 .33	EM81 .42	P81 .50	PL500 .68	UF85 .34	AC128 .20	BF163 .20	0C22 .38
1L4 .13	6F25 .65	12AE6 .48	30L15 .64	DK96 .37	ECC811 .33	EM84 .34	PABC80 .35	PL504 .68	UF86 .63	AC156 .20	BF173 .33	0C23 .38
1N5GT .39	6F28 .70	12AT6 .23	30L17 .78	DL96 .37	ECC812 .33	EM87 .38	PC86 .52	PL505 .44	UF89 .24	AC157 .25	BF180 .30	0C24 .38
1R3 .28	6H6GT .15	12AT7 .19	30F4MR .88	DM70 .30	ECC813 .33	EM88 .38	PC88 .52	PL508 .40	UL41 .59	AC158 .25	BF181 .30	0C25 .38
1R4 .24	6J5G .19	12AU6 .24	30F12 .69	DM71 .38	ECC814 .33	EM89 .38	PC95 .53	PL509 .44	UL84 .32	AC168 .38	BF185 .30	0C26 .38
1R5 .22	6J6 .18	12AU7 .23	30F19/ .60	DW4/ .35	ECC815 .33	EM90 .38	PC97 .40	PL502 .75	UM80 .33	AC176 .65	BFY60 .23	0C26 .25
1U4 .29	6J7G .24	12AV8 .28	30P4 .80	DW4/ .35	ECC816 .33	EM91 .38	PC99 .38	PL503 .75	UY1N .50	AC177 .23	BFY61 .19	0C28 .60
1U5 .48	6J7GT .38	12AX7 .23	30PL1 .89	DW4/ .35	ECC817 .33	EM92 .38	PC99 .38	PL504 .75	UY21 .55	AC178 .23	BFY62 .20	0C29 .63
2D21 .35	6K7G .10	12BA6 .30	30PL12 .87	500 .38	ECC818 .33	EM93 .38	PC99 .38	PL505 .75	UY21 .55	AC179 .23	BFY63 .20	0C30 .63
3D6 .19	6K7GT .23	12BE6 .30	30PL13 .78	DY86/7 .28	ECC819 .33	EM94 .38	PC99 .38	PL506 .75	UY21 .55	AC180 .23	BFY64 .20	0C31 .63
3Q4 .38	6K8G .20	12BH7 .40	30PL14 .75	DY802 .28	ECC820 .33	EM95 .38	PC99 .38	PL507 .75	UY21 .55	AC181 .23	BFY65 .20	0C32 .63
8Q5GT .35	6L6GT .39	12E1 .85	30PL15 .93	E80F 1.20	ECC821 .33	EM96 .38	PC99 .38	PL508 .75	UY21 .55	AC182 .23	BFY66 .20	0C33 .63
384 .29	6L7GT .63	12J7GT .33	35L6GT .44	E83F 1.20	ECC822 .33	EM97 .38	PC99 .38	PL509 .75	UY21 .55	AC183 .23	BFY67 .20	0C34 .63
3V4 .32	6L18 .45	12K5 .50	35W4 .23	E88CC .60	ECC823 .33	EM98 .38	PC99 .38	PL510 .75	UY21 .55	AC184 .23	BFY68 .20	0C35 .63
5V4G .38	6LD20 .48	12K7GT .34	35Z4GT .24	E180F .95	ECC824 .33	EM99 .38	PC99 .38	PL511 .75	UY21 .55	AC185 .23	BFY69 .20	0C36 .63
5Y3GT .38	6N7GT .40	12Q7GT .28	35Z5GT .30	E182CC1.13	ECC825 .33	EM100 .38	PC99 .38	PL512 .75	UY21 .55	AC186 .23	BFY70 .20	0C37 .63
5Z4G .35	6Q7 .43	12SA7GT .24	50L6GT .45	E1148 .53	ECC826 .33	EM101 .38	PC99 .38	PL513 .75	UY21 .55	AC187 .23	BFY71 .20	0C38 .63
6/30L2 .58	6Q7G .30		72 .40	E1148 .53	ECC827 .33	EM102 .38	PC99 .38	PL514 .75	UY21 .55	AC188 .23	BFY72 .20	0C39 .63
6A8G .32	6R7 .55	12SC7 .35	85A2 .35	E1148 .53	ECC828 .33	EM103 .38	PC99 .38	PL515 .75	UY21 .55	AC189 .23	BFY73 .20	0C40 .63
6AC7 .16	6R7G .35	12SG7 .23	807 .59	E1148 .53	ECC829 .33	EM104 .38	PC99 .38	PL516 .75	UY21 .55	AC190 .23	BFY74 .20	0C41 .63
6AG5 .25	6SA7GT .35	12SH7 .16	5763 .50	E1148 .53	ECC830 .33	EM105 .38	PC99 .38	PL517 .75	UY21 .55	AC191 .23	BFY75 .20	0C42 .63
6AK5 .25	6SA7M .35	12SJ7 .23	AC2/PEN .98	E1148 .53	ECC831 .33	EM106 .38	PC99 .38	PL518 .75	UY21 .55	AC192 .23	BFY76 .20	0C43 .63
6AL5 .12	6SC7GT .33	12SK7 .24		E1148 .53	ECC832 .33	EM107 .38	PC99 .38	PL519 .75	UY21 .55	AC193 .23	BFY77 .20	0C44 .63
6AQ5 .28	6SG7GT .33	12SQ7GT .24	AC2/PEN/ .98	E1148 .53	ECC833 .33	EM108 .38	PC99 .38	PL520 .75	UY21 .55	AC194 .23	BFY78 .20	0C45 .63
6AT6 .20	6SH7 .53		DD .98	E1148 .53	ECC834 .33	EM109 .38	PC99 .38	PL521 .75	UY21 .55	AC195 .23	BFY79 .20	0C46 .63
6AU8 .25	6S7 .35	1487 .15	AC6PEN.33	E1148 .53	ECC835 .33	EM110 .38	PC99 .38	PL522 .75	UY21 .55	AC196 .23	BFY80 .20	0C47 .63
6AV6 .30	6SK7GT .28	19A5 .24	AC/PEN(7) .98	E1148 .53	ECC836 .33	EM111 .38	PC99 .38	PL523 .75	UY21 .55	AC197 .23	BFY81 .20	0C48 .63
6B8G .13	6SQ7GT .38	20F9 .70		E1148 .53	ECC837 .33	EM112 .38	PC99 .38	PL524 .75	UY21 .55	AC198 .23	BFY82 .20	0C49 .63
6BA8 .23	6V8G .18	20L1 .98	AC/TH1 .50	E1148 .53	ECC838 .33	EM113 .38	PC99 .38	PL525 .75	UY21 .55	AC199 .23	BFY83 .20	0C50 .63
6BE6 .24	6V6GT .38	20P1 .88	AC/TP .78	E1148 .53	ECC839 .33	EM114 .38	PC99 .38	PL526 .75	UY21 .55	AC200 .23	BFY84 .20	0C51 .63
6BH6 .43	6X4 .22	20P3 .90	AL60 .78	E1148 .53	ECC840 .33	EM115 .38	PC99 .38	PL527 .75	UY21 .55	AC201 .23	BFY85 .20	0C52 .63
6BJ6 .43	6X5GT .25	20P4 .93	ATP4 .12	E1148 .53	ECC841 .33	EM116 .38	PC99 .38	PL528 .75	UY21 .55	AC202 .23	BFY86 .20	0C53 .63
6BQ7A .38	7B6 .58	20P5 .1.00	AZ1 .40	E1148 .53	ECC842 .33	EM117 .38	PC99 .38	PL529 .75	UY21 .55	AC203 .23	BFY87 .20	0C54 .63
6BR7 .79	7B7 .35	25A6G .29	AZ31 .48	E1148 .53	ECC843 .33	EM118 .38	PC99 .38	PL530 .75	UY21 .55	AC204 .23	BFY88 .20	0C55 .63
6BR8 .63	7C6 .30	25L6G .29	AZ41 .53	E1148 .53	ECC844 .33	EM119 .38	PC99 .38	PL531 .75	UY21 .55	AC205 .23	BFY89 .20	0C56 .63
6BW6 .72	7H7 .28	25Y5 .38	B36 .33	E1148 .53	ECC845 .33	EM120 .38	PC99 .38	PL532 .75	UY21 .55	AC206 .23	BFY90 .20	0C57 .63
6BW7 .66	7R7 .65	25Y6G .43	CY1C .58	E1148 .53	ECC846 .33	EM121 .38	PC99 .38	PL533 .75	UY21 .55	AC207 .23	BFY91 .20	0C58 .63
6BZ6 .63	8D7 .78	25Z4G .30	CY31 .58	E1148 .53	ECC847 .33	EM122 .38	PC99 .38	PL534 .75	UY21 .55	AC208 .23	BFY92 .20	0C59 .63
6C9 .78	10C1 .1.25	25Z5 .40	DAC32 .35	E1148 .53	ECC848 .33	EM123 .38	PC99 .38	PL535 .75	UY21 .55	AC209 .23	BFY93 .20	0C60 .63
6CD6G 1.15	10C2 .50	25Z6G .43	DAF91 .22	E1148 .53	ECC849 .33	EM124 .38	PC99 .38	PL536 .75	UY21 .55	AC210 .23	BFY94 .20	0C61 .63
6CH6 .38	10F1 .75	30C1 .30	DAF96 .35	E1148 .53	ECC850 .33	EM125 .38	PC99 .38	PL537 .75	UY21 .55	AC211 .23	BFY95 .20	0C62 .63
6CL6 .43	10F9 .45	30C15 .65	DF33 .39	E1148 .53	ECC851 .33	EM126 .38	PC99 .38	PL538 .75	UY21 .55	AC212 .23	BFY96 .20	0C63 .63
6CW4 .63	10F18 .35	30C17 .80	DF91 .14	E1148 .53	ECC852 .33	EM127 .38	PC99 .38	PL539 .75	UY21 .55	AC213 .23	BFY97 .20	0C64 .63
6F1 .63	10LD11 .53	30C18 .84	DF96 .35	E1148 .53	ECC853 .33	EM128 .38	PC99 .38	PL540 .75	UY21 .55	AC214 .23	BFY98 .20	0C65 .63
6F6 .63	10P13 .65	30F5 .80	DF97 .63	E1148 .53	ECC854 .33	EM129 .38	PC99 .38	PL541 .75	UY21 .55	AC215 .23	BFY99 .20	0C66 .63
6F6G .25	10P14 1.10	30FL1 .64	DH63 .30	E1148 .53	ECC855 .33	EM130 .38	PC99 .38	PL542 .75	UY21 .55	AC216 .23	BFY100 .20	0C67 .63

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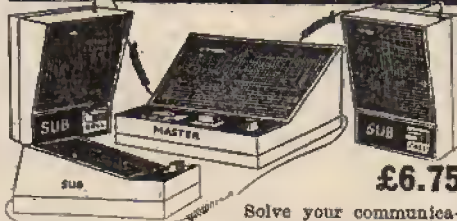
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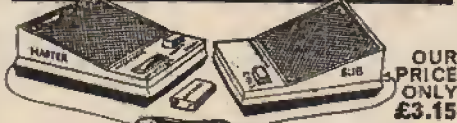
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365+365 with 25+25pF, 55p; 500pF slow motion, standard

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350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a. or 5 v. 2 a.	£2.00
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	£2.50
MINIATURE 200 v. 20mA., 6.3 v. 1 a. 2 1/2 x 2 1/2 in.	75p
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2 1/2 x 2 1/2 in.	90p
HEATER TRANS. 6.3v. 1 1/2 a.	70p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1 1/2 amp.	80p
GENERAL PURPOSE LOW VOLTAGE. Tapped Outputs	
3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 amp. £2.00	
1 amp., 3, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60, £2.00	
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CHARGER TRANSFORMERS. Input 200/250v.	
for 6 or 12v., 1 1/2 amp., £1.20; 4 amp. £1.90.	
FULL WAVE BRIDGE CHARGER RECTIFIERS:	
6 or 12 v. outputs, 1 1/2 amp. 40p; 2 amp. 55p; 4 amp. 85p.	



E.M.I. 13 1/2 x 8 in.

LOUDSPEAKERS

With flared tweeter cone and ceramic magnet. 10 watts.

Bass res. 45-60 cps. £2.25

Flux 10,000 gauss.

State 3 or 8 or 15 ohm. Post 15p each

Also with twin tweeters.

With crossover, 10 watt. £4

State 3 or 8 or 15 ohm. Post 15p each

Recommended Teak Cabinet

Size 16 x 10 x 8 in. Post 25p £5

10W MINI-MODULE £3.25

LOUDSPEAKER KIT

Post 25p

Triple speaker system combining on ready cut baffle. 1 in. chipboard 15 in. x 8 1/2 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 15 ohm.

TEAK VENEERED BOOKSHELF ENCLOSURE.

18 1/2 x 10 1/2 x 6 in. Modern Design, £5 Post 25p

dark grey Tygan covered baffle

RADIO BOOKS—LIST S.A.E.

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. Voice coils 3 or 8 or 15 ohms. Post Free

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. £11.50

BAKER "BIG-SOUND" SPEAKERS

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

12 inch £7 12 inch £9 15 inch £19

25 watt 35 watt 50 watt

3 or 8 or 15 ohm 3 or 8 or 15 ohm 8 or 15 ohm

TEAK HI-FI SPEAKER CABINETS. Fluted wood front

For 12in. round Loudspeaker £9. Post 25p

For 13 x 8in. Loudspeaker £5. Post 25p

For 10 x 6in. round Loudspeaker £4. Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft.

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LATEST DESIGN AND GIVES A HIGHER

STANDARD OF PERFORMANCE THAN

MORE EXPENSIVE UNITS.

The moving coil diaphragm gives a good

radiation pattern to the higher frequencies

and a smooth extension of total response

from 1,000 cps to 18,000 cps. Size 3 1/2 x

3 1/2 x 2in. deep. Rating 10 watts. 8 ohm or

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TWO-WAY XOVER NETWORK 3000 c/s.

With variable tweeter attenuator giving accurate high/low

frequency balance. Mounted on panel 6 1/2 in. x 4 in. with

control knob, tweeter and woofer leads and

input terminals. Suitable for 8 to 8 ohm imp. £1.90 Post

10p

Horn Tweeters 2-16Kc/s. 10W 8 ohm or 15 ohm £1.50.

De Luxe Horn Tweeters 2-18 Kc/s. 15W, 8 ohm £3.

TWO-WAY 3000cps CROSSOVERS 3 or 8 or 15 ohm 95p.

SPECIAL OFFER: 80 ohm, 2 1/2 in., 2 1/2 in. dia.; 35 ohm, 3 in.

25 ohm, 3 in. dia.; 6 x 4 in.; 8 x 5 in.

15 ohm 3 1/2 in. dia.; 7 x 4 in.; 8 x 5 in.

8 ohm, 6 x 4 in.; 3 ohm, 2 1/2 in. dia.; 5 x 3 in. 7 x 4 in.

LOUDSPEAKERS P.M. 3 OHMS. 6 in. £1.10; 8 x 5 in. £1.25;

8 x 2 1/2 in. 60p; 8 in. £1.75; 10 x 6 in. £1.90.

5 in. WOOFER 8 watts max. 20-10,000 cps. 8 or 15 ohm. £1.80.

HOW TO TELL A STEREO SYSTEM THAT LOOKS GOOD FROM A STEREO SYSTEM THAT SOUNDS GOOD-BEFORE YOU PART WITH YOUR MONEY.

There's only one way to buy stereo equipment. Listen to it. Lots of it. Until you find the sound you like for the money you've got.

Sound advice. But try acting on it in 99% of hi-fi dealers and you'll be asked to show the colour of your money. We at Roc think that's unfair. So we fitted out our store in the Edgware Road with a series of sound systems, so you can hear all the stereo you want until you find the equipment you like. With no hustling.

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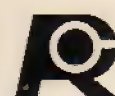
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Amplifier
Output: 4 Watts per channel
Frequency Response: 50-10000 Hz.
Inputs: Tuner, Ceramic Cartridge
Controls: Volume, Tone & Balance
Speakers: 6 Watts
Capacity: 40-16000 Hz.
Frequency Response: Garrard 2025TC, Ceramic Cartridge,
Turntable: Base and Cover
Matching AM/FM/FM Stereo Tuner

System II.

Price: £49.90

Amplifier
Output: 8 Watts per Channel
Frequency Response: 40-18000 Hz.
Inputs: Tuner, Tape, Ceramic Cartridge
Controls: Volume, Bass, Treble and Balance
Speakers: 10 Watts
Capacity: 40-19000 Hz.
Frequency Response: As system I.
Turntable:

System III.

Price: (A) £59.90 (B) £69.90

Amplifier
Output: 15 Watts per Channel
Frequency Response: 30-18000 Hz.
Inputs: Tuner, Tape, Magnetic & Ceramic
Controls: Volume, Bass, Treble and Balance
Speakers: As System II
Turntable: System IIIA Garrard 2025TC,
Ceramic Cartridge, Base and Cover
System IIIB Garrard SP.25 MK III,
Magnetic Cartridge, Base and Cover

System IV.

Price: £79.90

Amplifier
Output: 20 Watts per Channel
Frequency Response: 25-20000 Hz.
Inputs: Tuner, Tape Magnetic & Ceramic Cartridge
Controls: 2 Volume, Bass, Treble and Loudness
Speakers: 20 Watts
Capacity: 35-20000 Hz.
Frequency Response: Garrard SP.25 MKIII, Magnetic Cartridge,
Turntable: Base and Cover
Matching AF/FM/FM Stereo Tuner: £36.00

System V.

Price: £115.00

Tuner Amplifier
Output: 18 Watts per Channel
Frequency Response: 30-20000 Hz.
Inputs: Tape & Magnetic Cartridge
Controls: 2 Volume, Bass, Treble and Tuning
FM Sensitivity: 2.5 micro volts
AM Sensitivity: 100 micro volts
Speakers: 20 Watts
Capacity: 35-20000 Hz.
Frequency Response: As System IV
Turntable:

System VI.

Price: £182.00

Amplifier
Output: 30 Watts per Channel
Frequency Response: 20-30000 Hz.
Inputs: Auxilliary, Magnetic & Ceramic
Controls: Volume, Bass, Treble, Balance,
Loudness and Monitor
Speakers: 30 Watts
Capacity: 35-20000 Hz.
Frequency Response: Thorens TD150AB Magnetic
Turntable: Cartridge, Base & Cover

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AKG K50 Dynamic Stereo headphones

Complete with spare ear muffs.

Total (value £10.40) Our Price **£5.90** + 23p p. & p.

Available only from us at this price. Due to entire purchase of manufacturer's remaining stock this fantastic offer is open only while stocks last.

- * High-fidelity reproduction due to broad frequency response (20-20,000Hz)
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- * Only expensive studio loudspeakers can match the reproduction quality of the K50.
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GARRARD SP25

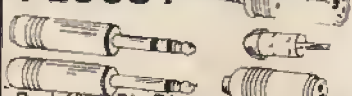
mk II **£11.50** Plus 50p carriage

Normal price £15.57

Single record playing unit. Features include cue and pause and automatic pick-up return and switch off.

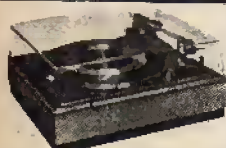
Wired with mains cable and 5ft. twin screened stereo cable, 5 pin din plug. 53p extra. AP75 Complete with base and cover £25 plus 75p carriage.

PLUGS?



- Pack 107 5-Pin Din .. 20p
- Pack 108 3-Pin Din .. 18p
- Pack 135 1/2" Jack .. 25p
- Pack 130 1/2" Jack Stereo .. 48p
- Pack 103 Loudspeaker Plug .. 15p
- Pack 100 Phono Plug .. 6p
- Pack 230 3-Pin Socket .. 23p
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- Pack 234 Loudspeaker Socket .. 30p

Ready-made Leads:
 3-pin to 3-pin Din .. 63p
 3-pin to open end .. 53p
 5-pin to 5-pin Din .. 80p
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 5-pin to 4 phono plugs .. 93p
 Speaker lead Din to spade 12ft 38p. Extension lead Din plug to socket 12ft. 65p
 All leads approx. 6ft. in length. Post free, by return.



PLINTH & COVER £5.25

Unbeatable Value

plus 50p p. & p

Suitable for AT60; SP25; 3000; 2500; 3500. Superb finish. Spindle can be left in position with cover on. Cover of neutral smoke tint perspex. Also available for AP75; SL99; SL75 £6.88 plus 50p carr.

Replacement Stereo DIAMOND STYL

8TA 9TA 9TANC
 GP91 ST4 ST9
 EV26 GC8

75p each
 p. & p. 13p

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Teak Cabinet

£12 Insurance & carr. 38p

A speaker of outstanding specifications and technical merit. Solid teak cabinet size: 14" x 10" x 6". Originally designed for use with our Countdown stereo budget system but now available separately.



EMI 10w matched loudspeaker set 450

Our price **£3.75** Inc. 25p p. & p.

13 1/2" x 8 1/2" elliptical loudspeaker and independent high frequency units with associated crossover network. Frequency range 55 to 13000Hz. The cone of the bass unit has a surround designed for high travel giving freedom from distortion when operated at low frequencies. Also 350 KIT 20W Frequency range: 20 to 20,000Hz. Normal price £12.50 plus 40p p & p. Also 150 KIT 10W **£2.50** plus 40p p & p. 3, 8 or 15 ohms



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SAVE nearly £5 Normal price £23.90

Designed for building into plinths etc., complete with two 230 Output stages **£19** plus 50p carr.



(20 watt) and power supply unit. Send S.A.E. for full technical brochure. **SINCLAIR 2000 AMPLIFIER** SAVE £6.30 Our price **£24.15**

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Diamond **£4.75**

stylus plus 13p p. & p.

Today's value £6.

Stylus replacement can be carried out without removing cartridge. Fully guaranteed.

Ronette 105 Stereo cartridge (Sapphire 78 Diamond LP) **£1.25** 13p. p. & p.



SONOTONE Cartridge ...

(Fitted Diamond Stylus) (Ceramic) 1st price **£4.10**

Sensitivity: 9TANC 55mV/cm/sec **£2.50**
 rms minimum at 45° at plus
 1,000Hz measured on 13p
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PADGETTS RADIO STORES

OLD TOWN HALL, LIVERSEDGE, YORKS

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40 ONLY. The much sought after Sighting Computer Mark XIVA. For the model maker. Condition Good. **£2.50p** (30/-) Carriage **£1.00** (£1)

AMPLIFIER UNIT TYPE A1413. Complete with 5Z4 and 6V6GT valves 250/230 volt. 50 cycle. Transformer. Clear Condition, Untested. **£1.25p** (25/-). Carriage **75np** (15/-).

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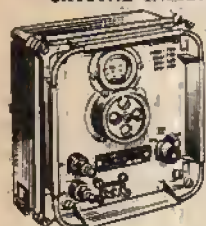


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HIGH QUALITY
TUNER, SIZE
ONLY 6x4x2 1/2 in.
3 I.F. stages.
Double tuned dis-
criminator. Ample
output to feed most
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Stereo multiplex adaptors £4.97½.

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Battery operated, fully transistorised.
Sensitivity 100mΩ/v.
Measures AC/DC Voltages 12mV to 1,200V.
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HF, VHF, UHF Voltage with multiplier
4v to 400v up to 50 Mc/s, 40mV to 4v up to
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Offered in perfect condition.
£55 each. Carr. 50p.

CRYSTAL CALIBRATORS NO. 10



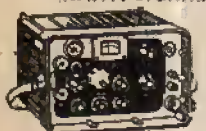
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wavemeter. Size
7 x 7 1/4 x 4 in.
Frequency range
500 Kc/s-10 Mc/s
(up to 30 Mc/s on
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Calibrated dial.
Power require-
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15mA and 12V
D.C. 0.3A.

Excellent condition. £4.47½. Carr. 37½p.

B.C. 221 FREQUENCY METERS

latest release 125 KHz-20 MHz. Excellent
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£27.50 each. Carr. 50p.

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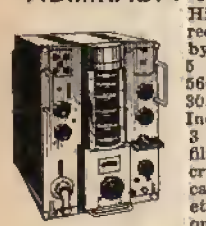
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precision instru-
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20-80 Mc/s. AM
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porates precision dial, level meter, precision
attenuator 1μV-100mV. Operation from 12
volt D.C. or 0/110/200/250 volt A.C. Size
12 x 8 1/4 x 9 in. Supplied in brand new con-
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tested. £45. Carr. £1.

incorporates precision dial, level meter, precision
attenuator 1μV-100mV. Operation from 12
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12 x 8 1/4 x 9 in. Supplied in brand new con-
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High quality 97 range instrument which
measures A.C. and D.C. Voltage. Current,
Resistance and Power Output Ranges D.C.
volts 250mV-10,000V. (10 meg Ω - 11 Gmeg Ω
input). D.C. current 10μA-25 amps. Ohms,
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(with R.F. measuring head up to 250 Mc/s)
A.C. current 10μA-25 amps. Power output
50 micro-watts-5 watts. Operation 0/110/
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High quality 10 valve
receiver manufactured
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5 bands 150-300 Kc/s,
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Incorporates 2 R.F. and
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filter, noise limiter,
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Size 19 1/2 x 13 1/2 x 16 in. Weight 11½lb.
Offered in good working condition. £22.50.
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3in. tube. Y amp. Sensi-
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Input imp. 2 meg Ω 25pF
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50p.

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A general purpose low
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Bandwidth 2 CFS-1MHz.
Input imp. 2 meg Ω 25
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1mA £2.97½	1mA £2.47½
20V. D.C. ... £2.97½	20V. D.C. ... £2.47½
50V. D.C. ... £2.97½	50V. D.C. ... £2.47½
300V. D.C. £2.97½	300V. D.C. £2.47½
1 amp. D.C. £2.97½	1 amp. D.C. £2.47½
5 amp. D.C. £2.97½	5 amp. D.C. £2.47½
300V. A.C. £2.97½	300V. A.C. £2.47½
VU Meter... £3.75	VU Meter... £3.37½

"SEW" CLEAR PLASTIC METERS

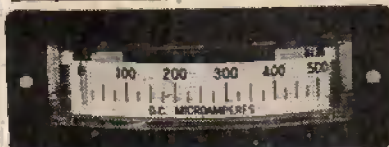
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50mA £2.60	200mA £1.37½
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1 amp. £2.60	750mA £1.37½
5 amp. £2.60	1 amp. £1.37½
15 amp. £2.60	2 amp. £1.37½
30 amp. £2.60	5 amp. £1.37½
20V. D.C. ... £2.60	10 amp. £1.37½
50V. D.C. ... £2.60	3V. D.C. £1.37½
150V. D.C. £2.60	10V. D.C. ... £1.37½
300V. D.C. £2.60	10V. D.C. ... £1.37½
15V. A.C. ... £2.60	20V. D.C. ... £1.37½
300V. A.C. £2.60	100V. D.C. ... £1.37½
8 Meter 1mA £2.87½	100V. D.C. ... £1.37½
VU Meter... £3.60	150V. D.C. ... £1.37½
1 amp. A.C.* £2.60	300V. D.C. ... £1.37½
5 amp. A.C.* £2.60	500V. D.C. ... £1.37½
10 amp. A.C.* £2.60	750V. D.C. ... £1.37½
20 amp. A.C.* £2.60	15V. A.C. ... £1.37½
30 amp. A.C.* £2.60	50V. A.C. ... £1.37½

Type MR.52P. 2 1/2 in. square fronts.	Type MR.45P. 2 1/2 in. square fronts.
50μA £3.10	50μA £2.25
50-0-50μA £2.60	50-0-50μA £2.10
100μA £2.60	100μA £2.10
100-0-100μA £2.37½	100-0-100μA £1.87½
500μA £2.25	200μA £1.87½
1mA £2.00	500μA £1.87½
5mA £2.00	500-0-500μA £1.50
10mA £2.00	1mA £1.50
50mA £2.00	5mA £1.50
100mA £2.00	10mA £1.50
500mA £2.00	50mA £1.50
1 amp. £2.00	100mA £1.50
5 amp. £2.00	500mA £1.50
10V. D.C. ... £2.00	1 amp. £1.50
20V. D.C. ... £2.00	5 amp. £1.50
50V. D.C. ... £2.00	10 amp. £1.50
300V. D.C. £2.00	20 amp. £1.50
15V. A.C. ... £2.00	30 amp. £1.50
300V. A.C. £2.00	5 amp. £1.50
8 Meter 1mA £2.10	10V. D.C. ... £2.10
VU Meter... £3.10	20V. D.C. ... £2.10
1 amp. A.C.* £2.00	50V. D.C. ... £2.10
5 amp. A.C.* £2.00	300V. D.C. £2.10
10 amp. A.C.* £2.00	500V. A.C. £2.10
20 amp. A.C.* £2.00	8 Meter 1mA £1.87½
30 amp. A.C.* £2.00	VU Meter... £2.25

Type MR.65P. 3 1/2 in. x 3 1/2 in. fronts.	"SEW" BAKELITE PANEL METERS
50μA £3.37½	Type MR.65. 3 1/2 in. square fronts.
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100μA £2.75	1 amp. £1.75
100-0-100μA £2.60	5 amp. £1.75
200μA £2.60	15 amp. £1.75
500μA £2.37½	30 amp. £1.75
500-0-500μA £2.10	50 amp. £1.75
1mA £2.10	5V. D.C. £1.75
5mA £2.10	10V. D.C. ... £1.75
10mA £2.10	20V. D.C. ... £1.75
50mA £2.10	50V. D.C. ... £1.75
100mA £2.10	150V. D.C. £1.75
500mA £2.10	300V. D.C. £1.75
1 amp. £2.10	30V. A.C.* £1.75
5 amp. £2.10	50V. A.C.* £1.75
10 amp. £2.10	150V. A.C.* £1.75
15 amp. £2.10	300V. A.C.* £1.75
20 amp. £2.10	500mA A.C.* £1.75
30 amp. £2.10	1 amp. A.C.* £1.75
50 amp. £2.37½	5 amp. A.C.* £1.75
5V. D.C. ... £2.10	10 amp. A.C.* £1.75
10V. D.C. ... £2.10	20 amp. A.C.* £1.75
20V. D.C. ... £2.10	30 amp. A.C.* £1.75
50V. D.C. ... £2.10	VU Meter... £3.10
150V. A.C. £2.10	
300V. A.C. £2.10	
500V. A.C. £2.10	
8 Meter 1mA £2.37½	
VU Meter... £3.37½	
50mA A.C.* £2.10	
200mA A.C.* £2.10	
500mA A.C.* £2.10	
1 amp. A.C.* £2.10	
5 amp. A.C.* £2.10	
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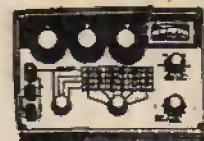
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2N2218	30p	BC186	25p	OC24	60p
2N2219	37p	BC187L	10p	OC25	37p
2N2368	12p	BC184L	12p	OC26	25p
2N2369	20p	BC212L	12p	OC28	62p
2N2369A	20p	BCY30	25p	OC29	62p
2N2484	35p	BCY31	30p	OC35	50p
2N2613	35p	BCY32	50p	OC36	50p
2N2648	50p	BCY33	25p	OC41	25p
2N2904	30p	BCY34	30p	OC42	30p
2N2923	17p	BCY38	40p	OC44	17p
2N2924	17p	BCY42	15p	OC45	15p
2N2925	17p	BCY43	20p	OC48	27p
2N2926G	12p	BCY71	30p	OC70	12p
2N2926V	12p	BCY72	15p	OC71	15p
2N2926W	12p	BCZ11	40p	OC72	25p
2N3053	25p	BD121	65p	OC73	30p
2N3054	25p	BD123	80p	OC74	30p
2N3055	75p	BD124	80p	OC75	25p
2N331A	30p	BF115	25p	OC76	25p
2N3416	37p	BF117	47p	OC77	25p
2N3570	21-25	BF167	25p	OC78	20p
2N3702	12p	BF173	30p	OC81	25p
2N3703	12p	BF180	37p	OC81D	25p
2N3704	17p	BF181	37p	OC83	25p
2N3705	15p	BF182	32p	OC84	25p
2N3706	22p	BF184	25p	OC139	25p
2N3707	15p	BF185	25p	OC140	37p
2N3708	17p	BF194	17p	OC169	20p
2N3709	12p	BF195	15p	OC170	25p
2N3710	12p	BF200	37p	OC171	30p
2N3711	12p	BF224	80p	OC200	40p
2N3819	35p	BF225	80p	OC201	60p
2N3903	25p	BF244	47p	OC202	75p
2N3904	25p	BFX12	25p	OC203	40p
2N3905	30p	BFX13	25p	OC204	40p
2N3906	30p	BFX29	30p	OC205	62p
2N4058	17p	BFX30	30p	OC207	75p
2N4059	25p	BFX44	37p	OC207	75p
2N4061	15p	BFX85	40p	OC207	75p
2N4062	22p	BFX86	32p	OC207	75p
2N4286	15p	BFX87	32p	OC207	75p
2N4287	17p	BFX88	25p	OC207	75p
2N4288	15p	BFY18	25p	OC207	75p
2N4289	17p	BFY20	62p	OC207	75p
2N4290	15p	BFY50	22p	OC207	75p
2N4291	15p	BFY51	22p	OC207	75p
2N4292	15p	BFY52	22p	OC207	75p
2N5354	27p	BSY90	67p	OC207	75p
2N5355	27p	BSX19	17p	OC207	75p
2S102	25p	BSX20	17p	OC207	75p
2S103	37p	BSX21	17p	OC207	75p
2S104	37p	BSX76	15p	OC207	75p
40250	60p	BSY26	27p	OC207	75p
40361	55p	BSY27	20p	OC207	75p
40362	60p	BSY28	17p	OC207	75p
AC107	37p	BSY33	20p	OC207	75p
AC126	25p	BSY39	22p	OC207	75p
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1R5	35p	30C17	85p	EM85	21-00
1R5	25p	30C18	75p	EM87	43p
1T4	25p	30P5	85p	EY61	40p
1U4	27p	30FL12	70p	EY86	40p
1U5	50p	30FL12	92p	EY87	42p
2D21	35p	30FL14	75p	EZ40	45p
3Q4	40p	30L15	85p	EZ41	45p
384	85p	30L17	80p	EZ80	25p
3V4	45p	30P12	80p	EZ81	28p
5R4	60p	30P19	80p	GZ32	48p
5U4	38p	30PL1	70p	GZ34	60p
6V4	42p	30PL13	63p	KT66	21-70
5Y3	35p	30PL14	90p	KT88	21-75
5Z4G	40p	35L6	50p	MU14	60p
5Z4G	40p	35W4	30p	PABCO80	40p
5Z4G	40p	35Z4	30p	PC86	60p
5Z4G	40p	35Z5	40p	PC88	60p
5Z4G	40p	35Z6	45p	PC97	45p
5Z4G	40p	35Z7	45p	PC900	45p
5Z4G	40p	35Z8	50p	PC934	40p
5Z4G	40p	35Z9	45p	PC955	40p
5Z4G	40p	35Z10	50p	PC988	55p
5Z4G	40p	35Z11	50p	PC989	50p
5Z4G	40p	35Z12	50p	PC989	50p
5Z4G	40p	35Z13	50p	PC989	50p
5Z4G	40p	35Z14	50p	PC989	50p
5Z4G	40p	35Z15	50p	PC989	50p
5Z4G	40p	35Z16	50p	PC989	50p
5Z4G	40p	35Z17	50p	PC989	50p
5Z4G	40p	35Z18	50p	PC989	50p
5Z4G	40p	35Z19	50p	PC989	50p
5Z4G	40p	35Z20	50p	PC989	50p
5Z4G	40p	35Z21	50p	PC989	50p
5Z4G	40p	35Z22	50p	PC989	50p
5Z4G	40p	35Z23	50p	PC989	50p
5Z4G	40p	35Z24	50p	PC989	50p
5Z4G	40p	35Z25	50p	PC989	50p
5Z4G	40p	35Z26	50p	PC989	50p
5Z4G	40p	35Z27	50p	PC989	50p
5Z4G	40p	35Z28	50p	PC989	50p
5Z4G	40p	35Z29	50p	PC989	50p
5Z4G	40p	35Z30	50p	PC989	50p
5Z4G	40p	35Z31	50p	PC989	50p
5Z4G	40p	35Z32	50p	PC989	50p
5Z4G	40p	35Z33	50p	PC989	50p
5Z4G	40p	35Z34	50p	PC989	50p
5Z4G	40p	35Z35	50p	PC989	50p
5Z4G	40p	35Z36	50p	PC989	50p
5Z4G	40p	35Z37	50p	PC989	50p
5Z4G	40p	35Z38	50p	PC989	50p
5Z4G	40p	35Z39	50p	PC989	50p
5Z4G	40p	35Z40	50p	PC989	50p
5Z4G	40p	35Z41	50p	PC989	50p
5Z4G	40p	35Z42	50p	PC989	50p
5Z4G	40p	35Z43	50p	PC989	50p
5Z4G	40p	35Z44	50p	PC989	50p
5Z4G	40p	35Z45	50p	PC989	50p
5Z4G	40p	35Z46	50p	PC989	50p
5Z4G	40p	35Z47	50p	PC989	50p
5Z4G	40p	35Z48	50p	PC989	50p
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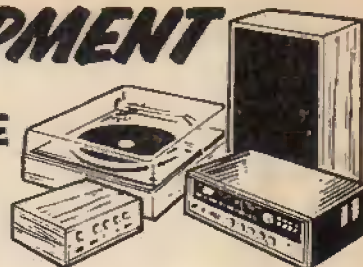
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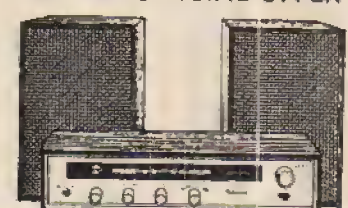


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T/44/TF956

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1 μ watts to 5 watts.

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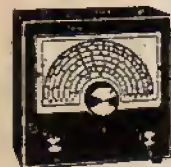


BELCO AF-5A SOLID STATE SINE SQUARE WAVE C.R. OSCILLATOR

Sine 18-200,000 Hz; Square 18-50,000 Hz Output max. +10 dB (10 K ohms)



Operation in internal batteries. Attractive 2-tone case 7 1/2" x 5" x 2". Price £17.50. Carr. 17p.



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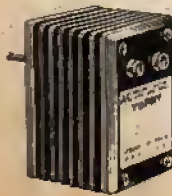
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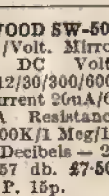
MODEL 5025. 57 Ranges. Giant 5 1/2in. Meter. Polarity Reverse Switch. Sensitivity: 50K Ω /Volt D.C. 5K Ω /Volt A.C. D.C. Volts: 125, 25, 1.25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.C. Volts: 1.5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.C. Current: 25, 50uA, 2.5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 2 K, 10K, 100K, 1 MEG, 10 MEG Ω . Decibels: -20 to +85 db. £12.50. P. & P. 17p.

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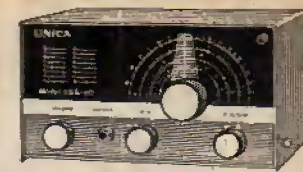
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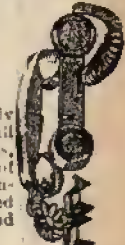
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Operative over amazingly long distances. Separate call and press to talk button. 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £6.97 1/2. P. & P. 17p.



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C.1001 MULTI-TESTER



Overload protection. 20,000 opv. AC volts 10, 50, 250, 1,000v. DC volts 5-25, 125, 500, 2500v. D.C. Current 0-50 uA, 0-250 mA. Resistance 0-60K 0-6 Meg ohm. Decibels -20 to +22dB.

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£4.25. P. & P. 17½p

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10,000 opv. RANGES: DC Voltage: 0-3-15-150-600-1200 Volt (10,000 ohms per Volt). AC Voltage: 0-6-30-300-1200 Volt (5,000 ohms per Volt).

DC Current: 0-120 uA, 0-300 mA. Resistance: 0-50K, 0-5 Meg (R x 10) (R x 1K)

Decibels: -20 to +17dB.

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C.1052 MULTI-TESTER



RANGES: AC Voltage: 6, 30, 120, 300, 1200 (15,000 ohm/V) DC Voltage: 0-6, 3, 15, 60, 300, 1200 (30,000 ohm/V)

DC Current: 0, 0-0.3, 3, 30, 300 mA. Resistance: 0, 6k, 60k, 600k, 6 M ohms

Decibels: -20 to +63dB.

£7.35. P. & P. 17½p

SM-370 MULTI-TESTER



20,000 opv. RANGES: DC Voltage: 0-5-25-100-500-1000V (20,000 ohms/V). AC Voltage: 0-5-25-100-500-1000V (20,000 ohms/V).

DC Current: 0-50 uA, 0-250 mA. Resistance: RX10, RX1K (300 ohms and 30K ohms at centre scale).

Decibels: -20dB to +16dB.

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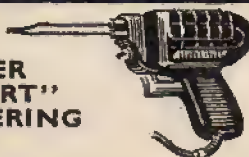


Enables transistor equipment to be operated from AC mains. 6/9/12v. output selector switch and

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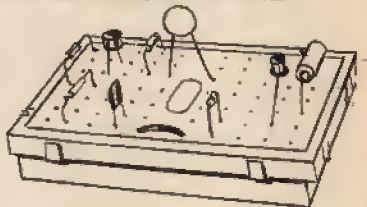
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PRACTICAL WIRELESS

VOL 46 NO 12

Issue 770

APRIL 1971

TOPIC OF THE MONTH

Servicemen all

THIS MONTH readers might feel that the issue is heavily weighted in favour of test instruments, for not only do we have a special 8-page supplement on the subject but two major supporting articles describe the construction of test instruments. Our excuse is that apart from readers who enjoy trying their luck at repairing the family radio set, many others get bitten harder by the servicing bug and relish the challenge of tracing faults and the satisfaction of a successful repair. No doubt about it, the acquisition of the ability to probe around inside a piece of equipment and come up with the right answers, works wonders for self esteem!

The idea behind the supplement this month is to provide a broad survey of the test instrument scene, examining the features of the various items of equipment and outlining their applications. This will be followed in the May issue by the first of a brand new series of articles on radio and audio servicing conducted by those two old PW favourites Gordon J. King and H. W. Hellyer, voted for previous efforts in this field as top of the work bench pops.

But servicing is really only one side of the coin, because everyone—from the absolute novice upwards—needs some test equipment, even if this consists solely of a cheap test meter, or a battery and bulb to make continuity checks! It is fairly safe to say, therefore, that constructors alike from novice to expert, experimenters as well as dabblers and professionals in servicing should have some knowledge of fault finding techniques. But in order to carry out logical fault finding it is necessary to have a reasonable theoretical grounding—somewhat of a vicious circle. The new series starting next month will, we hope, be helpful in providing a foothold for readers wanting to take a more active part in servicing activities.

W. N. STEVENS—Editor

P.W. COVER PRICE

Owing to the rising costs of production, it has been necessary to increase the cover price of *Practical Wireless* to 20p (4s. 0d) with effect from the next, May, issue. Much as we regret this increase, it has been made inevitable by the hard economic facts of publishing in these days of spiraling prices.

Existing subscriptions will, of course, continue to run out to their normal expiry date. The new subscription rate will be £2.65 per annum.

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**MAY ISSUE WILL BE PUBLISHED
ON APRIL 8th**

NEWS...

NEWS...

NEWS...

1971 R.S.G.B. President



At a reception held at the Bonnington Hotel, London, on 15th January, F. C. Ward G2CVV, Secretary of Derby and District Amateur Radio Society, was installed as president of the Radio Society of Great Britain. Over 150 guests attended the function, including J. Swinnerton G2YS, J. Graham G3TR, V. Desmond G5VM, W. A. Scarr G2WS, A. O. Milne G2MI, P. Hawker G3VA, W. Corsham G2UV, A. Forsyth G6FO, T. Hughes G3GVV, and L. Newnham G6NZ. Also present were representatives of the Ministry of Posts and Telecommunications, and 20 visitors from Derby including Mr. A. G. G. Melville, president of Derby and District Amateur Radio Society, and his wife.

The Mayor of Derby, Alderman Miss M. E. Grimwood-Taylor (whose father was a founder member of the Derby society) sent Mr. Ward her congratulations and best wishes.

Mr. Ward is employed by the Post Office Engineering Department, and at present is in the Radio Investigation Service. He is keenly interested in the history of amateur radio, and mainly through his efforts, Derby and District Amateur Radio Society (the oldest such society in the country) has a comprehensive collection of documents and equipment from the early days of amateur radio.

In his speech at the reception, the new president expressed the hope that all members of the R.S.G.B. would endeavour to enrol at least one new member, the aim being to double the existing membership by the end of his year of office.

Mr. Ward's call-sign G2CVV was issued to him in 1937. He is active on all bands from 160m down to 2m, and, he says, would be interested in the higher frequencies if there were more hours in the day!

Rank and Dolby

Rank Wharfedale have released a small Hi-Fi cassette tape recorder. Based on the Dolby system, this recorder, the DC9, is a four-track stereo/mono machine with piano key controls. Price is £115.

It is felt by Wharfedale that the Dolby system together with other improvements have enabled the company to design a player with a performance as good or better than that of big and expensive machines.

North Devon A.R.C.

The above Club has recently been formed. Meetings are held the second and fourth Wednesday in every month at: Crinnis, High Wall, Sticklepath, Barnstable, North Devon. Meetings start at 7.30 but members wishing to study for the RAE should be there at 6.30. Further details may be obtained from H. Hughes, G4LG, at the above address.

Contestitus

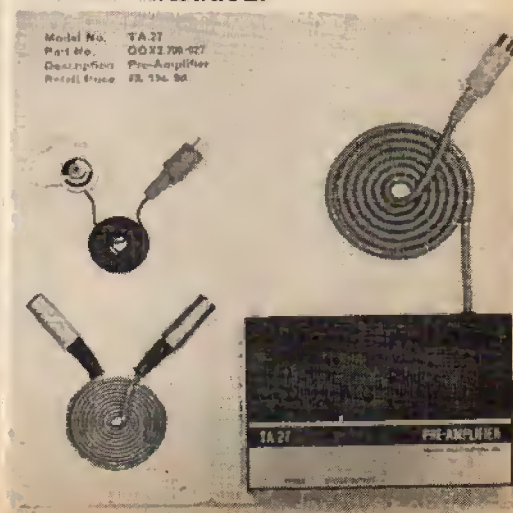
Those with "contestitus" will be pleased to note the following events for the mad month of March. March 6-7, ARRL DX contest (phone), 13-14 BERU contest, 20-21 ARRL contest (c.w.), 27-28 WPX s.s.b. contest. Don't forget to listen on April 4 in the low power 80 metre contest. It should bring out some transistor rigs who would appreciate a report.

Accessory guide

The British Radio Corporation has published a leaflet illustrating details of the wide range of accessories designed for use with BRC audio equipment.

There are nearly 30 different accessories in the range, including synchro-amps, pre-amps, slide synchronisers, mains adaptors for portable cassettes and radios, stethosets, footswitches, microphones, carrying cases and various connecting leads.

Each type of accessory is illustrated and a short description gives its applications. The picture shows a few of the accessories included.



NEWS... NEWS... NEWS...

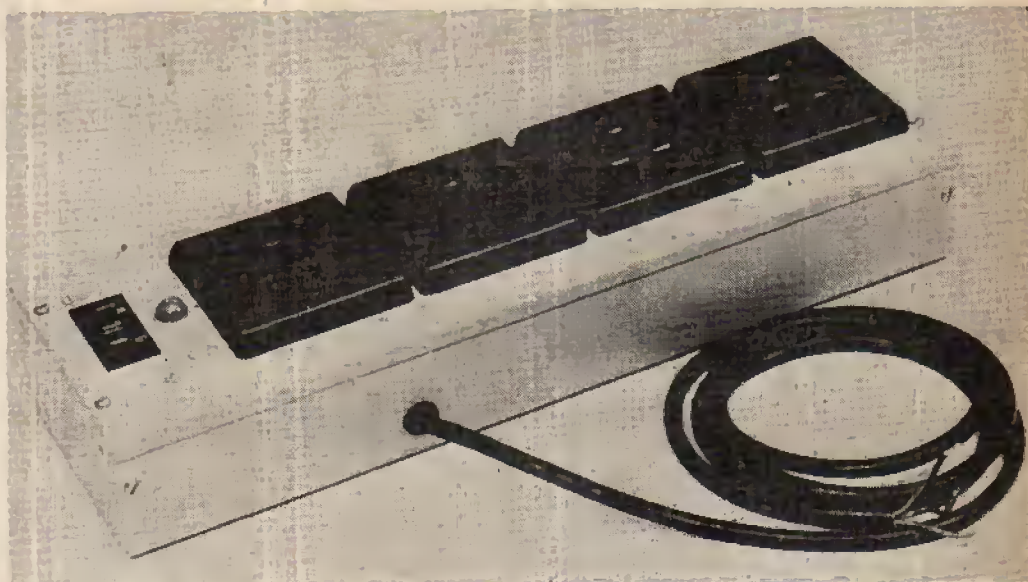
Price Drop

It certainly makes a change these days to hear of a reduction in prices, but this is exactly what Light Soldering Developments have done! Having recently relocated the production of their Litestat temperature-controlled soldering instruments in a new factory, they are now in a position to expand production and reduce costs.

They are therefore making reductions of 20% in the list price of both the Litestat 50 and Litestat 70 and spares including copper bits.

The Company are also introducing their new catalogue. In preparing this, they have taken the opportunity to incorporate details of all their products in one booklet using the A4 format (for our technical printing-type readers). Prices are shown in £sd and the new-fangled decimalised system and metric equivalents of all dimensions are given. Further gen from: *Light Soldering Developments Limited, 28 Sydenham Road, Croydon, CR9 2LL.*

Distribution Panel



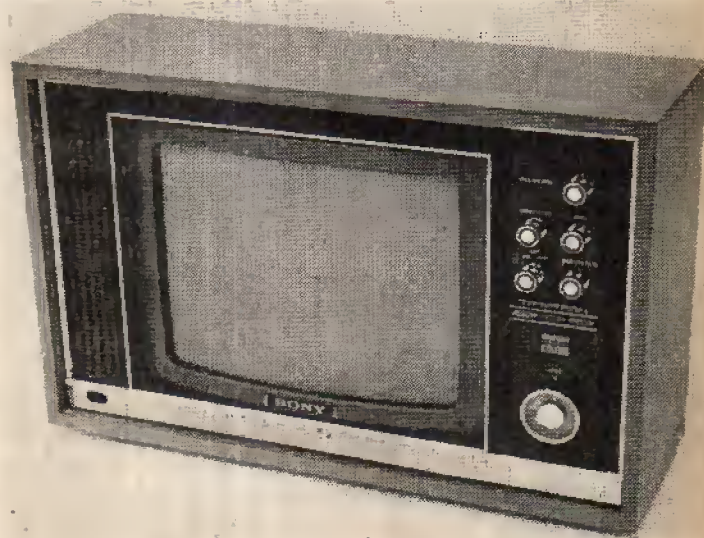
A new, multi-socket mains distribution panel is now included in the Lektrokit range.

Designated the LKU-413, it consists of four, 3-pin, 13A shuttered outlet sockets, mounted side-by-side on the top of the unit, a combined on/off switch and magnetic circuit breaker, a red neon indicator and 6ft. of extension cable as standard.

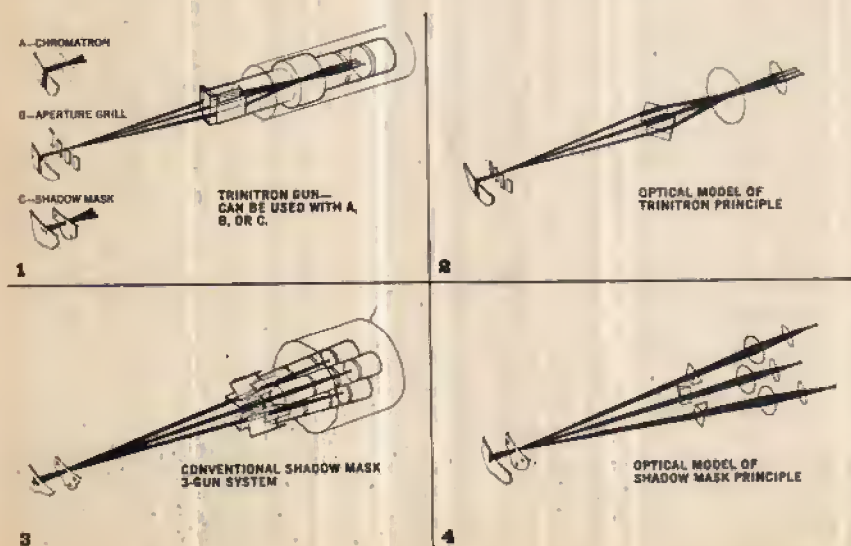
Available direct from the manufacturers, the new unit is priced at £6.30 including purchase tax. If required, the panel can be supplied with 30ft. of cable (LKU-413L) at an inclusive price of £6.97½. *A.P.T. Electronic Industries Ltd., Chertsey Road, Byfleet, Surrey.*

Sony mini-colour TV.

The Sony Corporation of Japan are introducing a transportable colour TV set (Model KV-1320UB) using their Trinitron colour c.r.t. Price is £199.75 and screen size is 13in. The Trinitron tube has only one electron gun against three of a conventional Shadowmask tube. This gun emits three simultaneous



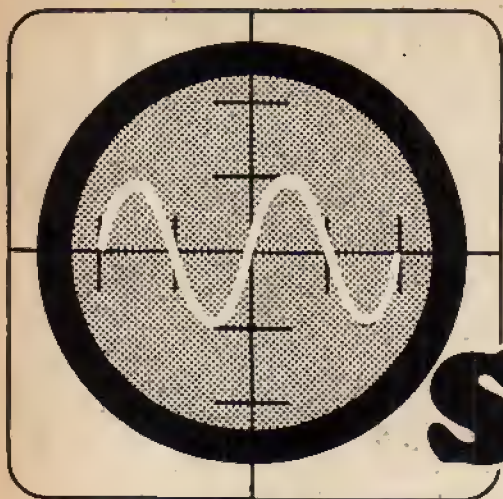
Sony KV-1320UB Trinitron colour TV.



Diagrammatic representation of the Trinitron principle compared with that of the Shadowmask system.

in-line beams which are converged and focused through the Trinitron electro-optical system consisting of two large diameter lenses and a pair of electron prisms. An aperture-grill is mounted behind the screen and takes the place of the Shadowmask used in conventional tubes.

A description of the Trinitron tube appeared in the September 1970 issue of our sister magazine *Television*.



A. LESTER-RANDS

PW WORKSHOP oscilloscope

PART 1

ON examining the circuit for the workshop oscilloscope, readers may wonder why valves have been used for the P.W. Workshop Oscilloscope. First of all, a cathode ray tube requires a heater voltage and high h.t. potentials for which a suitable mains transformer is necessary. It was found that as the requirements for the specified c.r.t. could be met with a fairly inexpensive standard 350-0-350v (plus heater windings) mains transformer, which would also provide potentials and heater supplies for a valve timebase and Y amplifier, there was little point in using transistors for a job which valves would do just as well and at no extra cost.

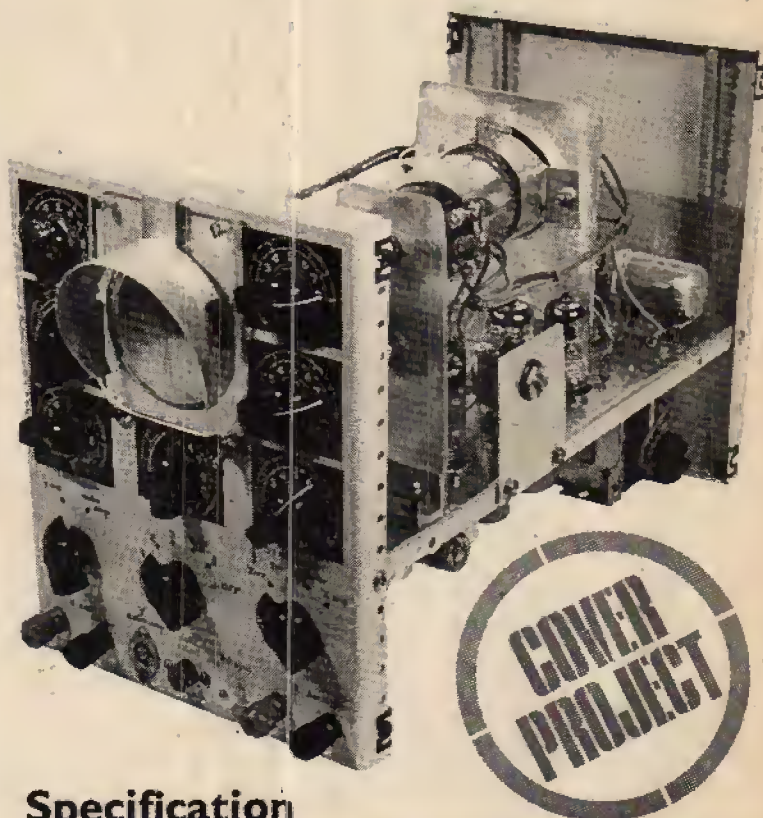
Most low cost general purpose oscilloscopes presently available use valves and as far as cost is concerned, the P.W. Workshop Oscilloscope can be built for much less than a commercially made equivalent.

CIRCUIT FUNCTION AND FACILITIES

The P.W. Oscilloscope is intended for general workshop use and is suitable for all audio work and many r.f. applications up to frequencies of at least 2MHz at which the main Y amplifier response is -3dB but extends up to nearly 5MHz. The fastest timebase speed allows the resolution and display of several complete cycles at frequencies around 1MHz and the slowest speed will allow the display of several complete cycles at frequencies as low as 10Hz.

The main Y amplifier has an input sensitivity of 250mV r.m.s. for a display of 4cm peak-to-peak (sine wave) and a nominal frequency response of 10Hz to 2MHz. The Y preamplifier has an input sensitivity of 10mV for a display of 4cm peak-to-peak (sine-wave) and a frequency response of 10Hz to 50kHz ± 1 dB. This additional stage to the Y amplifier chain is to provide adequate signal display from low level signal sources. The gain of the Y amplifier is continuously variable, regardless of which input is used, and each of the inputs have relatively large overload margins. The gain of the Y amplifier has been adjusted, in the relationship to the c.r.t. sensitivity, so that the final amplifier stage reaches clipping point after full Y plate deflection.

The timebase is a Miller-transitron circuit with its own sync amplifier that can be switched for internal or external signals. Each timebase range is continuously variable and each overlaps. The timebase can be switched off and the sync selector switch used to provide a small 50Hz sweep (internal signal source) or select a separate X plate amplifier with its own



Specification

Frequency Responses

Y amplifier		10Hz to 2MHz
Y preamplifier		10Hz to 50kHz
X amplifier		10Hz to 50kHz
Timebase frequency		10Hz to 24kHz

Input Sensitivities

Y amplifier		4cm deflection for 250mV
Y preamplifier		4cm deflection for 10mV
X amplifier		4cm deflection for 1.5V
(Deflection peak-to-peak, volts in r.m.s.)		

Controls

1. Y amp. gain	6. Timebase amplitude
2. Timebase Function	7. Brilliance
3. Y preamp. in/out	8. Focus
4. Timebase sweep	9. Y shift
5. Timebase fine sweep	10. X shift

Timebase Ranges

1. 10-50Hz	4. 500-4,500Hz
2. 30-270Hz	5. 2,700-24,000Hz
3. 90-800Hz	6. Off.

Valve Lineup

C.R.T. CV1526 (3EG1), 3-off EF80's, ECC81, ECC83, ECF80.

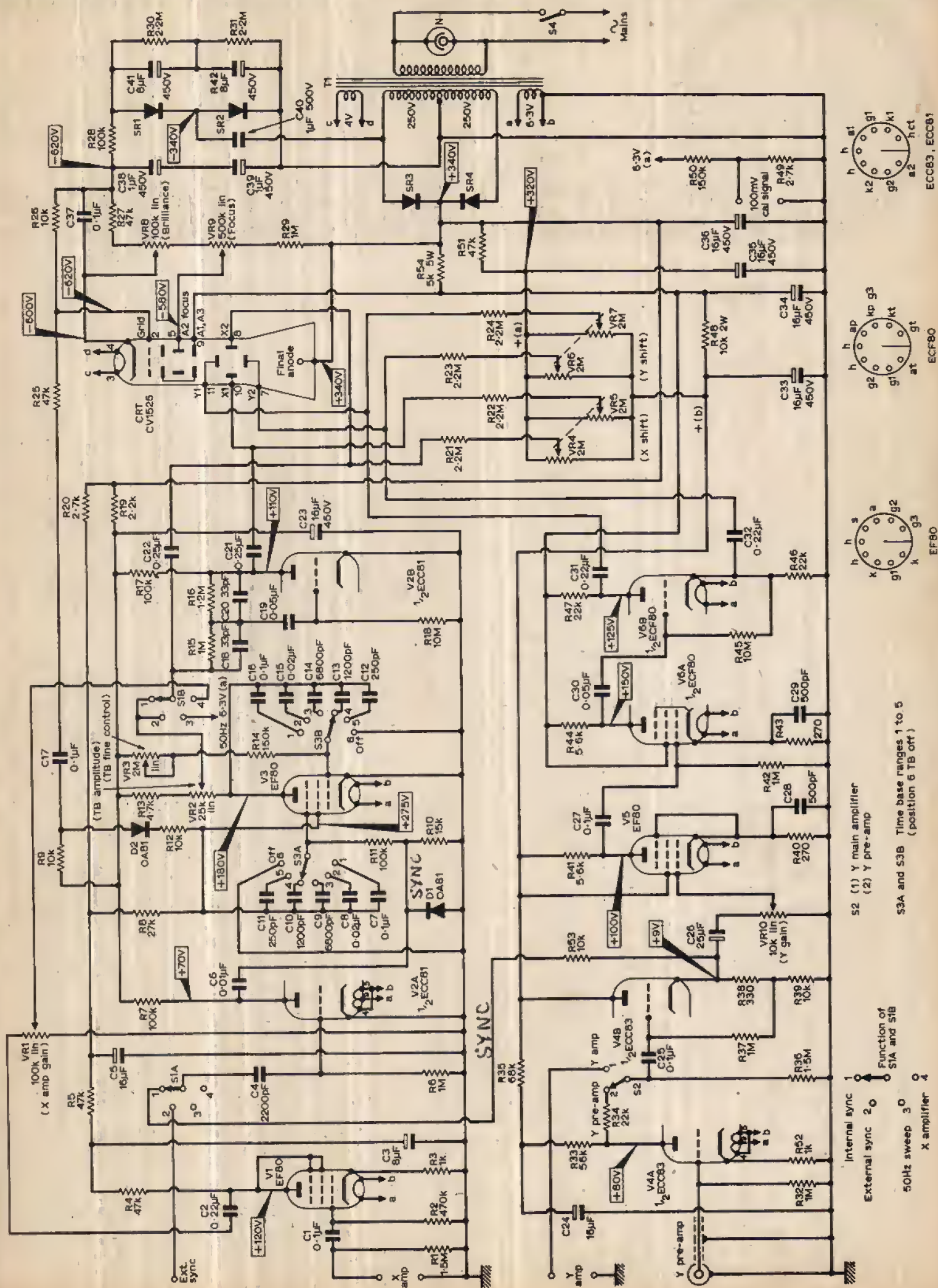


Fig. 1: The complete circuit of the P.W. Workshop Oscilloscope.

★ components list

Case as used for prototype

Contil type Q 13 x 9 x 7in. West Hyde Developments Limited

Cathode Ray Tube

Type CV1526 (3EG1) Henry's Radio or
2½in. screen. Green trace RST Valve Company
12-pin B12B Base P.C. Radio Limited
(Price should be around £3.25)

CRT Base

12-pin B12B (suppliers as above)

Mains Transformer T1

230V pri-Sec. 350-0-350V 80mA
Heaters 6.3V and 4V Type MT2 Home Radio
(Catalogue No. TM2)

Rectifiers (SR1, 2, 3 and 4)

SR1, 2, 3 and 4 Type 1N2374 Silicon Henry's Radio Limited

Valveholders

B9A 9-pin (6 off)

Valves

V1, V3, V5 EF80 Mullard
V2A-B ECC81 Mullard
V4A-B ECC83 Mullard
V6A-B ECF80 Mullard

Diodes

D1, D2 OA81 Mullard

Switches

S1A-B 2-pole 4-way
S2 Single pole 2-way
S3A-B 2-pole 6-way
S4 Mains on/off toggle type

Potentiometers

VR1 100kΩ lin. VR8 100kΩ lin.
VR2 25kΩ lin. VR9 500kΩ lin.
VR3 2MΩ lin. VR10 10kΩ lin.
VR4/5 } 2MΩ (Dual Potentiometers) Home Radio
VR6/VR7 } (Catalogue No. VR78/2M)

Resistors ½W 10%

R1 1.5MΩ	R14 150kΩ	R27 47kΩ	R40 270Ω
R2 470kΩ	R15 1MΩ	R28 100kΩ	R41 5.6kΩ
R3 1kΩ	R16 1.2MΩ	R29 1MΩ	R42 1MΩ
R4 47kΩ	R17 100kΩ	R30 2.2MΩ	R43 270Ω
R5 47kΩ	R18 10MΩ	R31 2.2MΩ	R44 5.6kΩ
R6 1MΩ	R19 2.2kΩ	R32 1MΩ	R45 10MΩ
R7 100kΩ	R20 2.7kΩ	R33 56kΩ	R46 22kΩ
R8 27kΩ	R21 2.2MΩ	R34 22kΩ	R47 22kΩ
R9 10kΩ	R22 2.2MΩ	R35 68kΩ	R49 2.7kΩ
R10 15kΩ	R23 2.2MΩ	R36 1.5MΩ	R50 150kΩ
R11 100kΩ	R24 2.2MΩ	R37 1MΩ	R51 47kΩ
R12 10kΩ	R25 47kΩ	R38 330Ω	R52 1kΩ
R13 4.7kΩ	R26 10kΩ	R39 10kΩ	R53 10kΩ

All resistors 10% ½Watt

Resistors (Special)

R54 5kΩ 5watt
R48 10kΩ 2watt

Capacitors (special)

C40 1μF paper type—500/600V working Home Radio

Capacitors

C1 0.1μF	C15 0.02μF	C29 500pF S.M.
C2 0.22μF	C16 0.1μF	C30 0.05μF
C3 8μF 350V	C17 0.1μF	C31 0.22μF
C4 2200pF	C18 33pF S.M.	C32 0.22μF
C5 16μF 350V	C19 0.05μF	C33 16μF 450V
C6 0.01μF	C20 33pF S.M.	C34 16μF 450V
C7 0.1μF	C21 0.25μF	C35 16μF 450V
C8 0.02μF	C22 0.25μF	C36 16μF 450V
C9 6800pF	C23 16μF 450V	C37 0.1μF
C10 1200pF S.M.	C24 16μF 350V	C38 1μF 450V
C11 250pF	C25 0.1μF	C39 1μF 450V
C12 250pF S.M.	C26 25μF 50V	C41 8μF 450V
C13 1200pF	C27 0.1μF	C42 8μF 450V
C14 6800pF	C28 500pF S.M.	

Note: C33/C34—may be dual type capacitors

C35/C36—may be dual type capacitors

All other electrolytics must be singles and all capacitors 350V working min.

S.M.—Silvered Mica

Miscellaneous items

Terminals 2 red, 2 black (X and Y inputs) insulated type

Sockets (Insulated) 2 for sync and cal. voltage

Socket Recessed co-axial type

Pointer knobs 10 off

Mains panel neon indicator 230V

Insulated spindle couplers (focus and brilliance controls) 2 off

2-18 way and 4-10 way miniature tagboards 1½in. wide

Aluminium 18 swg for screen etc.

Aluminium angle ⅜ x ⅜in.

Paxolin or perspex ⅛in. thick for brilliance and focus controls

Sundry capacitor clips and chassis tag strips

1 6-way standard tagboard 2in. wide

(pre-set) gain control. This latter facility is extremely useful for Lissajous pattern work over a wide frequency range and with low signal levels. The X amplifier sensitivity is 1.5V rms for a 4cm peak-to-peak (sine-wave) display and the frequency response is 10Hz to 50kHz ±1dB.

CONTROLS

The timebase controls include a selector for the five timebase ranges plus a timebase 'off' position, a timebase fine frequency control and a timebase amplitude control. The 'sync' switch selects either internal or external synchronizing signals, a 50Hz X sweep of about 1.5cm, or the X plate amplifier. Brilliance and focus controls are provided, of course,

and there are controls for X and Y shift with sufficient shift potential to move the trace vertically or horizontally to beyond the edge of the c.r.t. screen. The Y amplifier gain control is common to both Y inputs and is a front panel control but the X amplifier gain control is a pre-set mounted at the side. It can be easily adjusted with a screwdriver.

THE CATHODE RAY TUBE

Cathode ray tubes of currently available manufacture and type are quite expensive and are also difficult to buy because the demand is so low that few component dealers will keep them in stock. The tube chosen for the workshop oscilloscope is a type CV1526 (3EG1) which is readily available at low cost (see components list) and has a 2½in. diameter screen.

It operates with a final anode potential of approximately 1,000V and displays a green trace. *It should be emphasised that the workshop oscilloscope has been virtually designed around this c.r.t. and that the use of any other type is not recommended.*

THE CIRCUIT

The full circuit for the oscilloscope is shown in Fig. 1. E.H.T. for the tube final anode is derived from a voltage doubler arrangement (SR1-SR2) operated from one half of the secondary of T1, the 600V or so d.c. obtained from this being connected in series with the nominal 350V supply (SR3-SR4) to obtain the required total 1,000V or so. The 350V supply from SR3-SR4 provides the working potentials for the timebase, the X and Y amplifiers and the shift controls. The timebase generator, V3, is a conventional Miller-transitron arrangement and is followed by a paraphase amplifier, V2B, to provide balanced sweep voltages for the X plates. The timebase frequency ranges, each of which overlaps the other, are selected by S3A and B and the total frequency range is approximately 10 to 24,000Hz. Fine timebase frequency control is obtained by VR3 and amplitude by VR2. Synchronizing signals for the timebase can be supplied from either the Y amplifier at the cathode of V4B, or from an external source via the 'sync' switch S1A and B. This also selects the internal 50Hz X sweep voltage from the 6.3V heater supply or switches in the X plate amplifier V1.

The main Y amplifier is preceded by a cathode follower (V4B) which provides a high impedance input and low impedance output via the gain control VR10. The Y amplifier itself consists of V5 and V6A, the output of which is terminated by the phase splitter V6B. This delivers symmetrical paraphased signals to the Y plates via the isolating capacitors C31 and C32. For low level signals the additional Y amplifier stage (V4A) is provided and this has an input sensitivity of 10mV for 4cm peak-to-peak deflection.

The c.r.t. operates at a potential of approximately 1,000V between cathode and the final anode. The potential dividing chain R27, VR8, VR9 and R29 provides the brilliance and focus control voltages. The grid of the c.r.t. is returned to the cathode via R26 but is also connected via C17 to obtain a negative going pulse for trace flyback suppression.

The X and Y plates are both connected to the shift potential networks VR4, VR5, VR6 and VR7, etc. via high value series resistors (R21, R22, R23, R24) so that no loading is imposed on either the X or Y plates or their respective amplifier outputs. The shift potential developed across VR4, VR5, VR6 and VR7 at the points marked +a and +b is approximately 200V and is sufficient to move the trace vertically or horizontally completely off the tube screen. A 100mV 50Hz calibration signal is derived from the 6.3V heater supply via the potential divider R49/R50.

PERFORMANCE

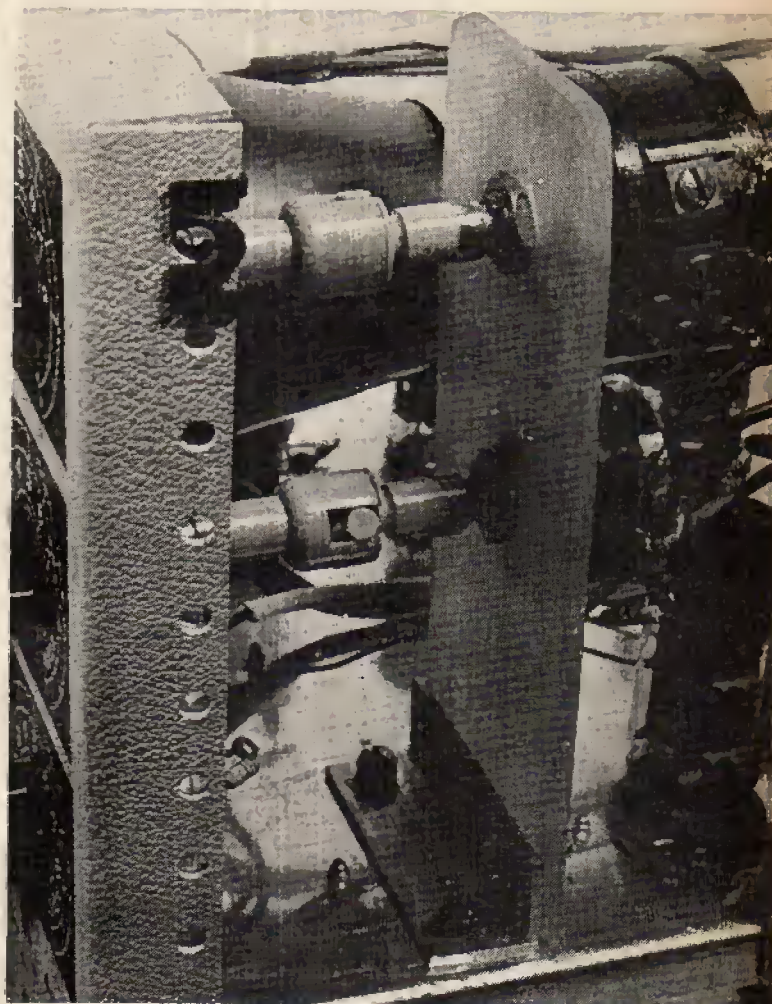
The workshop oscilloscope will cater for all normal audio tests including square-wave testing, frequency measurement by the Lissajous pattern method over a wide range of frequencies and signal levels and has many general "electronics" radio and video frequency applications. The Table gives details of the performance obtained with the prototype and which should be easily obtainable from the circuit shown in Fig. 1, providing the specified c.r.t. and other components are used.

X SWEEP

With the tube E.H.T. at 1,000V the brilliance is sufficient for photography and the trace focus is sharp. It is worth noting that no spurious spot deflection due to mains transformer field was discernible and providing the transformer specified is used and positioned below and to the rear of the c.r.t. as will be shown later, it should be quite unnecessary to provide mumetal shielding. With the timebase range control switched to 'off' and with the Y amplifier gain control at zero, the spot should appear completely round and sharp and not more than 1mm in diameter at normal brilliance. Note also that with the X and Y shift controls at exactly half way travel the spot should be at the centre of the screen.

CONSTRUCTION

The prototype was constructed exactly in accordance with the circuit given in Fig. 1 and as shown in the photographs, in a Contil case type Q (see components list). This has overall dimension of 13×



The insulated supporting bracket and insulated spindles for the focus and brilliance controls.

9×7in and is supplied with an internal chassis on which the c.r.t., the power supply and amplifier components and valves are mounted. A home constructed case of similar dimensions could of course be used. Construction also calls for an internal screen which supports the tagboards for the amplifier and timebase components, supporting brackets for the c.r.t. and the X amplifier gain control and a bracket of insulating material (paxolin or perspex) for mounting the brilliance and focus controls. Full details for construction and layout will be given in Part 2.

TO BE CONTINUED

RATE YOUR REFLEXES

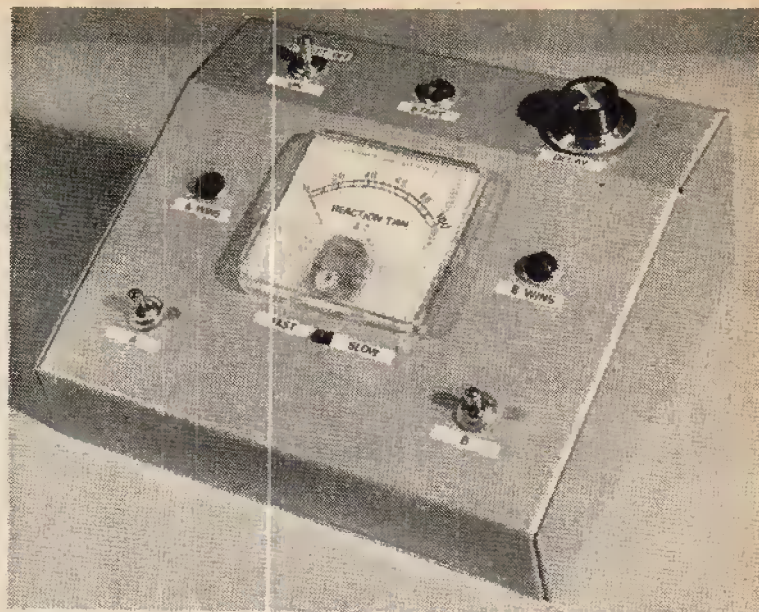
THE project described here has several uses. It will do as the title says: "Rate Your Reflexes"—but it also enables you to test your reactions against those of other people. It can incorporate other tests including manual dexterity and it is a very effective "Drunkometer" which will prove to yourself—or to other people—just how much alcohol affects your reactions. There aren't many ways of arguing with the man who says "I'm perfectly safe on the road after eight pints, etc." but this device will show him just how much slower his reactions are *even after only a couple of pints*. The results will be there for him to see for himself.

It is often true that the simplest games and tests are the most fun and that certainly applies to the reaction tester described here. At parties it has proved a real winner. Rather like the fortune teller who is never short of customers because people always want to know something about themselves that only someone else can tell them, the reaction tester will tell people how their reactions or reflexes compare to the average. Unlike the fortune teller, however, this device is scientifically accurate to quite a high degree—you *yourself* determine the readings and they cannot be disputed. Once people have got the hang of it the reaction tester fascinates them.

The reaction tester has proved so popular that those who have tried it have devised all sorts of games and tests. Some of these are mentioned at the end of the article but no doubt many will occur to you.

Operation

There are two distinct ways of using the circuit. Firstly there is the competitive side—at a signal



HALVOR MOORSHEAD

two "players" try to throw a switch as fast as possible, the one who is fastest is shown to be the winner by a second bulb lighting up above his switch. Even though the loser is a thousandth of a second behind the winner his bulb will fail to light and will not do so until the winner's switch is reset.

The competitive side can be built separately and will provide plenty of fun for very much less cost, but it does have limitations—it will only tell you who is the fastest of two players but no indication of the differences in their speeds and you cannot use it without another player.

The timer part of the circuit is additional and works as follows. As soon as the start signal bulb lights up, the needle of a meter starts to rise—and rise quickly—taking about a second to traverse the scale. As soon as the switches are thrown the needle stops and stays in the same position so that a reading can be taken of the time lapse between the "start signal" and the winner throwing the switch. It will of course only give the reading for the winner.

A considerable amount of thought was given to including a "cheat" device, that is one which would light up a bulb or sound a hooter if either switch was thrown prematurely but so much trouble was experienced with this that it was decided to leave it to the end. To the author's delight it was discovered that a "cheat" circuit is actually built into the existing circuitry and this will be explained later.

Although it may be rather pretentious, you could call the finished project a simple computer for it includes computer type circuits and this claim, made to non-electronic friends, should impress them!

The Circuit

There are three distinct sections to the circuit and these will be explained separately. They are the "start signal", the "winner" circuit and the "time indicator."

The "start" signal circuit should ideally be operated independently of either competitor and also ideally one would use some form of random circuit. However random circuits are very complex and it would be impractical to use one here.

The next best thing—and perfectly satisfactory in

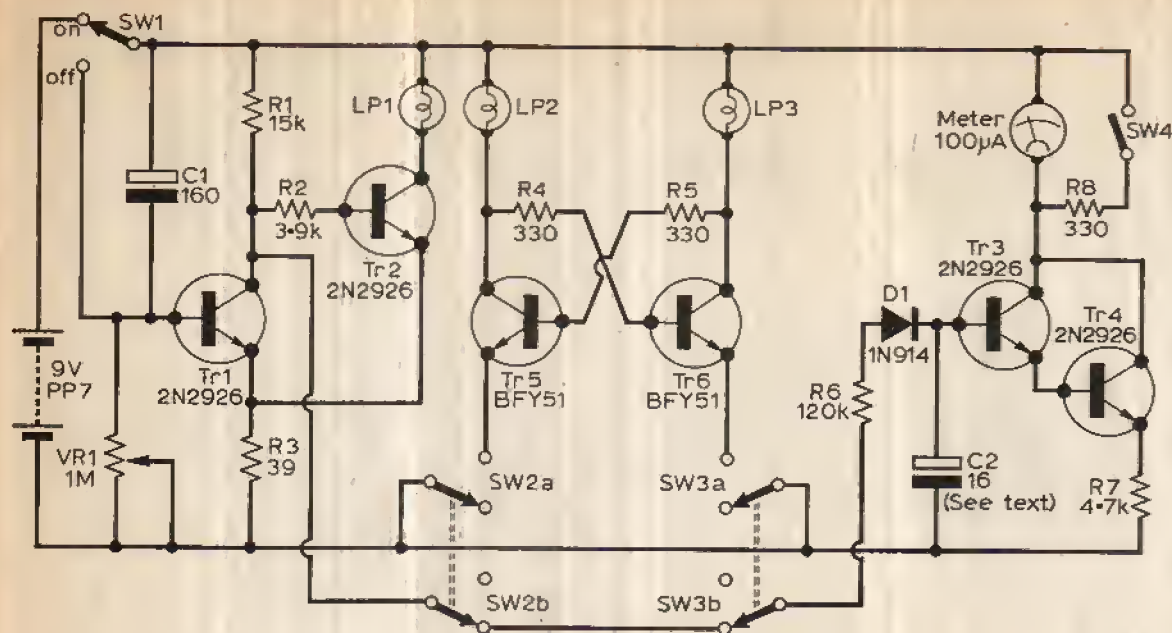


Fig. 1: The complete circuit of the Reaction Tester. Tr 1 and Tr 2 form the delay circuit which relies upon the charging of C1. Tr3 and Tr4 are coupled as a Darlington pair to form the high input impedance timing circuit while Tr5 and Tr6 are part of the "winner" indicator circuit.

use—is to use a time delay circuit in which the delay is of sufficient length so that it is impossible to remember or estimate exactly when the "start" signal will trigger.

Tr1 and Tr2, together with the associated components, act as a time delay circuit, the delay varying between instant and about 12 seconds. A longer delay was originally included but it was found that delays of much more than about ten seconds served no real purpose and tests became boring. A period of 12 seconds when you are waiting for something to happen is a very long time indeed.

The "start" signal circuit makes use of a Schmitt Trigger—that is a circuit which can only be in two states, on or off, and the switching action is very fast indeed.

Referring to Fig. 1, when SW1 is thrown to "on", C1 begins to charge through VR1. To begin with the potential across it is small—as it is charging—and therefore the base of Tr1, which is coupled to the junction of C1 and VR1, is at nearly supply potential and is switched fully on. This means that it is passing considerable current and the potential between the collector and emitter is very small. The base of Tr2 is coupled to the collector of Tr1 via a resistor R2 and the emitter joins directly to the emitter of Tr1.

When Tr1 is "on" the potential across it is so small that Tr2 will not have nearly enough potential between the base and emitter to be in a conducting state and will be completely "off" and the bulb LP1 will be off.

However, as C1 charges the potential across it increases and the base of Tr1 is moved slowly towards chassis potential until a point is reached when Tr1 approaches cut-off; this means that the potential across it rises and this in turn means that Tr2 starts to turn on. There is a regenerative action because of R3 and the switching action, once it starts, is very rapid. When Tr2 is on, current is allowed to flow through it and the bulb LP1 lights up.

The time delay will depend on the setting of VR1 and as mentioned this can be adjusted for any setting up to 12 seconds.

The values of R1, R2 and R3 are not over-critical for the operation of the bulb but their choice does affect the operation of the timer circuit which comprises Tr3 and Tr4 with their associated components.

When the "start" circuit is triggered the potential

★ components list

Resistors

R1 15kΩ	R5 330Ω
R2 3.9kΩ	R6 120kΩ
R3 39Ω	R7 4.7kΩ
R4 330Ω	R8 330Ω
All resistors ½W, 10%	
VR1 1MΩ linear track potentiometer.	

Capacitors

C1 160µF 12V or higher.
C2 16µF—10V, Mullard—see text

Semiconductors

Tr1 2N2926G	Tr5 BFY51
Tr2 2N2926G	Tr6 BFY51
Tr3 2N2926G	D1 1N914
Tr4 2N2926G	

Switches

SW1 2-way, 1-pole toggle
SW2 2-way, 2-pole toggle
SW3 2-way, 2-pole toggle
SW4 On/off slide switch

Miscellaneous

Meter	100µA, 3½in face—see text
Case	See text
LP1, 2 and 3	6V, 40mA MES bulbs
Bulbholders	3 MES types
Battery	PP9, 9V.
Component Board	0.15in matrix plain Veroboard

at the junction of R1 and R2 rises and capacitor C2 begins to charge through R6 and D1 and this in turn starts to bias on the high impedance circuit (the Darlington Pair) comprising Tr3 and Tr4 in which the current increases with the rise in voltage at the base of Tr3. Even before the "start" circuit has triggered there is of course a small potential at junction R1 and R2 and the capacitor will be charged but it is not enough to bias the Darlington pair into conduction.

As soon as either of the competitive switches are thrown the charging line is broken and C2 is no longer being charged.

As the input impedance of the meter circuit is very high—in the order of 100MΩ—so little current will be drawn from the capacitor that it can be

ignored and so the meter continues to register a nearly true reading of the charge on the capacitor. This is of course proportional to the time which has elapsed between the light coming on and either of the competitive switches thrown.

The needle will rise very fast but, once stopped, will stay there. In fact the needle will fall very slowly due to the leakage of C2 and to a far lesser degree due to the current taken for Tr3, but the fall on the prototype was only about one division on the meter in ten seconds, a division being one fiftieth of full scale deflection.

The quality of the component used for C2 is important. One of the Mullard "Blue" range was used as these appeared to be very much better than imported types at holding the charge. Some Japanese components hardly held any charge at all, the

pletes the indicator circuit first messes it up for the other.

Since the circuit has already been broken between the Schmitt Trigger and the timing indicator, the additional break contributed by SW3b doesn't affect the operation and the timing indicator registers the winners time only.

Cheat Circuit

From the circuit it will be seen that LP2 and LP3 can be switched on regardless of whether LP1 is alight or not. However if this is done one of the bulbs LP2 or LP3 will light and will draw a fair amount of current and this is not only taken from the battery but also from the charging timing capacitor C1 to a small degree. This has the effect of triggering the Schmitt circuit and LP1 will light. But since the line connecting the junction of R1 and R2 to R6 has been broken, the timing circuit will show no reading.

It could be claimed that this would give the same reading as for an instant reaction and this is true but the fastest reactions possible (I have it on good authority) are in the order of 1/10th of a second. If you believe that they are faster just try it. Not only does the cheat circuit work but it also shows who has cheated because of course their light is on!

Reset

Once a test has been completed it is necessary to discharge both capacitors C1 and C2 and this is done by switching off for about a second. SW1 is arranged so that it directly shorts out C1 while C2 will discharge through the base emitter circuits of Tr3 and Tr4.

C2, unlike C1, does not discharge instantly—it takes about half a second. If SW1 is thrown off and on again too quickly a small reading will still be shown on the meter.

Construction

There is available a very suitable case which might have been built for this very project; this is one of the "U" range marketed by H. L. Smith & Co. Ltd., of 287/9 Edgware Road, London W.2. The case, sized $9\frac{1}{4} \times 7\frac{1}{2} \times 3\frac{1}{2}$ in., is silver hammered finished and costs £1.20 plus postage and packing.

The meter is one of the Henelec or S.E.W. types with a $3\frac{1}{4}$ in. face and a large hole has to be cut in the sloping panel to hold it.

These meters are supplied in a cardboard box with a piece of card that acts as a perfect template for marking the size of the hole and the positioning of the mounting screws. A series of holes are drilled just inside the area marked out to remove the main aluminium and a file removes the rest.

SW2 and SW3 are mounted at the bottom left and bottom right respectively of the sloping panel; these can be marked "A" and "B" and the associated light mounted above them.

The start bulb is sited on the top "flat" with the Off-Reset/On switch and VR1 the delay potentiometer.

The two terminal contacts on the back of the meter provide a very suitable mounting for the component board and two holes should be drilled in this to enable it to be screwed on.

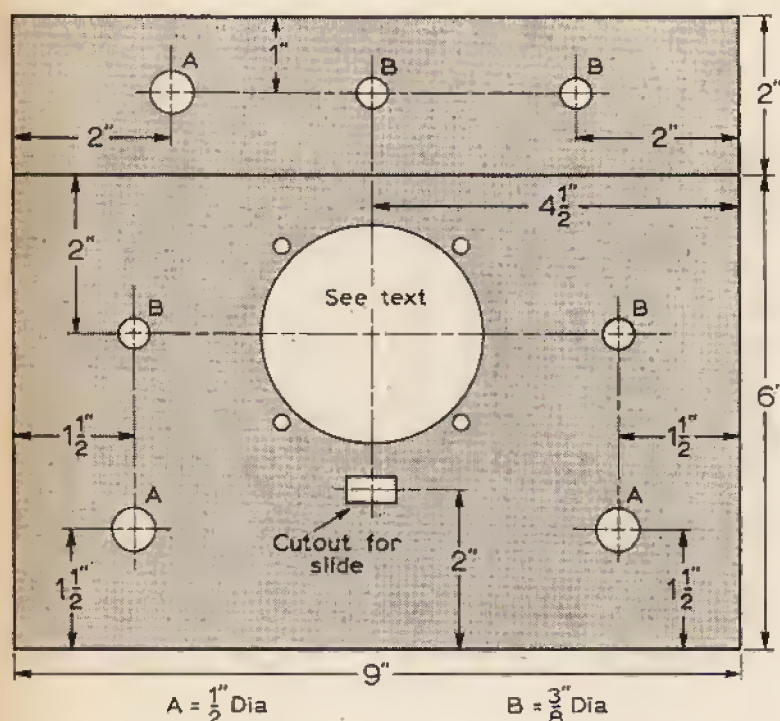


Fig. 2: The drilling of the face plate on the prototype. As can be seen from the heading photograph, this is angled.

leakage was so high. It is certainly worthwhile choosing a good component for C2 by experiment.

R6 is included to set the rate of charge. A small slide switch and R8 are included to shunt the meter to give two scales of reading.

In the prototype the unshunted meter takes about a second to reach full scale deflection, the 330Ω shunt reduces the rise rates to 20% of the original. On the "slow" setting readings above 7 are far from linear but this does not really matter.

The slow rate is only needed for certain experiments since all the simple tests can be completed in under a second by most people.

The "winner" indicator circuit comprises Tr5 and Tr6 with associated components. Let us assume that the person with the most rapid reactions is on SW2. When this is thrown the emitter of Tr5 is connected to chassis and since the base circuit is biased via R5 and LP3, as soon as the circuit is completed by SW2 the transistor conducts and LP2 lights up. When the other person makes his switch, the emitter of Tr6 is connected to chassis but as Tr5 is in conduction and fully switched on the voltage across Tr5 is so small that there is not enough to bias the transistor on. It therefore remains off whatever the position of SW3. So it comes down to whoever com-

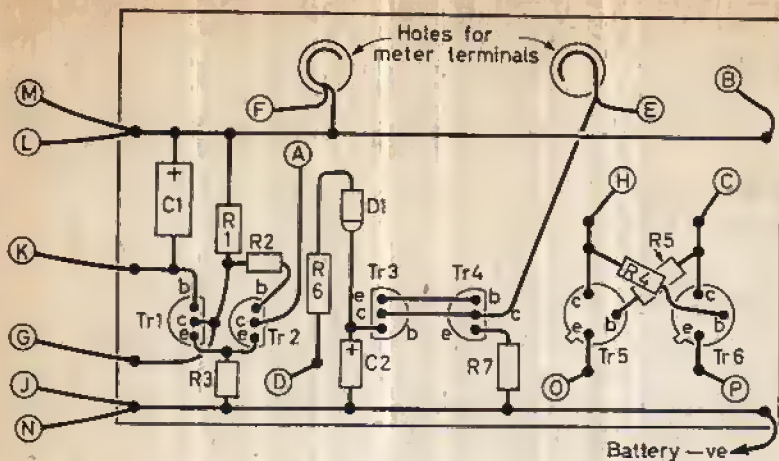
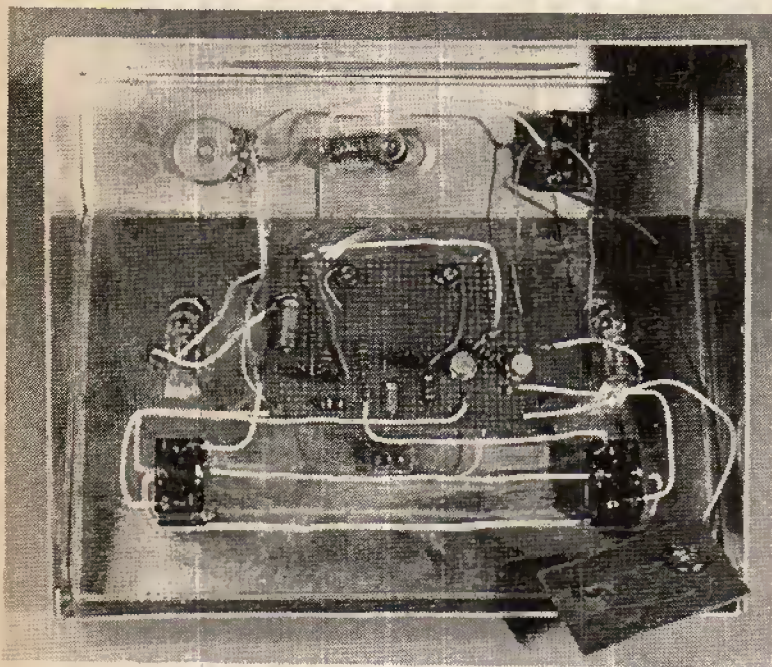


Fig. 3: The component layout on plain Veroboard. Note that Tr3 and Tr4 should read Tr5 and Tr6 and vice versa.



Compare this photograph with Fig. 4.

The component board is made from 0.15in matrix plain Veroboard and should be wired as shown in Fig. 3.

The wiring is shown in Fig. 4, the letters corresponding to the similar letter on the component board.

Using the Reaction Tester

It may be found on careful inspection that there is a very short delay between the bulb lighting and the needle starting to move. If this is so high that the fastest genuine reactions can be accomplished in the delay, the values of R1 and R2 should be experimented with. The delay is due to the voltage at the base of Tr3 having to reach a certain level before it begins to conduct.

The first tests can be done by yourself. With SW1 thrown to "on", switch either SW2 or SW3 as soon as the light comes on indicating "start". By the time you have thrown the switch a reading should have registered on the meter.

Try part-throwing the switch at the next test—that is, hold either SW2 or SW3 with such a pressure that the tumbler is just about to throw. This will remove as much of the mechanical delay (if one can call it that) as possible so that the time registered is only that of your reflexes. It will probably be found that this makes little difference. Then

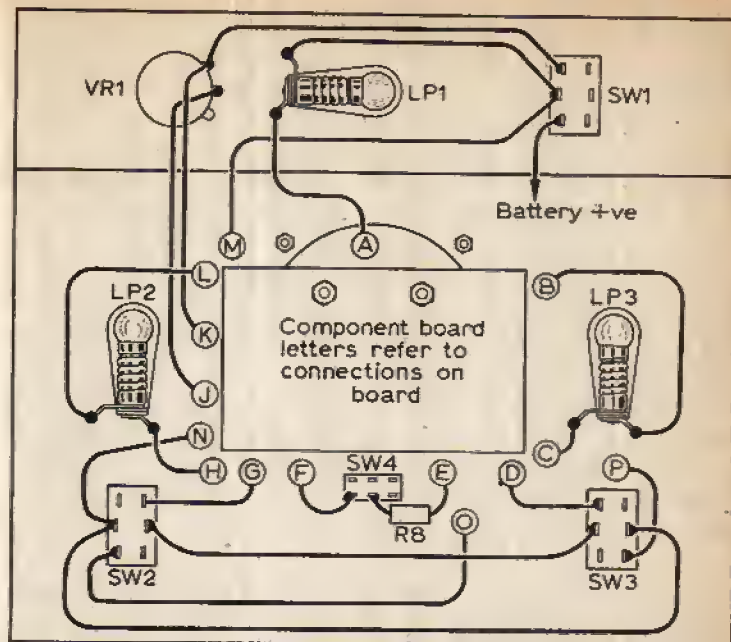
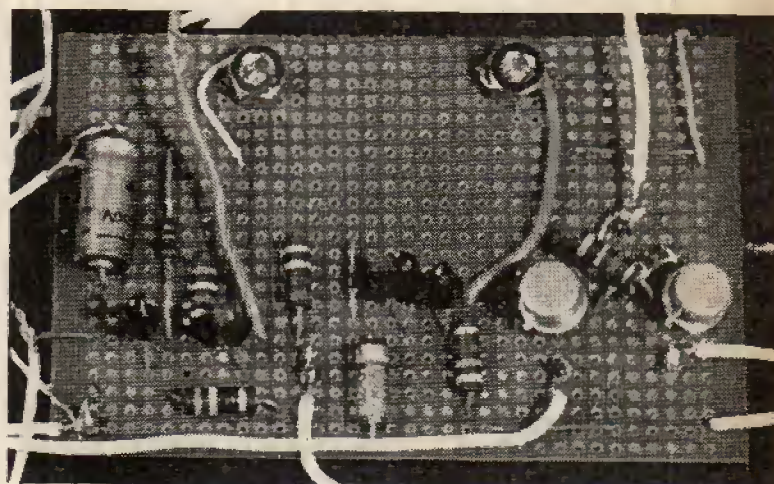


Fig. 4: The internal wiring of the reaction tester.



Closeup view of the component board. The meter terminals are visible at the top.

try having the hand that you are going to switch with flat on the table and only move it when the light comes on and note that reading.

One interesting point has been noticed on the prototype. If the unit has been off for a period of much over 20 minutes, the first reading will be much slower than subsequent ones. This is probably due to the electrolytics reforming. For this reason make sure that the first reading of a series is ignored.

If you leave the delay at one setting and try a series of tests you will find that both competitors get better as, even if the time delay is at maximum, they begin to estimate the starting signal and get ready for it.

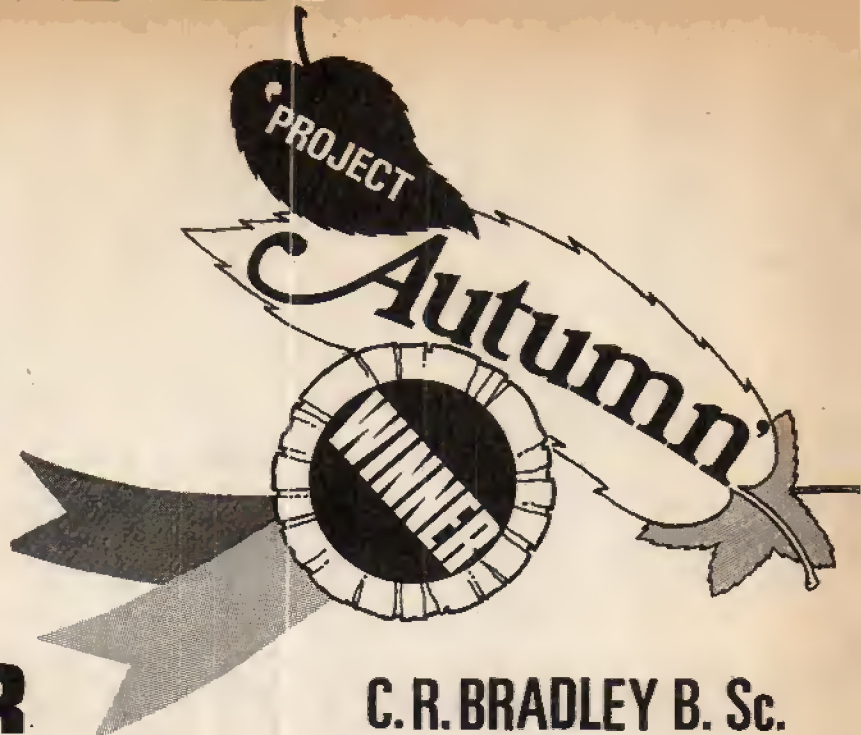
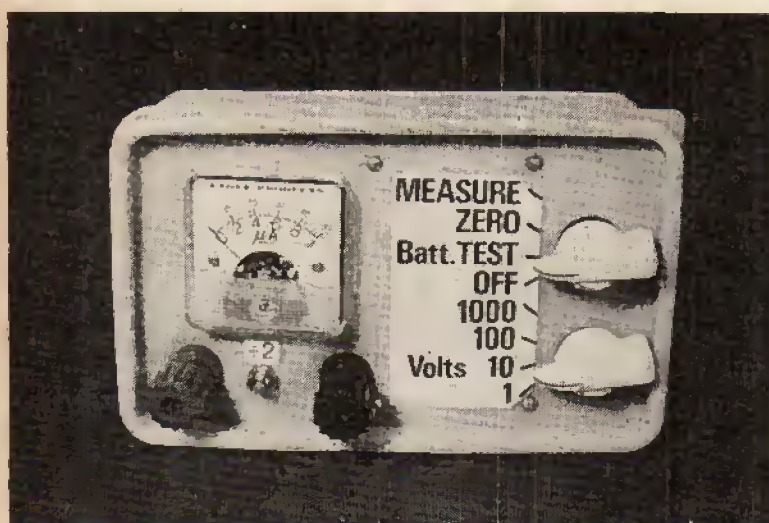
Try to take a series of twenty readings, take the average and have a pint of beer. After ten minutes or so your reactions may show a slight improvement but after a second pint and a further series of tests the reactions will show a marked decline. During these original tests one player was so fascinated that he continued to take readings till he had drunk eight pints—at which point he was unable to find the switch!

Averages must of course be used, as a single reading may be a fluke, either one way or the other.

A little ingenuity will enable you to make all kinds of tests and will provide hours of fun. ■

HIGH-Z

VOLTMETER



This article was the winner of the Project Autumn Silver Trophy Competition held last year. The judges considered it the best entry for several reasons including clear description and ingenuity. Although the likely popularity was not a major consideration in the judging, we believe that this project will be found to be very useful to the electronic experimenter.

THE improved noise performance, and only slightly diminished gain, provided by modern silicon planar transistors working at low collector current have encouraged the use of ever decreasing currents in small-signal circuits. The correctness of voltage measurements made using a conventional moving-coil multimeter therefore becomes increasingly doubtful, since the voltage conditions in the circuit may be seriously upset by the current 'stolen' by the meter. An example is illustrated in Fig. 1 where a voltmeter with a $50\mu\text{A}$ movement, which is about the highest sensitivity compatible with reasonable ruggedness and price, reads 50% low at the base of a typical transistor amplifier.

The only way to measure voltages with confidence is to use a voltmeter of much higher internal impedance than the point in the circuit tested. Excellent designs for high impedance voltmeters frequently appear and generally consist of a highly stable operational amplifier driving a moderately sensitive meter movement. However one must expect to invest several pounds in building such an instrument, or many more pounds to buy the cheapest commercial article. The author's aim was to design a high impedance voltmeter of adequate versatility for all likely experimental needs, which could be built for the absolute minimum cost. By careful shopping for components, the total cost of the prototype came to £4.25, which compares well with the cost of a moving coil multimeter. The latter, with its a.c. voltage, d.c. current and resistance ranges,

RANGES (D.C. VOLTS)

0-0.5-1-5-10-50-100-500-1000

USEFUL MEASUREMENT RANGE

0.05-1000V. All readings above 0.25V in upper half of meter scale

CONTROLS

Range switch: 1-10-100-1000V d.c.

Function switch: Off-Battery Test-Short Circuit Input-Measure

Pushbutton to divide range by 2

Internal preset for meter calibration

Two internal presets for meter zero setting with terminals open and short circuited respectively.

FEATURES

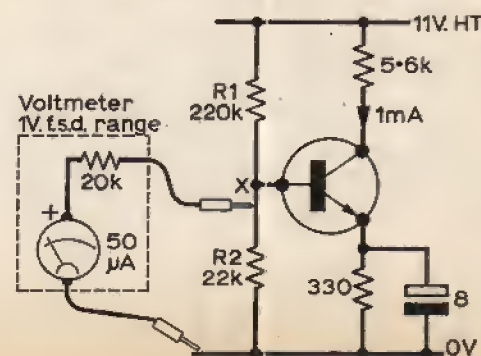
Both forward and reverse overload protection for meter movement. Long battery life

INPUT IMPEDANCE

Range	Impedance
0-1V	>7M Ω
0-10V	>3M Ω
0-100V	>5M Ω
0-1000V	>5M Ω

remains the essential first purchase for the experimenter.

The specification of the high impedance voltmeter is shown in the table.



DESIGN

The very simplest circuit which has a high input impedance and can drive a meter is the emitter follower shown in Fig. 2. Here the voltage gain from base to emitter is unity. This is because if the base

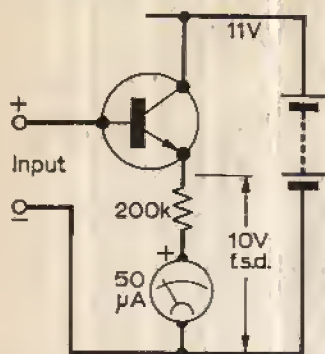


Fig. 2.

voltage is increased, base-emitter current and therefore collector current both increase, and the voltage drop across the emitter load rises until emitter and base voltages are similar. The 50µA meter in Fig. 2 has a 200kΩ series resistor so we should get full scale deflection for 10V at the input terminals. The input impedance of the circuit is $\text{transistor gain} \times 200\text{k}\Omega$ or typically $100 \times 200\text{k}\Omega = 20\text{M}\Omega$. This suggests the circuit would form an ideal basis for a high impedance voltmeter. In practice two complicating factors arise, which are handled in the final circuit.

The first problem is that if any current at all flows from base to emitter, there is a voltage drop of about 0.7V across the junction. Thus the simple circuit would be useless for measuring a voltage around 0.5V, say. The second problem is that even with zero base-emitter current, the transistor passes a

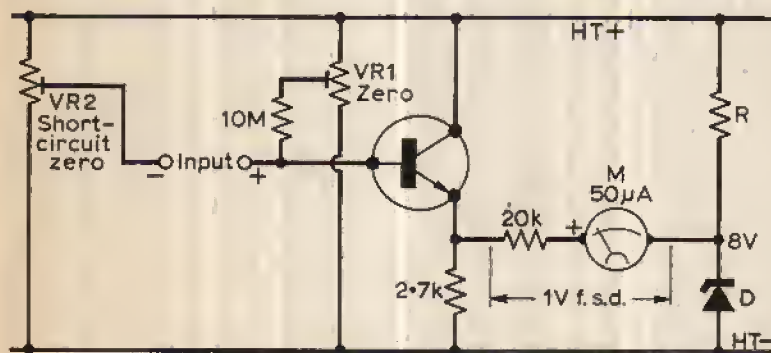


Fig. 3.

certain collector-emitter leakage current. Even with a silicon transistor, this leakage might be 5µA or more and this would show on the meter. In addition, these two values of 0.7V and 5µA vary with temperature.

The arrangement chosen to deal with this situation is shown in Fig. 3. Here the meter movement, with appropriate series resistor for the voltage range required, is connected between the transistor emitter and a constant supply of 8V provided by R and the zener diode D. Current is fed to the base by VR1 which is set up for zero meter deflection. This occurs when the emitter voltage equals the zener voltage. The transistor is then passing a collector-emitter current of $8\text{V} \div 2.7\text{k}\Omega = 3\text{mA}$ which leaves its leakage current far behind. As the base current is tiny (i.e. $3\text{mA} \div \text{transistor gain}$) a very large 10MΩ resistor can be put in series with VR1 slider to preserve the high input impedance of the emitter follower.

The positive input terminal is now at $8 + 0.7\text{V}$. This voltage is also set at the negative input terminal by VR2, done by shorting the terminals together and

setting VR2 for zero meter deflection. Now ready for measurements as low as 0.05V on the 1V f.s.d. range shown, the arrangement is simple and cheap, and the only drawback compared with a more sophisticated balance operational amplifier is a more frequent need to readjust the zero controls with changes in temperature.

FULL CIRCUIT

The full circuit of the instrument is shown in Fig. 4 and has been developed from that in Fig. 3 as follows. The single transistor is replaced by two transistors connected as a Darlington pair, which behaves like a single 'super' transistor whose gain is the product of the gains of the two separate transistors. Since the 2N2926 (green) has a specified gain (beta) of 235 to 470, the pair has a very high gain indeed. The emitter-base junction of another cheap silicon transistor is connected in reverse to serve as the zener diode in Fig. 3; this is cheaper than using the real thing and just as efficient. A batch of a dozen of this transistor all gave zener voltages in the range 6.5 to 9V which is acceptable for this use. The zero controls are combined with the zener diode to save one resistor (R in Fig. 3); this arrangement also allows finer adjustment of the two controls.

The total series resistance of VR1, R9 and the 50µA meter M is arranged to be 10kΩ; the meter therefore gives full scale deflection for $(50\mu\text{A} \times 10\text{k}\Omega) = 0.5\text{V}$ across this chain. The potentiometer VR1 is included so that the circuit can be set up for a meter movement of any likely internal resistance,

★ components list

Resistors

R1	3.3MΩ 2% ½W	R6	10MΩ 5% ½W
R2	TWO 10MΩ 2% ½W	R7	2.7kΩ 5% ½W
R3	TWO 10kΩ 2% ½W	R8	10kΩ 1% ½W
R4	TWO 100kΩ 2% ½W	R9	4.7kΩ 5% ½W
R5	390kΩ 2% ½W	R10	2.7kΩ 5% ½W

VR1, 2, 3 4.7kΩ (or 5kΩ) miniature skeleton preset potentiometers

All the above available from Electrovalue, 28 St. Judes Rd., Englefield Green, Egham, Surrey

Switches

S1	2-pole (or 3-pole) 4-way rotary
S2	3-pole 4-way rotary
S3	Push-to-close

Semiconductors

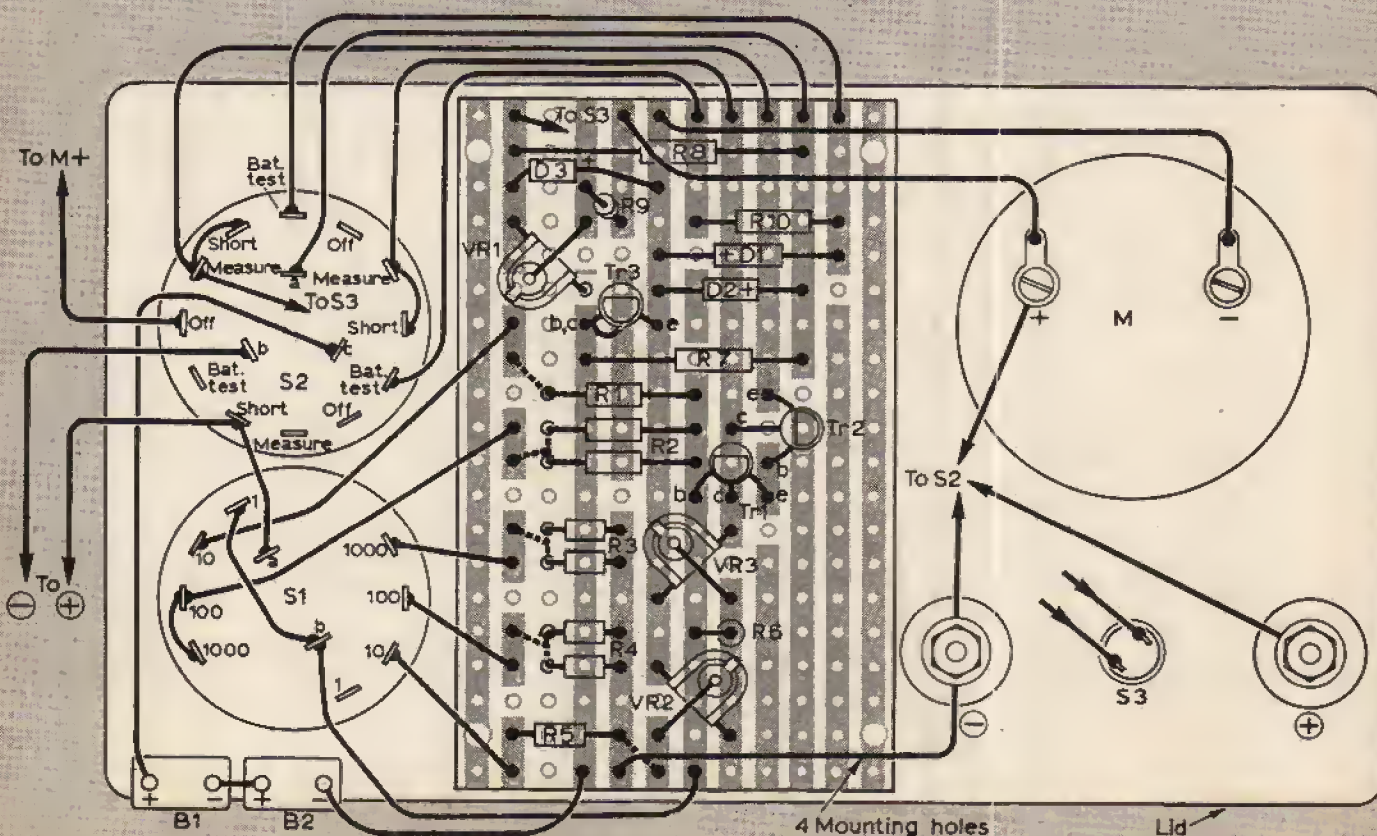
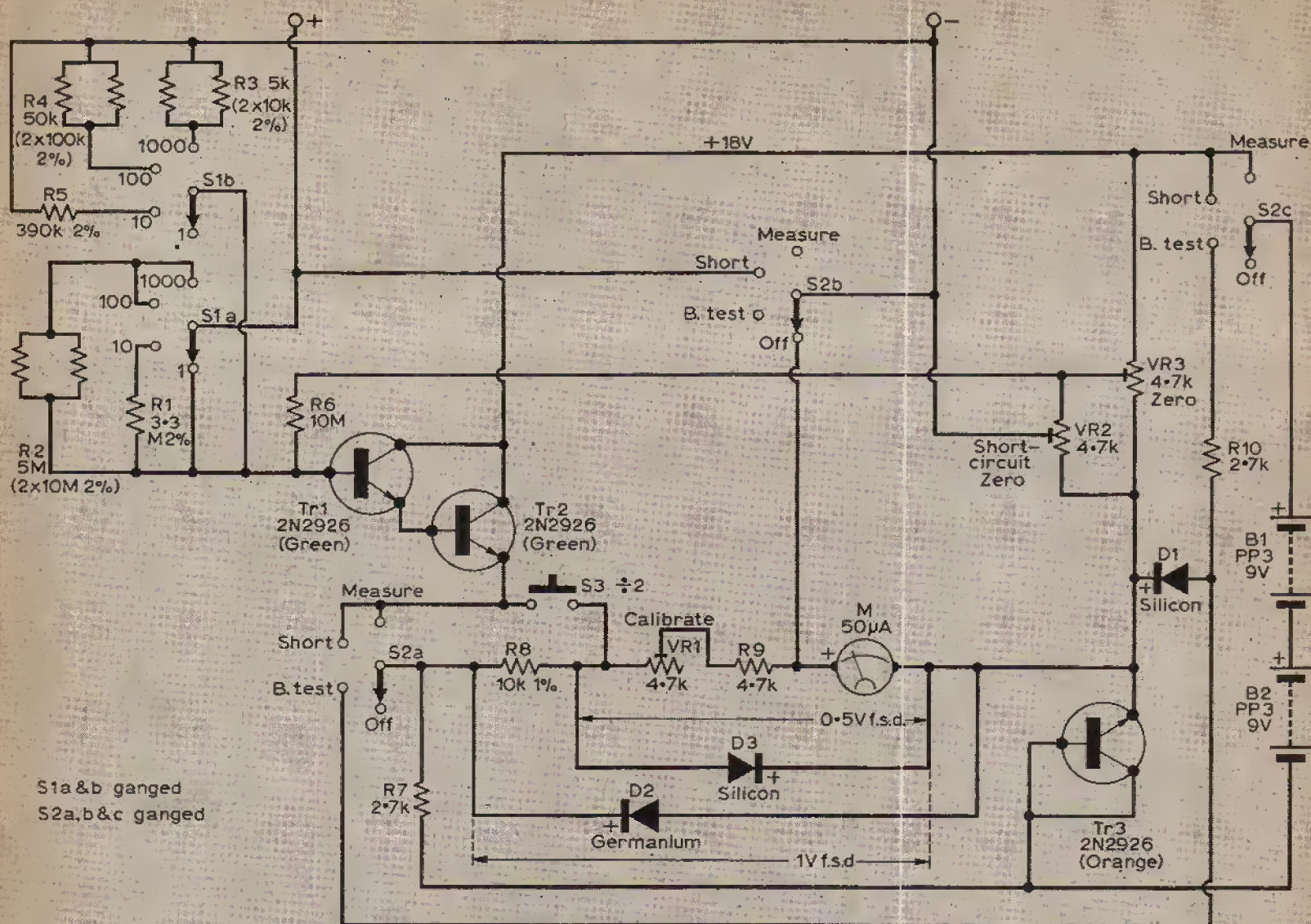
Tr1, 2	2N2926 (Green)
Tr3	2N2926 (Orange)
D1, D3	Any silicon diode e.g. 1N914
D2	Any germanium diode e.g. OA70

Meter

50µA f.s.d., 1.5in. square approx.
Eagle MR-2P or SEW MR.38P (latter from Barnet Factors Ltd., 147 Church St., London, W.2)

Miscellaneous

Veroboard 0.15in. matrix, $1\frac{7}{8}$ (across tracks) x $3\frac{1}{4}$ in.
Insulated terminals, red and black
2 PP3 batteries and battery clips
4 8BA bolts, nuts, etc.
Scrap piece of polystyrene or foam rubber (see text)
2 pointer knobs
Polythene box (see text)
Letraset for labelling



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£2.40 recommended
retail price

ANTEX precision
soldering kit

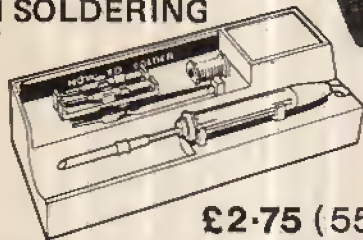
● 15 w soldering iron ● two spare bits ● resin-cored solder ● how to solder booklet ● heat sink ● 1A fuse

SK2 Soldering kit

In polystyrene pack, containing 15 watt miniature soldering iron, 240 volts fitted with $\frac{3}{16}$ " bit, 2 spare bits $\frac{5}{32}$ " and $\frac{3}{32}$ ". Coil of resin-cored solder, heat sink, 1A fuse and booklet "How to Solder".

how to solder
comment souder page 2
lötverbindungen seite 11
by ANTEX LIMITED 22

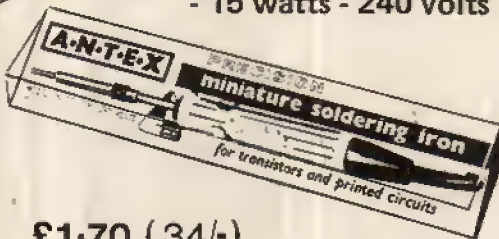
SK1 SOLDERING KIT



£2.75 (55/-)

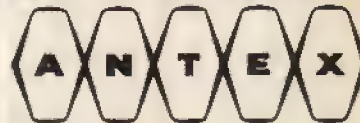
In rigid plastic "tool box" containing Model CN - 15 watts - 240 volts miniature iron fitted $\frac{3}{16}$ " bit. Spare bits $\frac{5}{32}$ " and $\frac{3}{32}$ ". Reel of resin-cored solder, heat sink, cleaning pad, stand and booklet "How to Solder"

Model CN 240/2
- 15 watts - 240 volts



£1.70 (34/-)

Fitted with nickel plated $\frac{3}{32}$ " bit and packed in handy transparent box.



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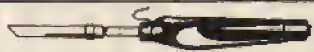
NAME

ADDRESS

PW.4



Model G - 18 watts. Fitted $\frac{3}{32}$ " bit. Spare bits $\frac{1}{8}$ ", $\frac{3}{16}$ " and $\frac{1}{4}$ " available. For 240 or 220 volts. £0.87 (17/5).



Model F - 40 watts. Fitted $\frac{5}{16}$ " bit. Spare bits $\frac{3}{32}$ ", $\frac{1}{8}$ ", $\frac{3}{16}$ " and $\frac{1}{4}$ " available. For 240, 220, 110, 20 volts. From £2.35 (47/-).

Model E - 20 watts. Fitted $\frac{1}{4}$ " bit. Spare bits $\frac{3}{32}$ ", $\frac{1}{8}$ " and $\frac{3}{16}$ " available. For 240, 220 or 110 volts. From £1.80 (36/-).

Model ES - 25 watts. Fitted $\frac{1}{8}$ " bit. Spare bits $\frac{3}{32}$ ", $\frac{3}{16}$ " and $\frac{1}{4}$ " available. For 240, 220 or 110 volts. From £1.80 (36/-).

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AC128	13p	OC201	25p
AC176	25p	2G301	13p
ACV17	15p	2G303	13p
AF239	37p	2N1302-3	40p
AF186	50p	2N1304-5	25p
AF139	37p	2N1306-7	30p
BC154	25p	2N1308-9	35p
BC171-BC107	18p	2N1389-FET	45p
BC172-BC108	13p	2N3844A	25p
BF194	15p	POWER TRANSISTORS	
BF274	15p	OC20	50p
BFY60	20p	OC23	30p
BSY26	37p	OC25	40p
BSY26	13p	OC26	40p
BSY27	13p	OC28	25p
BSY28	13p	OC35	25p
BSY29	13p	OC36	37p
BSA95A	13p	AD149	30p
OC41	13p	AUY10	21-25
OC44	13p	2N3055	25p
OC45	13p	2N3034	25p
OC71	13p	DIODES	
OC72	13p	AAV42	10p
OC81	13p	OA91	9p
OC81D	13p	OA79	9p
OC139	13p	OA81	9p
OC140	17p	IN914	7p

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H16	8	Experimenters' Pak of Integrated circuits. Data supplied.	50p
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B60	10	7 Watt Zener Diodes. Mixed voltages.	50p
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B81	10	Reed Switches, mixed types, large and small.	50p
B89	2	58P5 Light Sensitive Cells. Light Res. 400 Ω Dark 1M Ω	50p
B91	8	NKT163/164 PNP Germ. TO-5 equivalent to OC44, OC45.	50p
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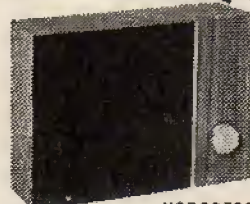
CAXTON COLUMN

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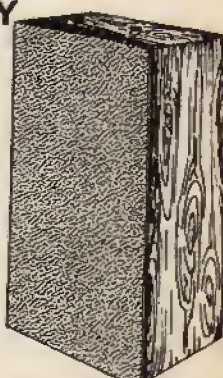
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Size 21 x 11 x 6 1/2 in.

An extremely elegant speaker system made of 12mm. chipboard covered with teak leathercloth with mottled Vynair front. This unique system uses three ex TV speakers. Carefully matched and tested. Will handle 10 watts and will match 8 ohms impedance. If preferred the speakers can be wired in series parallel to match 3 ohms impedance. A real bargain at £4.95 plus 65np P. & P. **MATCHING TRANSFORMER** for 15 ohms 80np post free.



and it need only be set once and left. If the actual resistance of the meter is known (to 1% accuracy), then VR1 and R9 could be replaced by a single 1% resistor to bring the resistance up to 10k Ω . However the present arrangement might still be preferred for economy.

An additional resistor R8 brings the series resistance up to 20k Ω , giving 1V f.s.d. Division of any range by two (i.e. doubling the meter deflection) is achieved by pressing S3 which shorts out R8.

The 1V, 10V, 100V and 1000V ranges are selected by S1. On the 1V range (0.5V when S3 pressed) the base of Tr1 is connected directly to the positive measurement terminal. For the other ranges, appropriate divider resistors are selected by the two sections of S1. The input impedance of the instrument varies with the range selected, partly because the aim has been to use inexpensive preferred value resistors throughout, but it is never less than 3.5M Ω . Pairs of resistors in parallel are used to obtain non-preferred values in the case of R2, R3 and R4; this arrangement can incidentally be shown to give one a statistically better chance of getting a high tolerance. The divider values R1/R5 may at first sight seem wrong for dividing by 10, but this is because the shunting effect on R5 of R6 and the impedance of Tr1 base has to be taken into account.

The meter is protected from forward overloads by D3 which starts to conduct when the voltage across it is about 0.7V i.e. 140% of f.s.d. A germanium diode D2 is used for reverse overload protection since it will conduct at about 0.4V i.e. -40% of f.s.d. (1V). Note that the reverse overload protection is ineffective if the $\div 2$ button is pressed. In the event of an extreme input overload of either polarity, it is more likely that one of the Darlington pair transistors (cost 10p each) will burn out than the comparatively expensive meter movement.

The function switch is S2. The battery test position is a necessary stop between off and measure. The batteries are tested by halving their voltage (nominally 18V) with R10 and R7 and applying the resultant voltage via D1 to the zener diode Tr3. The meter measures the voltage drop across D1. Since this cannot be more than 0.7V and the meter is giving 1V f.s.d. (the $\div 2$ is inoperative) the meter will not be overloaded. In fact a meter reading of 0.6 - 0.7V indicates fresh batteries, while any meter indication at all above zero indicates useable batteries.

In the short circuit zero position of S2, the measurement terminals are connected together for adjustment of VR2. In the off position, the batteries are disconnected and S2b places a short (actually a small portion of VR2 to simplify switching) across the meter movement. This helps to damp down oscillations of the needle if the instrument is jolted in carrying.

CONSTRUCTION

The instrument can be constructed in any convenient insulated box; the author chose the heavier type of polythene food container (size 5 $\frac{3}{4}$ in $\times$ 3 $\frac{1}{2}$ in $\times$ 2in) sold by camping shops, since its flexibility and the shape of the removeable lid gave some physical protection for the meter. There is also spare space inside which in practice proves useful for storing the test prods.

The components are wired on a small piece of

0.15in matrix Veroboard. There should be no difficulty fitting them on if the miniature types specified are used; the complete layout is shown in Fig. 5. Note that one conductor track is removed completely from the Veroboard, using a razor blade, and 17 breaks are made in the remaining tracks. The board is secured by four 8BA bolts to the box lid, with a piece of scrap foam rubber or polystyrene as a spacer (see Fig. 6), together with the meter, switches and terminals as shown. Before mounting, check that all

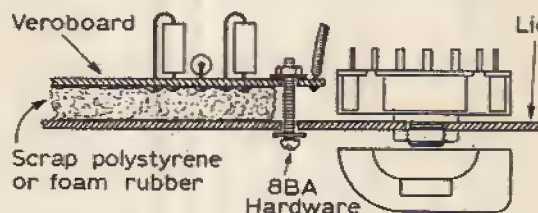
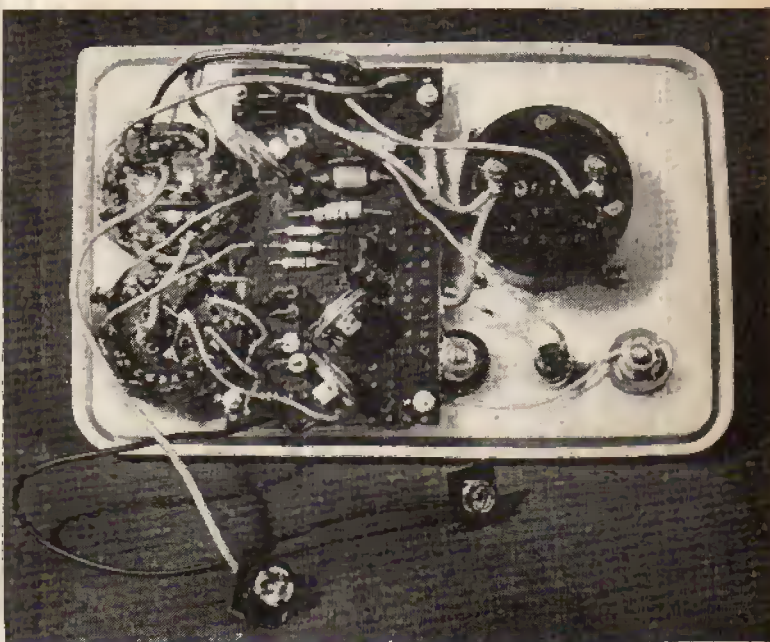


Fig. 6: The method used for mounting the component board.

these parts will fit together on the lid and allow the box to close; in the prototype it was necessary to trim the Veroboard slightly to clear the adjacent switches. The two batteries can be taped in any convenient position as they do not need frequent replacement. Two holes are made in appropriate positions on the box to allow adjustment of zero controls VR2 and VR3 from outside using a long screwdriver.

It is difficult to apply lettering direct to polythene. The panel labelling shown in the photograph was



An internal view of the completed high impedance voltmeter. Compare this with Fig. 5.

done by putting Letraset letters on white contact adhesive sheet (Woolworths) which sticks well to the box.

The meter scale is already labelled 0-50 which allows direct reading on ranges with the $\div 2$ button depressed, but is less appropriate for the 1V, 10V, 100V and 1000V ranges. For these a 0.1 scale can be added to the meter after removing the plastic face of the meter by gently pulling it away.

CALIBRATION

With the function switch at off, zero the meter by means of the screw on the meter front. This is purely a mechanical adjustment of the movement and must not be used instead of the electrical zero controls. Switch to measure and, with no input, adjust VR3

for zero meter deflection. Then switch to **short circuit zero** and adjust VR2 for zero. Initially it may be necessary to adjust VR3 and VR2 more than once. The calibration control VR1 can now be set. This is best done by connecting the voltmeter to any voltage in its range with a meter (any impedance) of known accuracy in parallel with it, and adjusting VR1 for corresponding readings. It is possible, though less easy, to set VR1 without any other meter. This is done by connecting the instrument to any voltage source that will give about 40 to 50% deflection on any range, and successively adjusting VR1 until pressing the $\div 2$ button exactly doubles the deflection.

USE

The function switch allows a quick check of the battery condition and the two zero settings every time the voltmeter is brought out for use. Once set accurately, VR1 should not be readjusted. It is necessary to readjust VR2 and VR3 occasionally, particularly with temperature changes. Allow a few seconds for the zero settings to stabilise when first switching on the meter.

The usual rule for meter usage should be followed, namely: select a higher range than the maximum voltage anticipated before connecting the meter to a circuit. In practice the $\div 2$ button proves extremely useful for doubling meter deflections of less than half scale. Remember that a meter measures most accurately over the upper 50% of its scale, where all measurements from 0.25 to 1000V can be made with this instrument. It is important that the Veroboard and switch wafers be kept clean and dry if measurements above about 500V are to be made as tracking problems could otherwise arise.

The impedance of the meter is high enough for confident voltage measurements in virtually all common circuits, except some high impedance valve grid and f.e.t. gate circuits. Unlike a moving coil multimeter, the impedance is virtually the same on all ranges.

It is possible to use the meter in a centre-zero mode for detecting d.c. nulls in bridges, etc. Set the function to **measure** and adjust VR3 for exactly half scale deflection, then switch to **short circuit zero** and adjust VR2 for the same deflection. The meter will now indicate voltages of either polarity at the terminals, the needle swinging to the right for a positive voltage at the positive terminal. The voltage swing over the whole meter scale is not changed, and the $\div 2$ button is still operative.

The batteries have a life of many months in normal use, or about a week if the meter is left on continuously. The instrument can in fact be operated on seriously run-down batteries, although the zero settings will drift badly. ■

TELEVISION

We are pleased to inform readers that our sister journal Television has now resumed publication following settlement of the recent printing dispute.

Issue dated **February 71** was published on February 12

Issue dated **March 71** will be published on March 8

Issue dated **April 71** will be published on March 29

We apologise to readers of Television for the loss of the December 70 issue and late appearance of subsequent issues.



COMPUTERS have been with us for some time but many people do not realise the degree of sophistication which is now being achieved. A fairly recent example is REDACAL. Basically a computer service, it enables any electronics customer to use a computer to solve problems. With REDACAL the design engineer has a powerful tool. He can, for example, ask this system to tell him of, say, an operational amplifier which has certain minimum and maximum gains. He might also specify that it must come within other limits, perhaps a 5V line. Within seconds, REDACAL will list all the currently available devices which will satisfy the conditions layed down and will also quote the current market prices, too.

But this system goes much further than providing such simple information. The designer can tell the computer what his newly designed electronic circuit is and seek its advice as to whether the circuit will work properly. For example, the designer can ask REDACAL in, say, the case of a square wave generator, what frequency the final output will be if all the capacitors and resistors were varied within a certain tolerance. Imagine if there were fifteen resistors in the circuit and they were all 5 per cent tolerance. They could all vary and this would affect the circuit. Once REDACAL has given a circuit the OK, the designer can literally put the design into production and know that the snags have been ironed out.

How does the designer tell the computer his problem? Easy, he simply telephones the computer and uses a thing called a modem (modulator/demodulator) which a standard telephone handset will sit in quite happily. He can also use a typewriter keyboard similar to the kind used in teleprinters. Thus any designer is no further away than the nearest telephone.

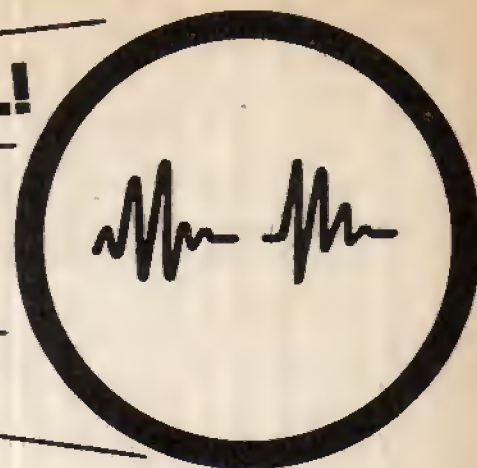
An interactive graphics terminal is available for circuit layout work. This is really a large cathode ray tube on which the designer can call up various shapes and pieces of circuit which he can then position very accurately with a light pen. He merely touches the portion he's working on with the light pen and points to the exact location he wants it and bingo—it's there immediately. Thus a designer can draw out a complex mask for an integrated circuit. When he has finished, he can ask the computer if there is a better way of drawing it, or if he has made any mistakes, etc. The system can then be used to provide masters for actually making the ICs. ■

LOOK!

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VISUAL!

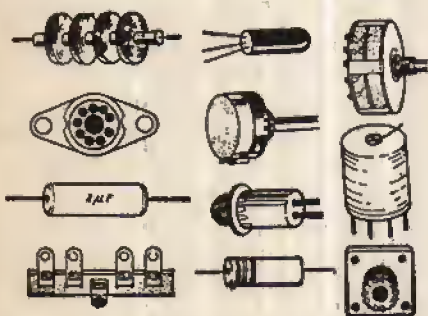
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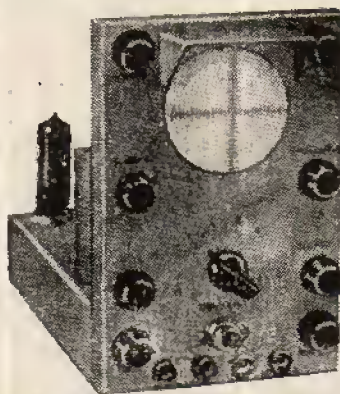
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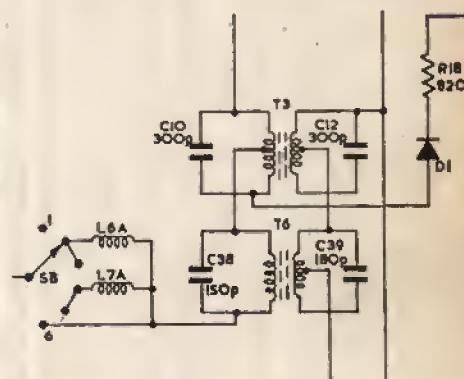


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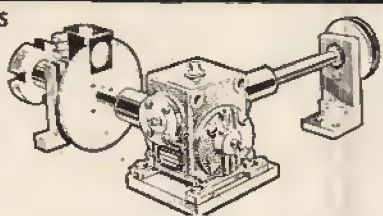


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Fully transistorized multi range instrument for measurement of voltage up to 1000 MHz (1500 MHz with reduced accuracy) and current up to 2 kHz and DC resistance. AC and DC voltage and current divided into 11 ranges. AC/DC volts 12mV-1200V. AC/DC current 12 μA-1.2A. DC resistance 5 ranges 0.1 ohm-1000 M ohms. R.F. voltages, 5 ranges 40mV to 4V. Battery powered. Offered in excellent condition. Tested before despatch. C/w handbook. £54.00, carriage £0.50.



NUMICATOR PRICE LIST

Quantity	Price each (less base)
1-3	£1.40
4-10	£1.35
11-25	£1.30
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Price Base. Bases £0.20 each.

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Quantity	Price each (less base)
1-3	£1.15 each
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11-25	£1.05 each
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Type R2285 for checking leakage current and gain current of pnp transistors. Audio o/p Meter for calibration purposes. Price £5.00.

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Type 385B 50W mains input, 200 ohm o/p audio power amplifiers. Only a few available. Selling well below the list price. £15.50 each carriage £2.00.

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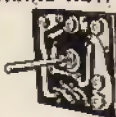
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Compact and portable. W 2 1/4". H 1 1/4". D 3". In black plastic case. Available as follows: 3-0.3 Volts. Prod on Base. 0-15 and 0-300V Dual Range Voltmeter 0-3 and 0-300V Dual Range Voltmeter 0-75 Amps Ammeter. Our Price £1.75.

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High grade full wave bridge circuit gives linear control of light brightness. Ideal for controlling room lighting and a.c./d.c. commutator motors fitted to portable electric hand drills. Fits standard 2in. conduit box. 240V, 50Hz, 400 W. Price £3.10.



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NEW 200-250V, 50Hz, 2W. Synchronous induction motor. 2 revs. per hour. O/P shaft, 1/4in. dia. x 1/2in. long. Clockwise rotation. Three-holed mounting at 120° on 2in PGD. Price £1.25.

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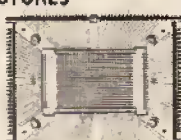
New 6 Bank 25 way 50V 75 Ohms Make before break. Half circle type—2 sets of wider arms at 180°. PRICE £3.13. Miniature Uniselector 3 Banks 12 Way 12V 35 Ohms. PRICE £5.25. Packing and postage free.

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from brand new Infra Red Tubular Quartz Lamps. Ideally suited as heat source for Drying Ovens, Egg Hatching, Incubators, etc. 240V, 1,440V, 20,000 Angstroms. Length 12in x 1/2in. dia. Price £1.00.

MEMORY CORE STORES

42 x 52-2K bit ferrite core store complete with 8 40A 10 load diodes. Ideal for building computer store or holding information in binary form. Price £2.83 post free.



Rx/IND APN-9

This is a combined swt tuned Rx and CRT Ind unit, the Rx section tunes approx. 1.8 to 2 Mc/s, uses tube 3BP1 3" green screen and 34 valves of the following types, 6SN7, 6SL7, 6H6, 5Y3, 6SK7, 6SJ7, 6SA7, VR105, 6Y6, 2X2, 6N7, also 100Kc xtal, Mu Metal shield, pots, swts, etc. Complete in case size 20 x 12 x 8" supply required 115v 400 c/s supplied new with magnifier, visor and circ. These units are well suited to scope conversion. Price £8 plus 75p carr.

TUNING UNITS

Type R.F.26 units these tune 50 to 65 Mc/s but can be modified up to 100 Mc/s fitted slow motion drive as 3 valves, I.F. O/P 7 Mc/s can be used with Rx that tunes 7 Mc/s supplied with circ good condition. Price £2.10 plus 40p post.

Rx UNIT 3645

This item is for use with the above RF unit or 24 unit, as 7 Mc/s I.F. strip with Det and O/P as high cycle P.U. requires 250v H.T. 80 Ma., 150v bias and 6.3v, complete in case supplied in used condition. Price £1.50 plus 75p carr.

TEST SET 210

Test unit for above RF unit or any equipment in range 20 to 85 Mc/s, this is a test osc that covers this range in 4 bands also as noise generator with 50 Ma meter, large S.M. dial 3 section Ae, 2Mc/s xtal check, requires 250v H.T. and 6.3v, supplied in case in good condition with cal charts. Price £3.25 plus 65p carr.

METERS

270 Deg. meter, meter 3 1/2" sq. basic movement 1.5 Ma, also available 6.5 Ma fitted range and on/off swt. Calibrated in Radio Altitude ideal for Rev. counters, supplied in new cond. Price 80p plus 15p post.

AMPLIFIER TYPE 1962

I/P 200/250v 50 c/s this is A.F amp in table cabinet, with 7 valves inc. push pull 6BW6, unit is fitted into monitor speaker and meter for monitoring valves. Main O/P is 600 ohm fitted on/off swt fuses etc., case size 19 x 12 x 10". Good basis for 10 watt amp with suitable o/p trans. Supplied in used condition. Price £4 plus 50p carr.

SPEAKER UNITS

Portable speaker in cabinet, size 18 x 18 x 6" fitted H.D. 8" unit 3 ohm also 600 ohm line matching trans and lead, supplied in new condition. Price £2.25 plus 65p carr.

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All 230v Pria C Cores. Type A. Sec 490-400-0-400-490v at 200 Ma, 5v 3a, 6.8v 4a, 6.3v 1.6a, 12v 1a, Price £2.25 plus 30p. Type B. Sec. 6.5v ct 5a 5 times will give 0 to 32.5v in 3.25v steps at 5a, Price £1.60 plus 30p. Type C. Sec 50v 1a, 6.3 .3a. Price £1.25 plus 25p. Type D. Auto 1.6 KVA tapped 190, 150, 110v, Price £4.50 plus 50p. Type E. Sec 12v 1.5a, Price 55p p.p. Note type D & E not C. core. All trans in good condition.

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Osc. unit with valves 12AT7x3, EF91x2, LA2 pot core, jack sk, coax sk, 10 and 500K pots etc., new 70p, RF24 unit swt. tuned 20 to 30 Mc/s with circ. can be used with 3645 Rx above as 3 valves £1. O/P and Test unit modern unit with 2 vinkors 4 Sil P.N.P. transis, 4 miniature relays coil Lk 2p c/o diodes, min. valves, etc., new 85p. Meter 1 Ma edgewise scale Lin 0 to 2000 yds, size 3 x 1 x 3 1/4", tested £1. E.H.T. smooth cond. dual type .1 and .5uf 2Kv wk size 4 x 2 x 2" inc. term, 50p. Tube type 3BP1 with base and Mu Met shield 3" green screen ideal scope used with connections ex equip. Price £2.50p. Control unit with 2 500 Ua basic movement meters 3 yax swts, pots, close tol res etc. new £2. Mod. Kits with 8 group boards with approx 130 conds and res good quality, new boxed 80p. Handset G.P.O. style with press to talk swt in handle new, £1. Valves 6SN7 ex equip 5 for 50p. Amplifier A1413 I/P 230v with int P.U. as 6V6 amp 600 ohm o/p in case used cond. £2. Min plugs and sks 18 way 15p, 14 way 10p. Control panel with 15 min pots 1 meg. 100K, 1K all 1/2 shafts ex equip. 65p. Circuit Diagrams. 1392 Rx, 1475 Rx, 30p ea. Scopes Sol CD513.2 set of 3 circs, £1.50. 13A, 50p. Dumont 208 and OS-8, 50p ea. C.T38 Multimeter, 50p.

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SHORT WAVES

MONTHLY NEWS FOR DX LISTENERS

THE first report for this month comes from new reporter **Steve A. Money** of Southsea. Steve has a Lafayette HE-30 receiver and a 50-foot long-wire antenna. He was lucky enough to be able to use a digital frequency meter to check the frequencies.

- 4110 *Urumchi, China* in Chinese at 2040.
- 4685 *Irkutsk, Siberia* in Russian at 2054.
- 4765 *RTV Congo, Brazzaville* in French at 1740.
- 4770 *ELWA, Liberia* in English at 0620.
- 4780 *Djibouti (RTF), Afars & Issas, French*, 1745.
- 4785 *Kunming, China* in Chinese at 0010.
- 4785 *Baku, Azerbaijan* in Russian at 1830.
- 4795 *Ulan Ude, USSR* in Russian at 0015.
- 4800 *YVMO, 'R. Lara', in Spanish* at 2330.
- 4815 *Ougadougou, Upper Volta* in French, 2220.
- 4823 *Hanoi, Vietnam* in Vietnamese at 2230.
- 4850 *Nouakchott, Mauritania*, in French at 2215.
- 4885 *Novosibirsk, USSR*, in Russian at 2350.
- 4890 *VLT4, P. Moresby, Papua* in English at 2030.
- 4900 *YVVK, 'R. Juventud' in Spanish* at 0005.
- 4907 *Phnom Penh, Cambodia, Cambodian* at 2300.
- 4940 *Abidjan, Ivory Coast* in French at 2225.
- 4945 *HJDH, 'R. Colosal' in Spanish* at 0715.
- 4955 *HJCQ, 'R. Nacional' in Spanish* at 0015.
- 4965 *HJAF, 'R. Santa Fe' in Spanish* at 0700.
- 4970 *YVLK, 'R. Rumbos' in Spanish* at 2350.
- 4975 *Yaounde, Cameroon, vernacular* at 2115.
- 4980 *YVOC, 'Ecos del Torbes' in Spanish* at 2310.
- 4980 *Ejura, Ghana* with African music at 2200.
- 4985 *R. Malaysia, Penang* in English at 2345.
- 4994 *Omdurman, Sudan* in Arabic at 2130.
- 5035 *Bangui, Cent. African Rep.* at 2140.
- 5042 *Bissau, Port. Guinea* in Portuguese at 0035.
- 5051 *R. Singapore* in English at 2330.
- 5055 *Chita, USSR, unknown language* at 0045.
- 5095 *HJGG, 'Accion Cultura' in Spanish* at 2320.

John H. Saunders of Paekakariki in New Zealand sent in an interesting report on what can be heard in that part of the world, his log included:

- 5054 *R. Singapore, English news* at 1130.
- 6035 *R. Monte Carlo* in Italian at 0700.
- 6085 *DMR24, Munich, Germany, Home Sce.* at 0600.
- 6090 *R. Luxembourg* heard at 1730.
- 6540 *Pyongyang, N. Korea* in English at 1900.
- 9640 *R. Kuwait* with news in English at 1839.
- 9680 *TWR, Monte Carlo* in German at 0905.
- 11680 *BBC, London* in Swahili at 0330.
- 11765 *SBC, Berne, Switzerland* at 0600.
- 11765 *ETLF, Ethiopia* in French at 0400.

Graham Close of Diss in Norfolk is a new reporter and his equipment consists of a GEC 5-valve domestic receiver, a 75-foot long-wire and a TV antenna. His log included the following:

THE BROADCAST BANDS

Malcolm Connah

Frequencies in kHz • Times in GMT

- 3338 *Radio Mozambique* at 1200.
- 5058 *Radio Tirana, Albania* at 2130.
- 6125 *Voice of America* with news at 0245.
- 6230 *Radio Tirana, Albania* at 0500.
- 9525 *Polish Radio* in English at 1645.
- 9625 *CBC, Radio Canada* in English at 0740.
- 11620 *AIR, Delhi* in English at 0900.
- 11710 *ABC, Australia*, sign-off in English at 1000.
- 11720 *R. Trans Europe* in English at 1000.
- 11795 *WINB, Red Lion, USA* in English at 2130.
- 11815 *TWR, Bonaire* in English at 0900.
- 11865 *R. Trans Europe, Portugal* at 1400.
- 11950 *NHK, Japan* with sign-off at 2130.

Colin Blanchard of Sutton Coldfield used his 5-valve domestic receiver and 50-foot long-wire to hear the following:

- 6025 *Radio Portugal* noted at 0210.
- 9660 *Radio Kiev, Ukraine* in English at 0100.
- 9805 *Radio Cairo* in English until 2300.
- 11765 *ABC, Australia, Sports News* at 0830.
- 11955 *BBC, Far East Relay, Tebrau* at 1815.
- 15320 *Radio Nederland, Bonaire* at 2015.
- 17710 *Austrian B.S.* in German at 1400.
- 17720 *WINB, Red Lion, USA* in English at 1815.
- 17740 *BBC, Atlantic Relay, Ascension Is.* at 1815.

John Young of Oxted in Surrey has a Pye domestic receiver which is 18 years old and 5 feet of mains flex as an aerial, with this combination he was able to hear:

- 5990 *CBC, Radio Canada* in English, 0715-0745.
- 6020 *Radio Nederland, Hilversum, English*, 0930-1050.
- 6025 *R. Portugal* in English, 2100-2130.
- 6135 *HCJB, Quito, Ecuador* in English, 0730.
- 6165 *SBC, Switzerland* in English at 1430.
- 7240 *Voice of the Palestine Liberation from Baghdad, Iraq* in English, 1900-1920.
- 7250 *Vatican Radio* in English, close at 2055.
- 7275 *RAI, Italy* in English, 1935-1950.
- 9625 *Radio Sweden* in English, 1100-1130.
- 9635 *R. Baghdad, Iraq* in English at 2010.
- 9715 *R. Nederland, Bonaire* in English, 0800-0920.
- 11735 *Moroccan R. & TV*, in English, 1700-1800.
- 11740 *ABC, Radio Australia* in English.
- 11750 *BBC, Far East Relay, Tebrau* at 1815.
- 11810 *R. Berlin International* in English at 2000.
- 11965 *Deutsche Welle* in German with close at 1810.
- 15235 *BBC, Atlantic Relay, Ascension Is.* at 1700.

All reports, which should be in frequency order, must arrive by the 15th of the month. They should be addressed to the author at 5 Ranelagh Gardens, Cranbrook, Ilford, Essex.

SHORT WAVES

THE AMATEUR BANDS

David Gibson, G3JDG

Frequencies in kHz • Times in GMT

IT'S been a fantastic month for the l.f. types with DX romping in from most parts of the globe. The h.f. bands have provided some goodies but twenty has developed its habit of dying rather early in the evenings. Ten metres is doing well but appears to be mostly North America. One solitary log arrived for two metres but surprise, surprise, someone sent in a 70cm log.

Details received about the WAB contests for 1971. These are: 14/21/28MHz March 14 (phone), March 28 (c.w.); 1.8/3.5/7MHz April 4 (phone), April 11 (c.w.); v.h.f. phone contest, June 20, any frequency above 30MHz. More details from **C. J. Morris**, G3ABG, 24 Walhouse Street, Cannock, Staffs.

N. Richardson (Bucks.), tells stories of a 46-element beam at 32ft. feeding a Garex 70cm. converter with a 9R59DE providing the eventual audio. Nick says that the crystal he is using is a bit near Channel 1 TV frequency and the result is nasty happenings on next door's telly. Despite this he managed to log six counties in one session. Call signs heard were: G3GWL, G3KPB, G3LQR, G3VZV, G8ACN, G8AEX, G8APZ/P, G8ATS, G8AUE, G8BBE, G8BJA, G8BGQ.

G. Richards (Isle of Wight), 4-over-4 slot fed, JXK converter, Mohican, sends details of calls heard on 144MHz. On a.m. and within a range of 60-90 miles: G2JF, G3FSA, G3NGK, G3UNT, G3XFW, G6LL, G8CEI, G8CHO, G8ECK, and on s.s.b. G3AKF, G3OUV, G3MCS. From 125-150 miles: G3DY, G3BHT, G3SBF, G6CW all s.s.b.

"We had the house rewired recently which knocked the RX gain up a bit", says **John Moore** from his Leicester shack. John's all-band log includes: 160-DL1FF, DL9KRA, GM3FSV, OK1AQW, OK1JAX, OK1JKA, OL4AMP, OL5ALY, OLØANU; 40-EA8HA, OL9LV, UL7AA, VE2APL; 20-CP6FG, CT3AS, FG7XT, FH8CY, FP8CS, FY7AE, M1I, OY3B, PY2PA, PY6HB, VE7IC, VP2AA, VP2VI, YV4TV, ZD7SD, ZL1AH, ZL4BO, ZM1ABO, ZS1EI, ZS2MI, ZS5EY, 4M1A, 4U1ITU, 8R1U, 9Y4AR (all s.s.b.); 15-AX2AU, AX2AVT, VU2JM, W5ILR/TF, ZE2JA, 7X2ZHS, 9H1BP; 10-AX5MF, AX6CT, KV4AD, MP4BRA, SVØWBB, UA9WO, YV1ACX, ZE2JA, 9K2AL. Gear in use is a CR100/2, a.t.u. and 130ft. long wire plus one pair of earholes Moore type Sharp Mk1.

How low can you get? Not much lower than 1.8MHz in Amateur terms. That's just what **J. Leaver** (Lancs.) did. Jim has a homebrew (good lad Jim) receiver, a.t.u., 100ft. of wire round the loft and an earth mat 20ft. square and 3ft. deep (he's the only man I know who uses a spade for spring cleaning). Topband c.w. log reads; DL1HS, DL9KRA, GD3DB, GM3OXX, GM3YCB, K8DBI, OK stations 1ARI, 1ATP, 1ATY, 1DJD, 1KRS, 1MLJ, 2BFN, 2SIX, 3KAS, 3KWO, 5VSZ, OL1AMR, OL4AMU, OL4AOK, OL7AOU, PAØPN, UR2CXY, WIHGT, W3ANO, W3GM, W8KFX, W9UCW.

"I know my writing is terrible", comments **P. Harris** (Lincs.). Deciphered Harris heiroglyphics inform of the following signals on 80; CT2BC,

DUIFH, EA8MA, ELØK/5A1, EP2DX, ET3USA, FP8AP, MP4TDT, ON5DO/P/AP2, TA2BK/P/1, UAØADO, UF6DR, UI8LM, VE1AX, VE2WF, VE3PT, VP2VI, VS6DO, ZC4JW, 3V8AB, 7X2OA, 8P6DO, 9K2AL.

C. Henderson (Kent), B40, 120ft. end fed running NW/SE, went s.s.b'ing on 3.5MHz. Fruits of his labours include; EA3QW, EA6BN, K7HNP, KX6BX, LU7AAC, LX1BJ, OD5BA, OX3WX, OY2R, OZ1LO, VE1IE, VO1FG, VO2DC, VS6DO, W2HCW, W3AZV, ZB2A, ZC4IK, ZM4KE, ZM4LM, 6W8DY, 9K2AZ.

T. Thornton (Berks.) says that 80 is providing nearly as much DX as any of the h.f. bands. He gives a list of times (GMT) when to listen as follows; 0800-1700 for Far East and Oceania, 0600 for North and South America and 2000 for South and East Africa and the Middle East. Tim's log for eighty reads; ON5DO/AP, CO2FA, CT2AK, DUIFH, EA6BN, EP2TW, ET3USA, FC2LG, FC8AP, HC1RF, HC2HM, HC2GG/1, HK3AVK, HK6BRK, HP1JC, HT1BW, IRØWX, IS1FIC, IT1ZGY, JX3MN, K5MU, LU7AAC, OD5BA, OX3WX, OY2R, PJ7JC, PY7ASQ, PZ1AK, TA2BK/1, K2LQQ/TF, TI2CF, VE7ZM, VO2JC, VP2MRK, VS6DO, VP2VI, XE1CE, YV5BQV, ZB2A, ZC4JW, ZL4NH, ZM2BCG, ZM2BHX, ZS1MH, 3V8AB, 3V8AL, 6W8DY, 9K2AL and 7X2OM on c.w.

R. Mortimore (S.Wales), has an H.A.C. one-valve receiver plus a three-transistor amplifier. A listen on 14MHz revealed; ET3USA, JA1KAV, KL7BK, KP4AST/M, VE1ASY, VE3FSV, VE7HP, VE9AT, 5H3MB, 7Q7LA, 8P6CC.

A. Crooks admits to lurking in Teeside but did a quick flit back to sunny Leicester. Stations heard on 21MHz while sunning himself in the warm winter sleet include; AX2XT, AX3ZJ, M1D, OA8I, PY4BO, VK2FU, VK5FM, W5RG, WB6NVW, YV5BPG, ZL4HE, ZS6QD, 3V8AL, 7X2HS, 7X2OM. Equipment used was an RA1, PR30 and 33ft. of wire draped round the room.

Enter **P. Beeson Esq.**, (Staffs.) complete with HA500 and 61ft. end fed. Fifteen metre squeaks from; CE3JY/P/WC, ET3USA, JA3DNL, KP4DCR, KR6EZ, KR6IL, PJ7JC, SV1CB, VE3XX, VE6AWC, VK2FU, VK6WV, VS6BE, VS6DO, WA9YGT/KG6, ZL2TA, ZL3FO, 3V8AL, 4Z4HF, 7X2OM.

D. Robbins has been looking through a general list of call-sign country locations and finds that the UK has a nice little bunch from 2AA to 2ZZ. He suggests things like GRO for Rockall and GDO for the Isle of Dogs but I think F1DO would be better. Fifteen metre log using a CR7OA and 70ft. end fed reads; CN8CS, CR6DB, CR7CH, EL2BA, G2MI/VP9, HC2HM, HR1KS, thirty seven JA's, KG4AM, KR6BD, M1B, VK2NN, PJØDX, PZ1DA, TG9MD, VP7DL, VP9GE, YN1CG, ZL3JC, ZL3SO, ZM3OH, ZP5FH, ZS6AXL, 3V8AL, 5U7AW, 5Z4KC, 7X2ON, 9Q5DL.

Logs for the Amateur Bands must arrive before the 15th. of each month. The address is: 12 Cross Way, Harpenden, Herts.

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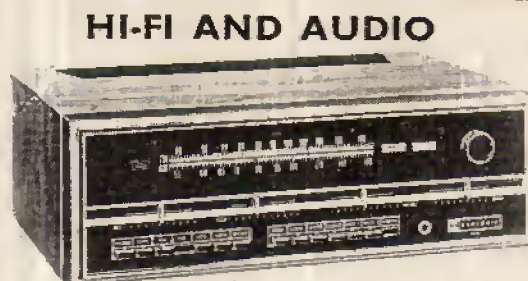
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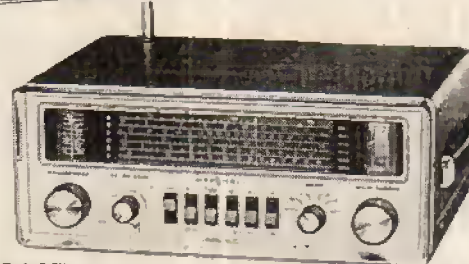
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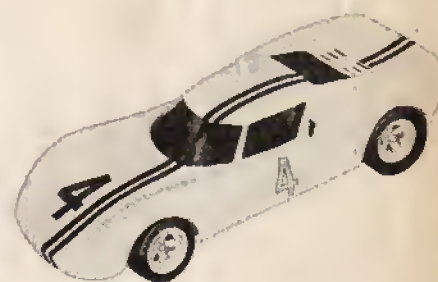
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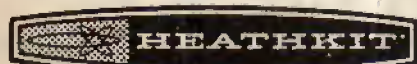
SHORTWAVE



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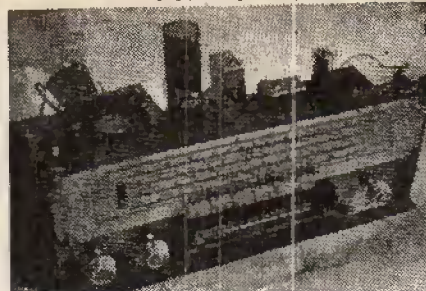


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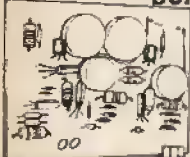
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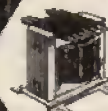
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TAKE 20

JULIAN ANDERSON

A series of simple transistor projects, each using less than twenty components and costing less than twenty shillings to build.

HAVE you ever heard the ladies of the house let out a yell because the washing is out and it has been raining without anyone noticing?—or have you ever had to cope with soaking deck-chairs? Well, this month's project should put a stop to all that for it is a fairly simple rain alarm that will sound a "hooter" as soon as the first drop of rain reaches a sensor.

It is of course no good having such a device unless you can leave it on for long periods without the battery running down. The circuit used here draws so little current in the stand-by condition that the battery will suffer a natural death long before the circuit runs it down. An on/off switch has been included to enable the alarm to be turned off once it has been sounded otherwise you would have to put up with the "hooter" until the rain was stopped and the sensor dried out.

THE CIRCUIT

The key to the whole operation is the use of silicon transistors throughout with their almost negligible leakage currents—a germanium transistor version of the circuit would be operational all the time and obviously be useless.

Tr1 is the "switch" which is triggered by the rain. Rainwater, although very nearly distilled water and

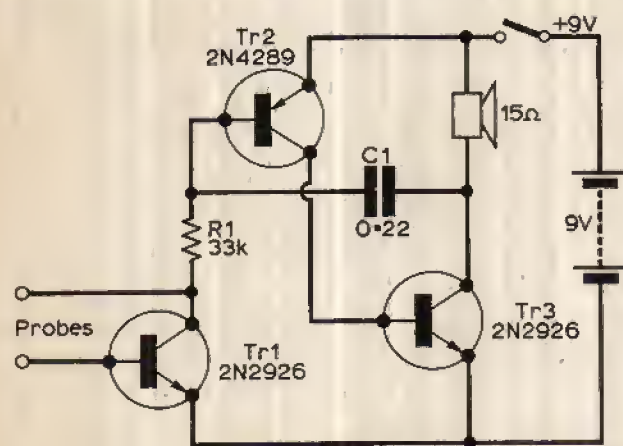


Fig. 1: The circuit of the Take 20 rain alarm

therefore not nearly such as good an electrical conductor as tap-water, has a definite resistance which is arranged to connect between the collector and base of Tr1. This will allow current to flow and allow Tr2, which is a low-cost p-n-p silicon type, to be biased into conduction. This in turn biases on Tr3 and a pulse of current is passed through the loud-

No. 24 RAIN ALARM

speaker. The base of Tr2 and the collector of Tr3 are in phase and by connecting a capacitor, C1, between them we have an oscillator which will produce an audio note in the loudspeaker as long as Tr1 is turned on.

As we have seen, Tr1, when switched on, sets up a chain reaction turning the other two transistors on and into operation. R1 is included, for, if Tr1 was completely switched on, damage may occur to the other transistors. Its inclusion only means that the minimum resistance between the base of Tr2 and battery negative is limited to 33kΩ.

When Tr1 is off (that is with nothing between the probes) the only current drawn is the leakage of the three transistors which is so small that we can forget it.

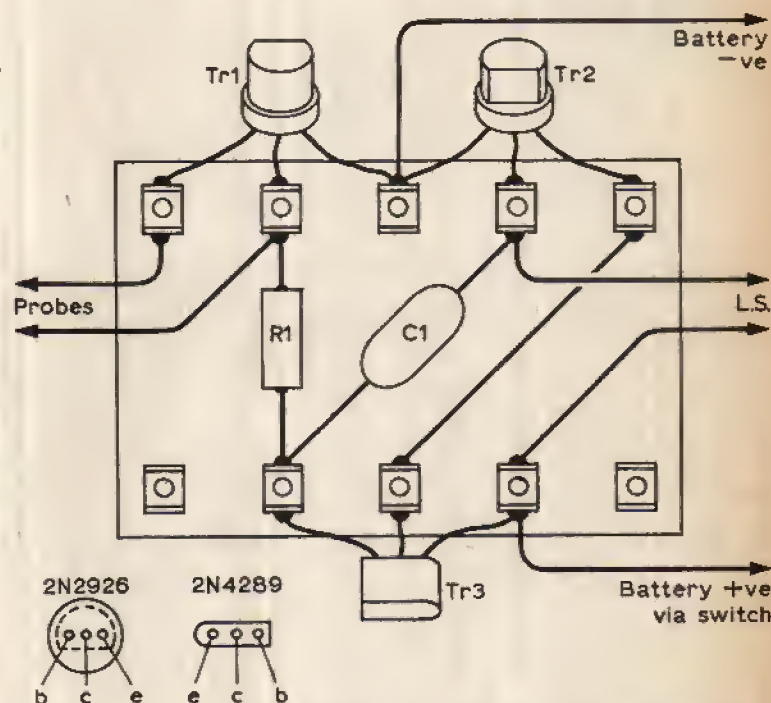


Fig. 2: A suggested component layout on a small tagboard.

CONSTRUCTION

A suggested layout for the components is shown in Fig. 2, the three transistors together with R1 and C1 are mounted on a tagboard. The probes can be made in a number of ways for it is only necessary to arrange for water to complete a conductive path between them. A sheet of plastic to which a piece of blotting paper has been glued with the probes pushed into the blotting paper works very well but will not last all that well. Alternatively a small piece of Veroboard can be used, one of the probe wires going to every second copper strip, the other probe connecting to the others. However, there are lots of ways for arranging for the rain-water to complete the circuit and with a little ingenuity you should be able to think up one of your own.



SOMEONE, somewhere, remarked that PW ought to consider publishing an article on a piece of equipment designed as a joint venture by the leading regular contributors. It needed only malicious encouragement, coupled with a subtle admixture of coercion, bribery and blackmail, for Mr. Eeven Steeven to find himself forming a small committee for this purpose and as a result of a second-generation application of coercion, bribery and blackmail, to discover that the following running order of volunteers had agreed to join him in this formidable and noble undertaking.

THE EXPERTS ASSEMBLE

The following have arrived:

Eric Foulpest, (G4NGB), Julius Andyman (of "Take 40" and "You too can build a computer for six and tuppence" fame), L. A. J. ("Icky") Iceland, Downy Arthur and Rickey Colins (founders of the PW Darby and Joan Club), A. S. Bricklayer (G8 and Bar), Rave Glibson (author of "Tahiti on a Hat-pin or Bust"), Salvador Hogshead (of no fixed abode).

Starting prices: Foulpest 2/1 favourite, Andyman 5/2, 100-8 the field. Arthur and Colins wear blinkers.

The following declined to support the project for reasons too numerous and scandalous to mention: Mr. F. Greyer, Q. Cameron-Highlander, Randy Lester ("The Electronic Entrepreneur"), J. Thornton Lawrence of Arabia and Aberystwyth (henceforth referred to as J. T.), Malcolm Conman ("DX on a G-string"), R. F. Gravyboat (author of "Up the Spout"), F. C. Judder and M. Wallis-Collection ("The Testmaster in sickness and health").

A special sub-committee was also formed to liaise among themselves and with powers to mind their own business. This comprised: Henry (to make rude remarks), Pax (to do the doodling), Maxwell (to make the coffee) and the office boy (to sweep up spare committee members). Components were obtained from Steptoe's Surplus Stores. Gowns by Renta-Rag Ltd.

MOMENTOUS DECISION

At the first meeting Mr. Steeven appointed Mr. Steeven as Chairman of the Committee with sole discretionary rights to abandon the project at the slightest provocation. The Committee then adopted the motto *Nil Nijinsky* which, for the ignorant is an allusion to the ancient precept that a camel is a horse designed by a committee.

During several sessions, each followed by a "session", various proposals were put forward—and then pulled back. Messrs. Colins and Arthur suggested that if it was not going back too far the committee might consider resurrecting a classic receiver design of the early '20s. The Chairman asked if they meant the 1820s or 1920s.

Mr. Iceland was soon up in arms at the idea remarking that readers would probably take such a set to be an Ancient Monument. However he would agree to any other suggestion provided it was for a disintegrated digital clock using nine NAND/AND and four EITHER/OR TTLs with positive flip-flap readout, which he happened to have in his junk box. During questioning Mr. Iceland agreed that he had the copy ready for such a project but had hesitated to submit it to the Editor fearing it might be below the usual standard of material in the magazine.

The Chairman remarked that nothing could be lower than the present level. (Applause and cries of "Resign").

COST FACTOR

Mr. Andyman supported Mr. Iceland's project with the proviso that the total cost to the reader should not exceed 20p. Nor should it use more than 20 components. After allowing for the nine NAND/AND and four EITHER/OR TTL's it should be possible to complete the design with not more than seven other components. Mr. Iceland's remarks are not recorded but it is understood that he muttered something about £200 and 2000 somethings.

Mr. Hogshead also approved of the disintegrated clock concept provided he was allowed to design the peripheral hardware for the necessary testing of the clock. He was prepared to completely re-design and up-date his VCR97 oscilloscope, his ultra-linear wide-band total distortion amplifier (EF50-EF50-EF50-EF50-PX4-PX25-DA100) and his guitar amplifier

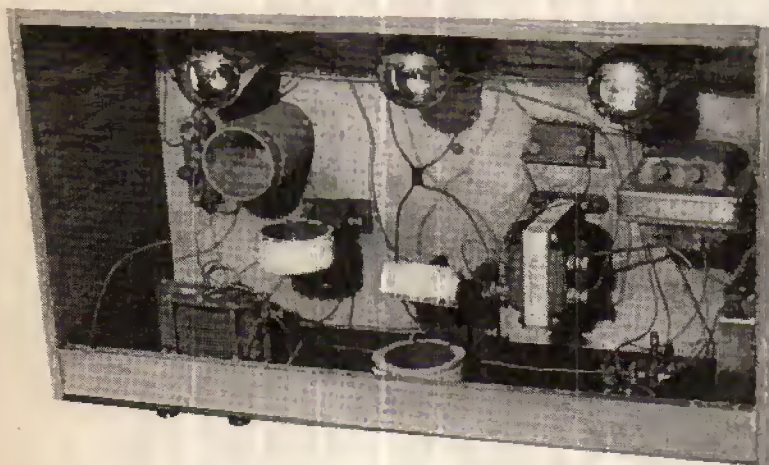
which he had never got around to using anyway. Off the record, the walls of his flat had caved in and collapsed when he first turned up the wick on the 50W job but his wife had blamed it on the Concord/Concorde (this is for our French reading reader).

THE TENSION MOUNTS

At the 54th. session of the Committee it was reported that the Editor was getting a little nervous and impatient after waiting so long for the promised article and anyway he was constantly complaining of cramp in his fingers from the signing of the steady stream of allowance claim forms from a slightly unsteady Committee. The Art Director reported that so far he had not received any instructions on the artwork for the article.

Eric Foulpest thought that the clock idea was "all right" if the output of the clock could be used to drive a series of 10kW power amplifiers to radiate time signals at the bottom end of each amateur band from 1.8 to 2300MHz for 24 hours a day. It was also desirable, he said, to be able to direct the output of all the amplifiers onto the frequency of any pirate station in any amateur band.

He was willing to accommodate the entire equipment at his own QTH in return for which service he would expect to be allowed to use the equipment during contests with the power input reduced to 150W of course and to 10W on Top Band, naturally. (He's got to be joking! Ed.) Mr. Glibson commented that after listening around the bands recently it would be all contests and no time signals.



This excellent shot reveals the ingenious hybrid circuitry of the "Super-Fet". The familiar ST2-TD2-ZD2 line-up is followed by a DITTO2U2 audio gain-block located in the very centre of the layout. The plug-in power supply can be seen in the bottom righthand corner. The signal input attenuator is at the extreme left centre. (Photographs courtesy PW Space Centre).

THE BIG RE-THINK

At the 73rd. session Mr. Glibson submitted that all previous proposals should be forgotten and a fresh start made. The Committee agreed and went to lunch, then tea, then supper and so to bed.

Mr. Colins admitted that he had not really been paying attention at the previous meetings being mostly pre-occupied with his love life and his new house. He volunteered to write an article describing a bed, a vast bed, with a giant console from which he could control all the curtains, all the doors, all the radios and the TV's not to mention the tea-maker. Trouble was that he'd have to get out of bed to

service the equipment but he was working on that problem.

The Chairman interrupted Mr. Colins to remark that if Mr. Colins cared to submit his plans...but Mr. Colins cut in to say that he was not going to submit his plans to anybody especially as he was getting married soon.

Mr. Bricklayer arrived in time for the 99th. session of the Committee and apologised for his absence from the previous meetings. Without any further ado he proceeded to outline briefly the circuitry for his 64-dollar (sorry-transistor) *Super-Fet All Band Receiver*. Four hours later the Committee approved the design for publication without further discussion.

Circuit

The circuit is the same as the physical layout which can be seen in the photograph of the *Super-Fet*.

CONSTRUCTION

The layout is the same as the circuit which can be seen in the photograph of the *Super-Fet*. The only component worthy of comment is the band switch which has the following positions:-

- Band 1. Vienna Philharmonic.
- Band 2. Foden's Motor Works.
- Band 3. Plastic Ono.
- Band 4. Carrol Gibbons and the Savoy Orpheans.

TESTING

Don't bother to check the wiring, it won't work anyway. Connect up a 9V non-polarised battery, stand well back and switch on. Go out and buy a kit set.

CONCLUSION

If you want to do an article for PW but can't think of a subject, dream of all the things you'd like to make for yourself and then pick on something else. Above all else, don't make the mistake of doing this on April the First. ■

WHAT'S IN THE MARCH TELEVISION?

(On sale March 8th)

■ HELICAL-SCAN VTRs

An upsurge of interest in videotape recording seems imminent. For amateur and semi-professional use this means the helical-scan v.t.r. Just what are the problems?

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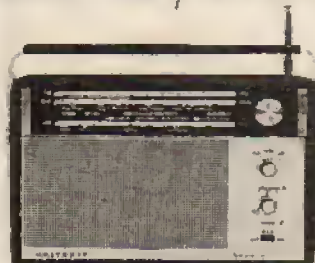
Want to know more . . . the unique Heathkit one-step-at-a-time construction manual is your guarantee to kit building success. To see for yourself how easy it all is, simply order the manual for the model of your choice (price only 10/- each). If you order a kit at a later date the manual price can be deducted. Your first step is to send for the Free catalogue, yours for only the price of a postage price stamp.

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'SEVERN' AM/FM Radio



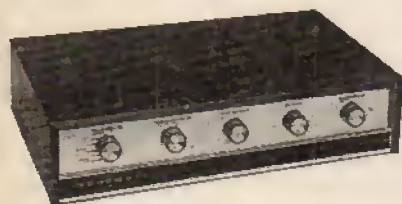
Beautiful Looks — Luxury Sound
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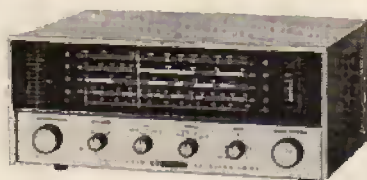
Heathkit Value—Powerful Output
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30W Stereo Amplifier



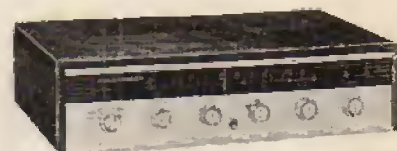
Stereo Gram, Radio, Aux inputs
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World-wide Reception
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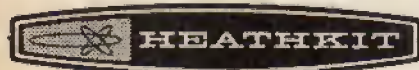


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51/4/71



GUIDE TO TEST INSTRUMENTS

by **GORDON J. KING**

THIS supplement is designed to herald a new series of articles focussed on radio and audio servicing, starting next month. The servicing series will be handled by colleague H. W. Hellyer (Mac to his mates and the author of the recently acclaimed *Tape Recorders* book by *Fountain Press*) and yours truly, and between us we shall be exploring the theoretical and practical aspects of radio and audio equipment servicing, taking in the ordinary radio receiver as well as the more exotic hi-fi receiver (tuner-amplifier?) along with audio amplifiers and tape recorders, with Mac concluding the series on the latter note and reflecting his vast experience in the fields of tape recording theory and servicing.

We shall also be unweaving the enigmas of valve and transistor theory while introducing practical relationships. We shall demonstrate contemporary testing procedures, tell how to work out component values, delve into the mystery of multiplex f.m., introduce hi-fi specifications, have a look at pickup theory and practice; in fact we shall be embracing as widely as possible the entire area of 'servicing' and in order to do just that we might well find it necessary to split all or some of the five parts into two sections to yield a desirable balance between theory and practice.

Although the actual *using* of test instruments will be adequately highlighted in the series, such things as instrument basics, what instruments are available, what they do and how they do it, their salient features, respective importance and so forth will not be included. This is where I come in with this supplement, the plan being to set the instrument stage, so to speak.

There has been little intrinsic change in instruments over the decade. We still have meters for measuring voltage, current and resistance by means of a pointer; and we still have instruments for generating various types of signal, pure tone, pulsed or modulated. The versatile oscilloscope is still the same. There is still the cathode-ray tube with its pin-point of light which, under the control of a suitable timebase, traces out the signal waveform on its screen.

TEST METER SENSITIVITY

Nevertheless, there has been change, but of a detailed rather than intrinsic nature. Change has been necessary, of course, to enable servicing and testing to keep abreast of the rapidly developing state of the art. For example,

some of the early multimeters are now singularly unsuitable for accurate fault diagnosis, testing and adjustments in some of today's solid state equipment. This applies both to the d.c. and a.c. aspects. Transistors and integrated circuits commonly run on smaller voltages than valves, and the currents in some of their circuits are remarkably small meaning the voltage dropped across resistive elements is also of a small magnitude. Thus our test-meters nowadays need to measure very small voltages over a substantial length of scale to maintain accuracy of readout. Moreover, as small voltage settings on such instruments reflect a reducing shunt resistance across the test circuit, the sensitivity of the movement itself must be higher than considered adequate in the valve heyday. Thus while we used to get by with a sensitivity of around 1,000 ohms/volt, we now require a sensitivity of at least ten times that value. Fortunately, development has been on our side, and we can now obtain quite a fair 10,000 ohms/volt species for a relatively modest outlay. Indeed, models are available up to 100,000 ohms/volt.

Current taken by a d.c. voltmeter merely follows Ohm's law. For example, the resistance of a movement giving a full-scale deflection of 1V when passing 1mA of current must be 1,000 ohms. The test circuit will then 'see' a shunt of 1,000 ohms; moreover, it will have to yield the corresponding power to cause the pointer to swing full-scale. If this meter current upsets the circuit conditions the measurement will be in error.

A voltmeter like that has a sensitivity of 1,000 ohms/volt for obvious reasons. If the full-scale deflection is geared, say, to 100V, then series resistance would be included to increase the total resistance as 'seen' by the circuit to 100,000 ohms. But the sensitivity would still be 1,000 ohms/volt. Sensitivity is enhanced only by a movement which gives full-scale deflection for a smaller current. A movement which requires, say, 0.1mA (100 μ A) yields a sensitivity of 10,000 ohms/volt, while a 10 μ A movement steps up the sensitivity to 100,000 ohms/volt.

TEST METER ACCURACY

Clearly, it pays to use the highest voltage setting consistent with a usable readout, for then the current drawn from the test circuit is reduced. However, working like that can impair the readout accuracy for two reasons. One because small voltages are not easy to determine on a highish voltage scale, and two because the inherent accuracy commonly tends to deteriorate at small deflections.

Meter accuracy is often geared to full-scale deflection.



GUIDE TO TEST INSTRUMENTS

Thus a specification of $\pm 2\%$ of full-scale deflection means that on the 100V range, say, a true 100V could read as 98V or 102V (the latter just in advance of the final calibration mark). However, a true 50V on the same range could read as 48V or 52V, thereby corresponding to an error of $\pm 4\%$ at half-scale deflection. In practice, therefore, it is best to select a range giving the greater pointer deflection for the applied voltage. In that way the readout error is minimised.

A common multimeter sensitivity is 20,000 ohms/volt, a value which satisfies the requirements for the vast majority of servicing tests in both valve and solid-state equipment. Even so, there are times when even greater sensitivity is demanded; when, for instance, voltage is measured from a high resistance circuit. Unless the current flowing from the test circuit into the meter is minimised, a substantial ratio of voltage will be dropped test circuit, the meter thus recording only a small ratio of the real voltage present without the meter connected.

ELECTRONIC TEST METER

When choosing a test meter, therefore, a major consideration should be the sensitivity voltage. From first principles, the greater the sensitivity the better; but since accurate meters of exceptionally high sensitivity (say, 100,000 ohms/volt) are more costly and possibly somewhat less robust than their lesser sensitivity counterparts, some technicians and enthusiasts prefer the electronic test meter alternative. Such an instrument commonly exploits the same sort of readout (moving-coil movement) as the 'directly applied' instrument just considered, though there are digital equivalents referred to anon. A major difference is that the movement is not operated directly from the power available in the test circuit, but instead from the power inherent in a valve or transistor circuit. In other words, the active (valve or transistor) circuit serves as a 'buffer' between the source and the meter movement, meaning that significantly less power is drawn from the source to work the meter.

Prior to the transistor era, instruments like this were often called valve voltmeters. Even today valves are sometimes employed, but many are now changing over to transistors with the advantage of battery powering and hence portability. A term which embraces both types is *electronic test meter*, but we might still talk of the valve voltmeter or transistor voltmeter.

Valves were particularly handy for the application since the power in the anode circuit is controlled by voltage of extremely low power in the grid circuit. Stemming from this was a very high input resistance, established essentially by the input attenuator, which remained relatively high even on the lowest voltage range. Transistors of the bipolar type are themselves current operated (like the meter movement) and are thus somewhat less matched to the requirement. Nevertheless, over the years circuit artifices have been adopted to secure the highest possible input resistance; the base input, in fact, monitoring the small current from the test source which is then reflected as a much higher collector current in the meter circuit. The

field effect transistor, which is endowed with a very high input resistance, similar to that of a thermionic valve, is now extensively used in electronic test meter circuits.

The active circuit, of course, needs to be powered from the mains supply or batteries, and an arrangement is incorporated for setting the pointer of the movement to zero prior to the application of the test voltage.

MULTIRANGE METER

The bread-and-butter instrument is the multirange meter. This comes in both 'directly applied' and electronic form. The most common is the 'directly applied' version, without which it is impossible to perform even the most elementary of servicing operations requiring testing of some kind. The days of 'wet-finger' and neon bulb testing went out with the thermionic valve. Least complex of the species is for d.c. applications only; but the extra initial outlay for an instrument embracing a.c. ranges in addition to the d.c. ones is well warranted. Basic ranges are voltage, current and resistance.

RESISTANCE MEASUREMENT

Resistance is effectively measured in terms of current readout, the reading being directly in 'ohms'. An internal battery supplies the current and this is switched in series with the meter movement and an internal resistive arrangement, a part of which comes out to a 'zero set' control on the front. When the test leads are shorted the meter is caused to read full-scale by control adjustment, corresponding to zero 'ohms'. When the leads are connected across an external resistance the meter current is reduced and the deflection is less, the pointer then indicating the approximate value of the resistance.

This is the simplest means of resistance measurement. Greater accuracy calls for a special 'bridge' or a more sophisticated direct-reading meter. Most multimeters provide for at least two resistance ranges, but it is not unduly difficult to measure higher values than allowed for by the internal battery by adopting an external battery to give a full-scale deflection on the highest practical voltage range, then introducing the resistance for measurement in series with the battery. This, though, might involve some sort of scale recalibration or mere scale multiplication, depending on the nature of the instrument and the battery voltage.

The greater the voltage sensitivity of the instrument, the higher the resistance value measureable. Very low values of resistance are not so easily measured in the manner expounded; again, a special kind of resistance meter is required for this.

DIRECT CURRENT MEASUREMENT

The voltage sensitivity reflects the lowest d.c. measurable. For example, a meter with a d.c. sensitivity of 20,000 ohms/volt would probably have a d.c. current range down to $50\mu\text{A}$ (0.05mA), while a 10,000 ohms/volt meter would be unlikely to measure d.c. below $100\mu\text{A}$ (all full-scale of course). However, it is noteworthy that this basic relationship is sometimes affected by meter movement 'padding', which may be adopted partly for calibration purposes and partly for temperature compensation, with meter overload protection probably having some influence.

For testing in transistor circuits a meter of 20,000 ohms/volt sensitivity reading full-scale down to about 0.1V

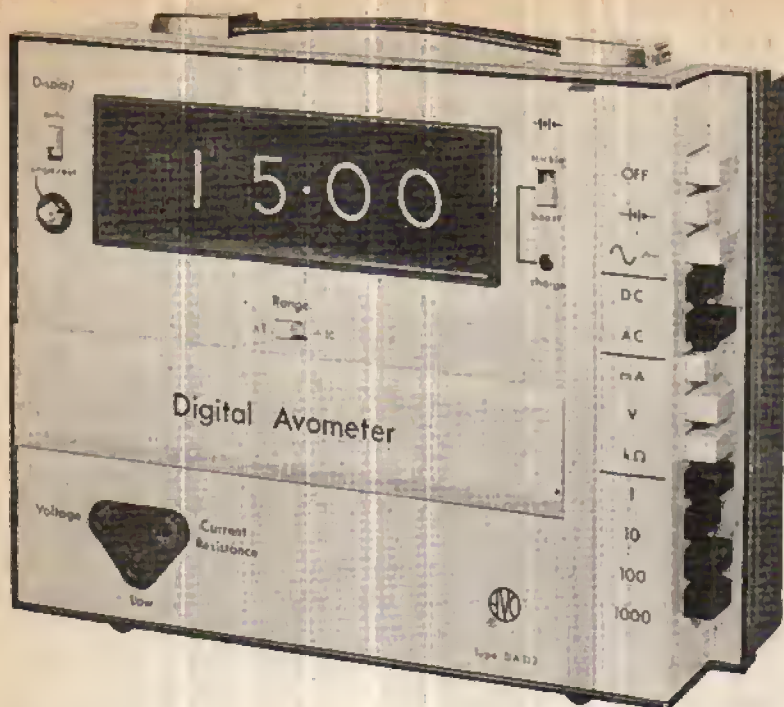


Fig. 1: The multimeter of the future—the Digital Avometer.

Fig. 2: The latest Electronic Avometer which operates from 4 mercury cells. Extensive multimeter range coverage is provided (see text).

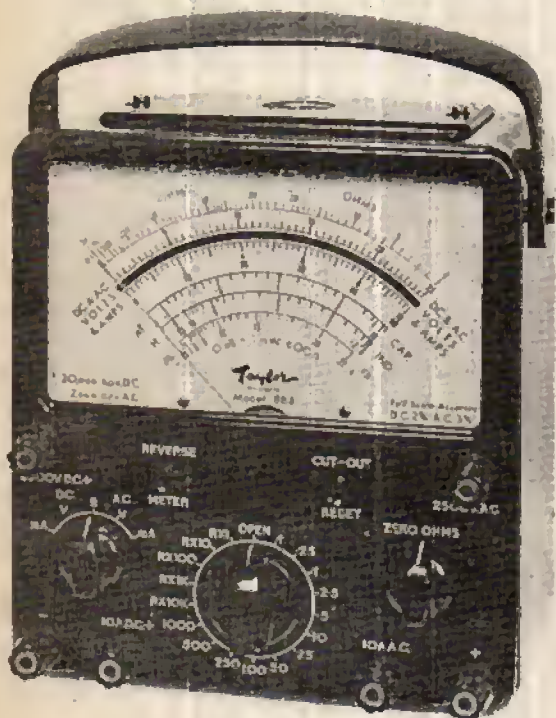
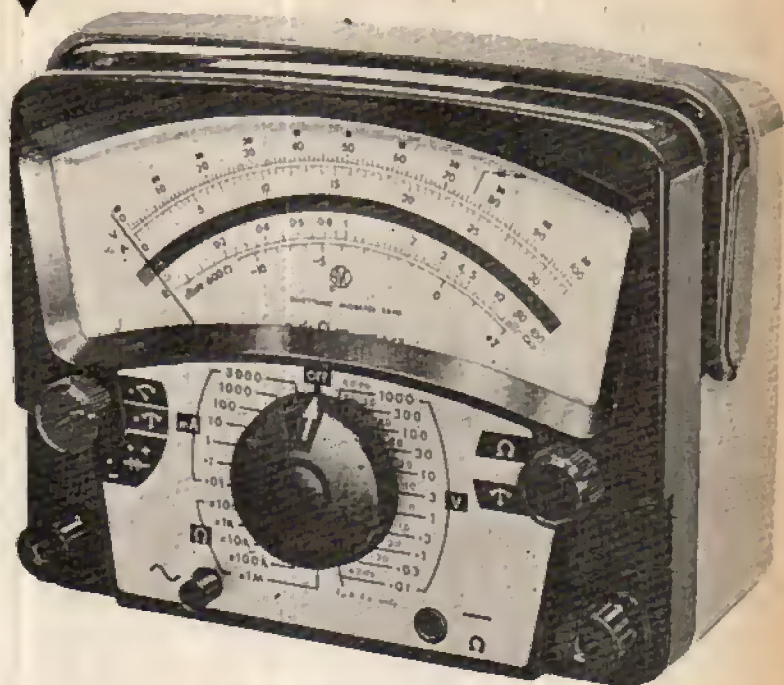


Fig. 3: The popular Taylor multimeter, Model 88B with a sensitivity of 20,000 ohms/volt d.c. and 2,000 ohms/volt a.c. Some idea of the scope range can be gleaned from the picture. Also see text.

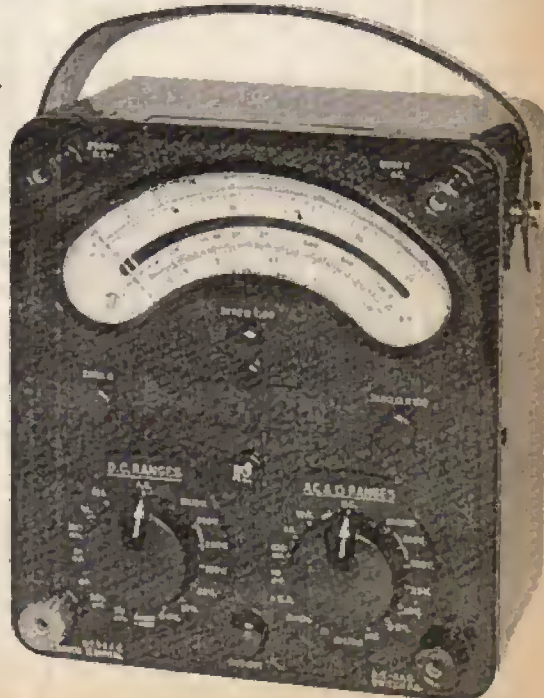


Fig. 4: Eagle K-1400 volt/ohm/milliammeter in action. This has a sensitivity of 20,000 ohms/volt d.c. and 5,000 ohms/volt a.c. and measures d.c. voltage 0-5kV in 8 ranges at accuracy better than $\pm 3\%$ f.s.d., a.c. voltage also 0-5kV but in 6 ranges, d.c. current 0-10A in 6 ranges, a.c. current 0-10A in 4 ranges and resistance in three ranges, to 20MΩ. Frequency response 10Hz to 100kHz (for 2.5V, 10V and 50V a.c. ranges), and a dB scale is fitted.



Fig. 5: An old favourite updated. The Avometer Model 8 MkIV. Meter movement sensitivity 50μA full-scale, providing a sensitivity of 20,000 ohms/volt on d.c. and 2,000 ohms/volt on a.c. Features include movement reverse control and overload protection. A.C. voltage accuracy maintained up to 15kHz on 250V range, suitable for audio frequency measurements. A dB scale is included.

Fig. 6: Heathkit Utility Solid-State Voltmeter, Model IM-17. This employs 4 silicon transistors, 1 field effect transistor and 1 silicon diode and has 4 d.c. voltage ranges from 1V to 1kV (full-scale) and 4 a.c. voltage ranges from 1.2V to 1kV (full-scale).





GUIDE TO TEST INSTRUMENTS

(100mV) would be useful. Complementary ranges might than be 0.25V, 1V, 2.5V, 5V, 10V, 25V, 50V, 100V, 250V, 500V, 1kV and, perhaps, 2.5kV. Remember that we often need to measure with fair accuracy down to 0.25V or less in transistor stages, so it is essential for the meter to feature well proportioned ranges down to at least 0.25V full-scale.

D.C. current ranges are also important, but possibly marginally less so than voltage ranges. This is because when testing in printed circuit equipment we endeavour to calculate the current by measuring the voltage dropped across a known value resistor in the circuit carrying the current, simple Ohm's law then giving the answer without the need to break the circuit to introduce a current meter.

Well proportioned voltage ranges are generally reflected in the d.c. current ranges, from the lowest full-scale value allowed by the meter movement to several amperes without external shunts. For example, a 20,000 ohms/volt multimeter might have full-scale ranges of 50 μ A, 100 μ A, 250 μ A, 500 μ A, 1mA, 2.5mA, 5mA, 10mA, 25mA, 50mA, 100mA, 500mA, 1A and 10A. These, it will be noticed complement the voltage ranges just mentioned.

A.C. MEASUREMENTS

A multimeter designed to measure a.c. *voltage* might not be equipped to measure a.c. current. There are two versions, the less costly one that measures a.c. voltage and the more costly one that measures a.c. current as well as voltage. In the valve days a.c. current measurements were more important than they are today, for valve heater current was an important parameter.

It is still desirable to be able to measure a.c. voltage, however, for some audio equipment, in particular, is sensitive to main voltage. We also commonly need to know the a.c. voltage across the secondary windings of the mains transformer feeding the rectifier or the a.c. voltage applied, say, to the motor of a tape recorder or turntable unit. To some extent, depending on instrument design, we can also use the a.c. voltage ranges to measure audio signal provided the level is sufficiently high. This is said with some qualification, however, since the meter loading on the signal source and the frequency response shortcomings of the meter circuit can seriously affect the readout accuracy.

A moving-coil movement responds correctly only to direct-current. This means that for a.c. measurements the instrument uses a rectifier, often of the bridge type. The nature of the a.c. circuit reduces the instrument's sensitivity on the a.c. ranges, and it is not uncommon to find that the a.c. sensitivity of a meter with a d.c. sensitivity of 20,000 ohms/volt is around the 2,000 ohms/volt mark. The a.c. volts ranges are thus generally fewer than the d.c. volts ranges, starting at about 1V full-scale instead of, perhaps, 100mV.

A meter which also measures a.c. current is similarly restricted, the first full-scale range being, perhaps, 1mA instead of 50 μ A or 100 μ A, as on d.c.

Knowing the mains loading (e.g., $W=VA$) of a radio receiver or item of audio equipment—even if solid state—

sometimes provides a clue as to a possible fault condition, and as this can be obtained only by measuring the a.c. input current the meter can usefully possess at least a fairly high current range.

The a.c. ranges are scaled in root mean square (r.m.s.) values based on sinewave input. Thus a signal which deviates from pure sinewave form will fail to provide an accurate r.m.s. indication.

OTHER MULTIMETER MEASUREMENTS

More advanced multimeters incorporate additional features which are sometimes useful for servicing applications. For example, a decibel scale (or scales) can be used in conjunction with the a.c. voltage ranges to measure the power response, say, of an audio amplifier, provided that the frequency response of the meter is reasonably 'flat' over the audio spectrum and that the voltage ranges match the audio voltage across the load ($W=E^2/R$). It is common for 0dB to correspond to 1mW into 600 ohms, and the scale or scales may extend from -10dB to +60dB or more.

Some models also provide for the measurement of capacitance and inductance with an external adaptor (the Taylormeter, Model 38B, for example).

MULTIMETER FEATURES

More costly versions are equipped with either mechanical or electronic overload protection, which is certainly very useful in the service workshop!

Another handy fitment is a switch for reversing the polarity of the test leads. Thus if the meter deflects against the stop, the switch can be operated to give a normal forward reading.

Maximum readout accuracy is given by the models with large scales (5in. or so), and to avoid reading error due to parallax effects, a section of the scale may carry a mirror (called anti-parallax mirror) so that the pointer can be aligned with its reflection when the reading is taken.

Number of ranges and facilities provided by a multimeter, of course, reflect its price. The small 'pocket' instruments are useful for field activities, but for workshop applications a more valuable investment is desirable.

ELECTRONIC MULTIMETER

The electronic multimeter generally boasts features in advance of those already described. The high input impedance is a useful attribute for certain tests, this sometimes being around 11M on d.c. and 1M or so on a.c.

A.c. frequency response, too, is significantly enhanced, sometimes by an external diode probe. The Heathkit 'Utility Solid-State Voltmeter', for example, has a ± 1 dB response from 10Hz to 1MHz. If the voltage sensitivity is in the order of millivolts full-scale, then such an instrument can almost be employed as an audio milli-voltmeter. The Avo Electronic Avometer Type EA113 goes down to 10mV on its lowest range with an accuracy of $\pm 1.25\%$ from 20Hz to 25kHz which makes it quite suitable for audio applications. The Grundig 'Universal Voltmeter', Model UV30 is another model suitable for audio work, in addition to the measurement of voltage and current, a.c. and d.c. This goes down to 100mV full-scale on the a.c. range with an accuracy of $\pm 3\%$ from 10Hz to 100kHz ± 0.5 dB. The instrument is battery powered and adopts field effect transistors.

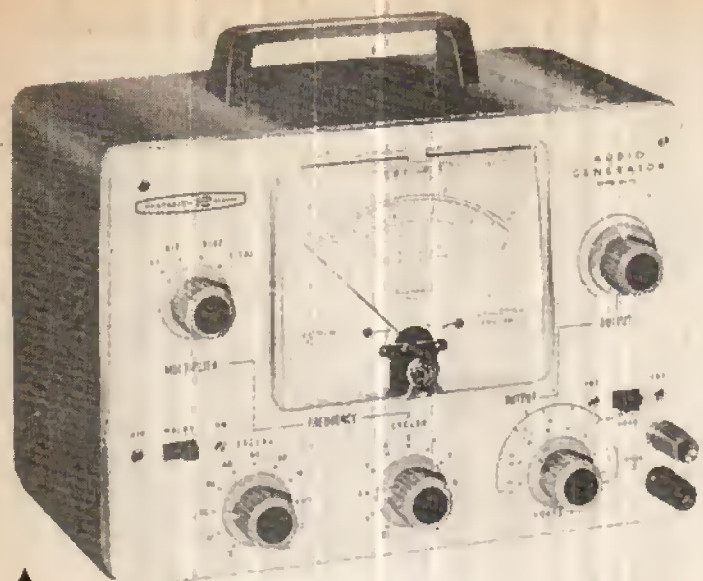


Fig. 7: Heathkit Audio Generator, Model AG-9U. Frequency range is from 10Hz to 100kHz with less than 0.1% distortion from 20Hz to 10kHz. Output voltage is indicated on a 4½ in. meter with three scales of 1 and 3 volts and -10 to +2dB.

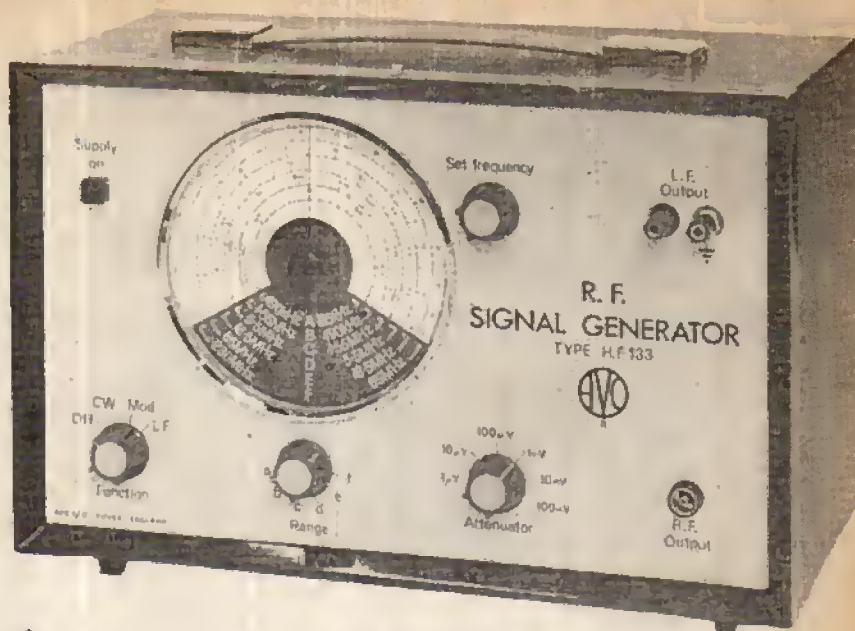


Fig. 8: An a.m. signal generator by Avo, Model HF133. The picture shows the facilities provided.

Fig. 9: The Heathkit (Heath, Gloucester Ltd.) Model 10-18U oscilloscope. This general purpose model has a 5in. tube, 4.5MHz bandwidth and 30mV (p-p)/cm. sensitivity. Sweep goes from 10Hz to 500kHz.

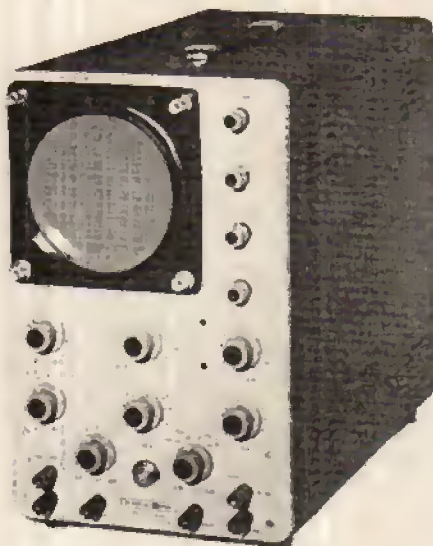


Fig. 11: A pocket-sized multimeter by Taylor, Model 127A. This is suitable for bench and field work in industry and for the student and amateur radio enthusiast. Sensitivity is 20,000 ohms/volt d.c. and 1,000 ohms/volt a.c.

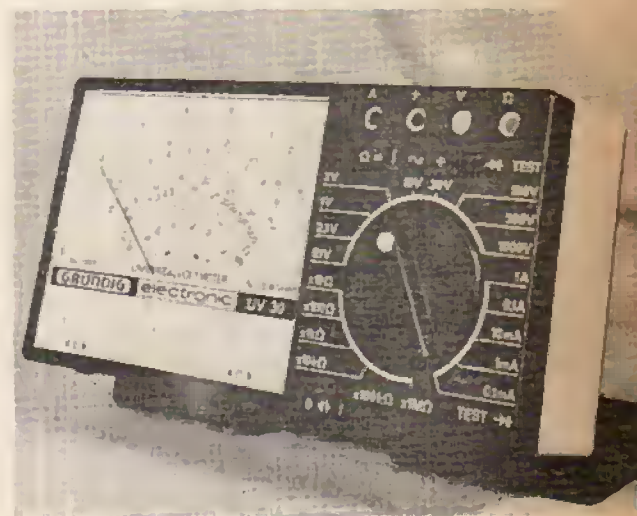


Fig. 10: A Universal Voltmeter by Grundig. Model UV30. This uses field effect transistors, is battery powered and pocket size. Impedance as high as 30M and resistance measurement from 1Ω to 500MΩ.

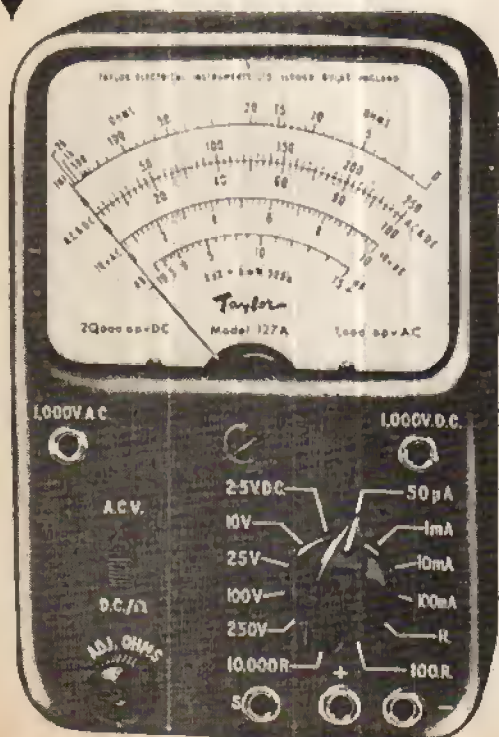
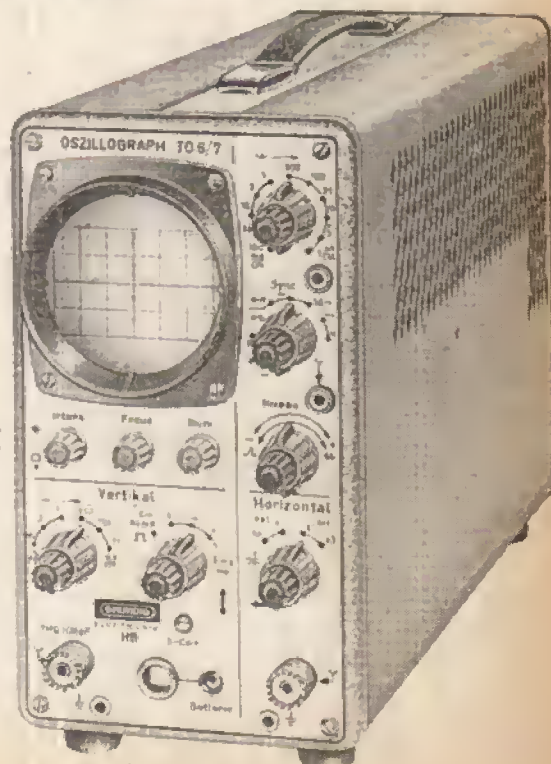


Fig. 12: Grundig Oscilloscope Model TO 6/7. This is an example from the very wide range of test instruments by Grundig. Using solid-state devices, it is suitable for mains and battery powering, with facilities for powering from external vehicle battery. Y bandwidth 0-6MHz -3dB and sensitivity 30mV/cm.





GUIDE TO TEST INSTRUMENTS

For checking the gain of r.f. and i.f. stages one needs to measure r.f. and i.f. input and output signals, and this mode of measurement is sometimes catered for by a diode probe designed for use with an electronic multimeter or similar instrument. Signals up to 100MHz (sometimes higher) can be measured by this method.

AUDIO MILLIVOLTMETER

This instrument differs from the multirange electronic meter in that it is designed to measure a.c. voltage only from low audio-frequency up to 30kHz or more. Some models, in fact, measure up to 1MHz or beyond this into the video-frequency spectrum.

Design is based on high response accuracy over the intended frequency range and also very high sensitivity on the low ranges. Indeed, some ultra-sensitive models give full-scale deflection from a signal as low as 100 μ V (sometimes less!). With such sensitivity it is possible to measure very low-level audio signals, such as those delivered by a magnetic pickup cartridge or microphone.

A multiplicity of ranges, based on a calibrated input attenuator, often extends the full-scale readout to several volts or tens of volts. Readings are commonly scaled in r.m.s. values, though there may also be peak voltage scales or a switch or control to change the readout from r.m.s. to peak.

As this sort of instrument is designed for audio and video applications it is almost certain to feature a decibel scale. The moving-coil meter is operated from rectified signal obtained from the output of an amplifier, the various ranges being catered for by switched attenuators.

Mains and battery powered versions are available and quite a few models are equipped with an amplifier output socket, prior to the meter rectifier, so that the measured signal can be viewed on the screen of an oscilloscope. This is useful when the instrument is reading audio distortion via a distortion analyser, for the 'scope display then reveals the nature of the harmonics of which the distortion is composed. Battery-powering leads to portability and reduces hum-loop problems when tests are being made in low-level circuits.

DIGITAL READOUT

Although digital instruments are fast becoming popular in laboratories, it will be some time before we can afford them specifically for servicing and experimental applications. At the time of writing a digital multimeter costs about three times more than an equivalent analogue instrument.

For lab. work the appeal lies in the accuracy, ease of readout and high sensitivity. For example, the Digital Avometer, Model DA112 features voltage ranges from 100 μ V to 1.5kV (with a 50% over-range facility) at an accuracy to 0.1%. Readout is from a 3½ digit display with automatic decimal pointing, and the design covers both mains and battery powering.

Cost lies essentially in circuit complexity, but with the

advancement of integrated circuits (of which many already employ) and mass demand, the cost is almost certain to decline eventually, though this may not be in the very near future!

SIGNAL GENERATORS

For radio servicing the signal generator must yield a modulated carrier-wave and operate over the bands corresponding to those tuned by the receiver. Modulation, too, must match the design of the receiver. Thus a.m. receivers require amplitude-modulation and f.m. ones frequency-modulation. The generator should also tune over the i.f. spectrum, commonly 10.7MHz f.m. and 470kHz a.m.

An important part of the design is the output attenuator. This should be reasonably accurate so that a fair approximation of the strength of the signal fed to the receiver is known. This is necessary for determining the sensitivity of the receiver. Calibration is either in decibels below the maximum signal output (sometimes referred to 0dB) or direct in μ V and mV. A switched attenuator generally sets the output range, which is then controlled by a 'fine' attenuator.

Some models have facilities for varying the modulation depth and a meter for setting the signal level prior to the attenuator, but for general servicing applications such refinements are not essential.

For range extension harmonic working is sometimes adopted. This is not generally a desirable scheme, although it tends to reduce cost. Fundamental working even into the higher frequency bands makes life less complicated and reduces errors which can sometimes result from harmonic working.

Models designed for radio and television servicing commonly incorporate a fixed-frequency audio oscillator, at 400Hz or 1kHz, for modulating the carrier-wave, and the signal from this is often brought out to a front socket, either at 'full force' or via a variable attenuator. This signal is useful for making tests in audio sections of receivers and in amplifiers. Modulation depth is fixed at approximately 30%, though it can vary slightly over the frequency ranges.

Even though the instrument might produce only amplitude-modulation, provided the modulation can be switched off and the r.f. range embraces Band II (from about 87 to 108 MHz), it can be used for f.m. receiver servicing to some extent (this will be explained in the forthcoming series).

F.M. generators are usually more costly than a.m. counterparts, but models are made which switch over a.m. and f.m., covering the range from about 130kHz to 250MHz over various bands.

For the visual alignment of radio receivers (using an oscilloscope to display the response characteristic), a special kind of signal generator is required, commonly referred to as a 'wobbulator'. The r.f. output from this swings either side of the nominal carrier frequency in synchronism with the X sweep of the oscilloscope, sufficient to embrace the full width of the response. A response display is then obtained by feeding the detector output of the receiver to the oscilloscope Y input.

AUDIO GENERATOR

For audio testing the generator should tune from at least 20Hz to 20kHz; but many go above this frequency. Signal output is a sinewave, but many instruments can be switched to change the sinewave to a square-wave,

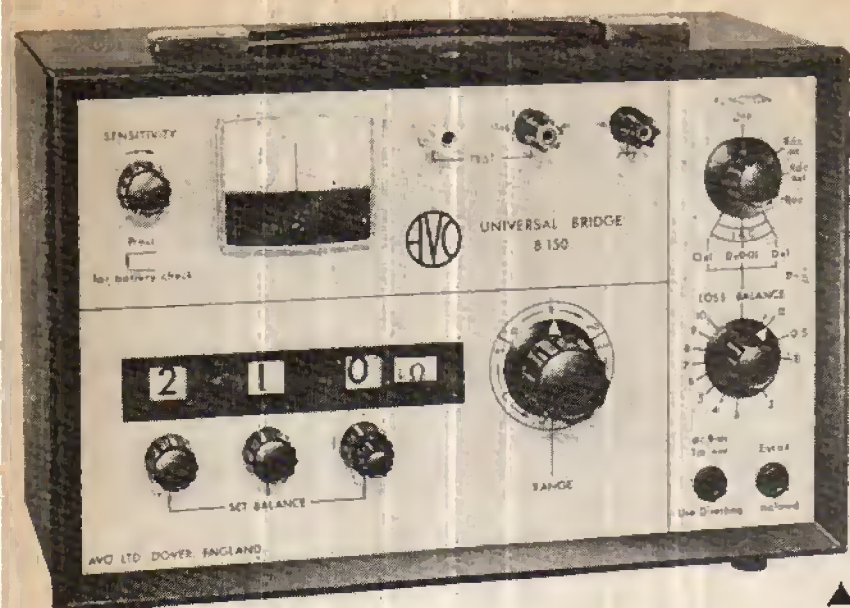


Fig. 13: For more advanced measurements and tests, this Universal Bridge by Avo, Model B.150, caters for a wide range of inductance, capacitance and resistance measurements. Balanced null point is indicated by a meter, while the value of the component under test is automatically presented in digital form.

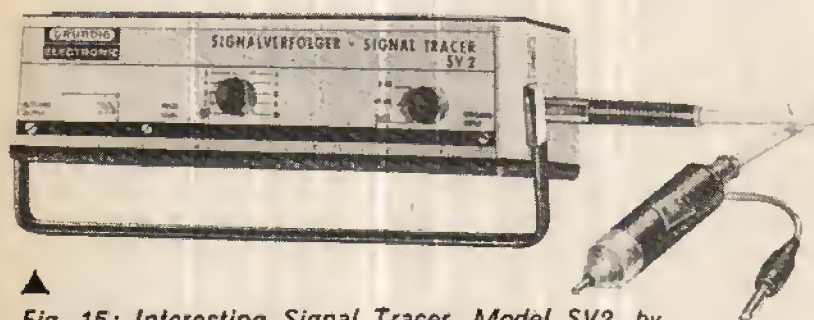


Fig. 15: Interesting Signal Tracer, Model SV2, by Grundig. Using transistors, the instrument is battery powered and of handy size. Signal is traced via a test prod which, after amplification, is indicated by meter or loudspeaker.

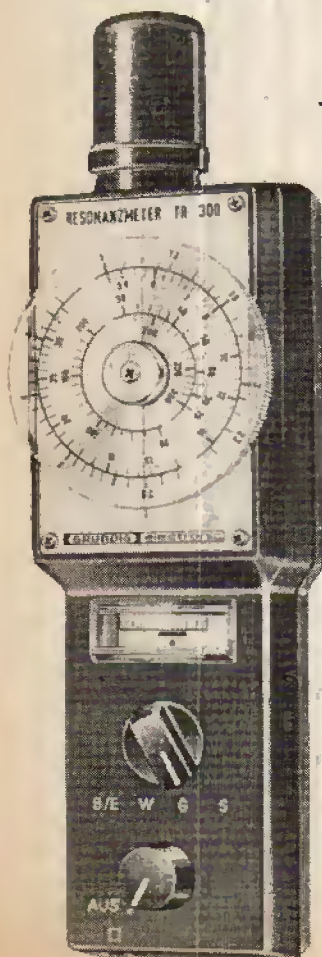


Fig. 17: Grundig Grid Dip Resonance Meter, Model TR300. This model covers 0.95MHz to 300MHz in 8 ranges (Model TR30 95kHz to 30MHz) and is battery powered. A very useful instrument for experimenters since not only is the frequency of an external tuned circuit indicated by a change in current, but switching changes the mode to absorption wavemeter and receiver, operated through a headphone set.

Fig. 18: Taylor Valve Tester, Model 45D. This general purpose instrument is capable of testing almost all thermionic valves with the exception of the larger transmitting type. There are ten valve bases, including the more recent B10B and B9D, and a special B14E base accepts a range of plug-in adaptors available; to cover new and old valves. Mutual conductance is measured (emission of diodes), and there is also a "replace —?— good" scale for speedy appraisal.

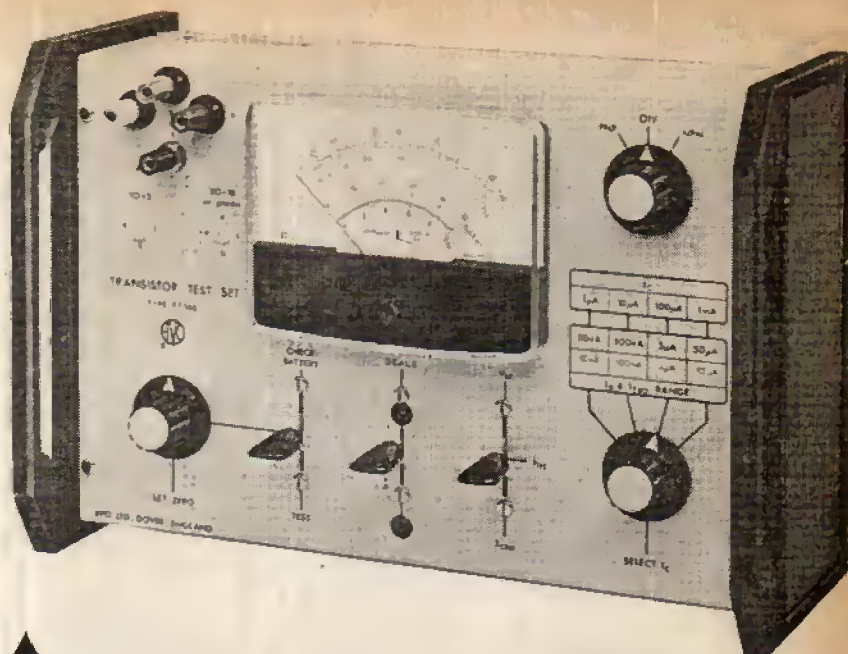
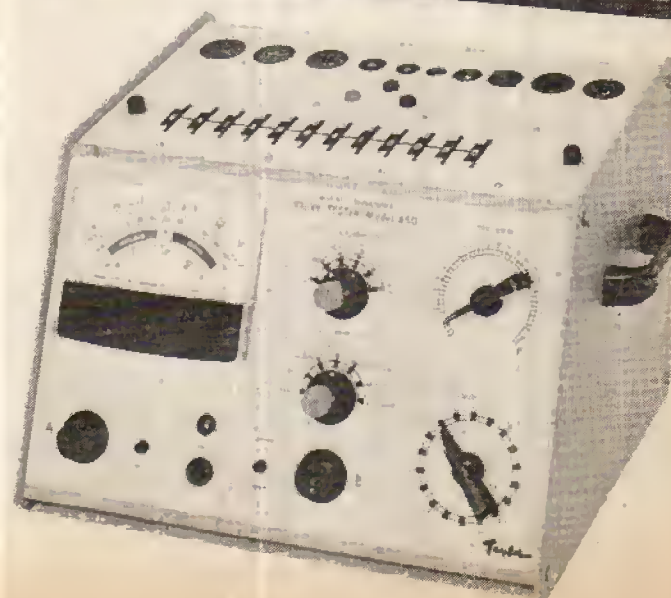
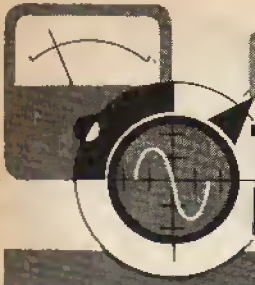


Fig. 14: Avo Transistor Test Set, Model TT.166. Design is for the measurement of bipolar transistor d.c. parameters. Tests can be made at very low collector currents appropriate to modern devices ($1\mu\text{A}$ to 1mA), p-n-p and n-p-n. Operation is from two internal 9V batteries.

Fig. 16: The still popular Taylor Model 68A/M signal generator. Frequency range is from 100kHz to 240MHz (all on fundamentals) over 8 ranges. Although a.m. only, the instrument is suitable for the alignment of ratio detectors and f.m. r.f. and i.f. stages. A variable 400Hz audio output is available and an r.f. monitoring meter allows accurate setting of the signal applied to the attenuators.





GUIDE TO TEST INSTRUMENTS

useful for 'transient' testing audio amplifiers.

The sinewave must be as pure as possible, especially when the signal is to be used for distortion measurements, and for this application the total harmonic distortion on the signal should be significantly less than 1%. However, it is possible to 'filter' the signal from a generator of relatively high distortion to delete the harmonics, thereby making it more suitable for t.h.d. measurements (this, too, will be explained in the forthcoming series).

Maximum output should be a volt or two (r.m.s.), and the attenuator should reduce this in decrements of 20dB, with a 'fine' attenuator varying the 'set output' down to zero. It is also important for the audio signal output to remain substantially constant over the entire frequency range.

OSCILLOSCOPE

For many radio and audio applications an oscilloscope with a Y bandwidth up to 3MHz can be very useful. Cost can be cut by building one's own from a kit of parts, such as the excellent Heathkits. The General Purpose Service Oscilloscope, Model OS-2 is a good illustration. This, by Heathkit, sells at £29.20 (carriage 60np) as a kit and for £44.20 (same carriage) in ready-to-use form.

For more specialised circuit investigations, however, a Y bandwidth to -3dB points) up to 10MHz and beyond is demanded; this applies to the study of very fast pulse signals and transients, etc.

X bandwidth is less critical for most normal applications (that of the Heathkit being 2Hz to 300kHz ± 3 dB, and the Y bandwidth 2Hz to 3MHz ± 3 dB). Y sensitivity (e.g., vertical deflection of the spot) is also important, and this should be at least 250mV p-p per cm. A useful feature is a 'voltage calibrator' which switches an a.c. voltage of known amplitude to the Y input.

For use with a wobulator an X (timebase) output terminal should be available, this then being coupled to the X or sweep input of the wobulator for securing a response display as already mentioned.

X sweeps should match the Y bandwidth in terms of waveform time. These are sometimes given as time (μ S, mS or S) per cm. of horizontal sweep.

It is also useful to be able to switch off the timebase so that external signals can then be applied to both the Y and X amplifiers. Certain tests of phasing require the use of these two circuits without the influence of the timebase.

The display is locked on the screen by a synchronising signal from the source, and most recent 'scopes embody an automatic circuit for this, the sync signal being extracted internally from the test signal.

Most instruments designed for general servicing still run on valves, particularly the less costly ones, but there is a trend towards the use of solid-state devices, giving a choice of mains or battery powering and the bonus of portability.

Screen diameter is not all that important for radio and audio servicing, though obviously the larger, the better; but some sort of calibration is desirable, and this commonly takes the form of a graticule scribed in cm. squares.

Another useful feature is X expansion. This merely

consists of an amplifier through which the timebase signal passes to the X plates of the cathode-ray tube. With the X expansion control—a variable attenuator—fully clockwise horizontal deflection just fills the screen. As the control is advanced so the deflection increases. It is thus possible to expand a waveform display horizontally (as well as vertically by the Y attenuator) to allow otherwise hidden artifacts to be examined. Turning on X expansion is tantamount to increasing the timebase sweep velocity, so the expansion control complements the sweep control.

It is sometimes required to examine two signals simultaneously and to compare one with the other. For this a dual beam 'scope is needed, with duplicated Y amplifiers, etc. Such instruments cost more than the single beam variety and are found mostly in laboratories. However, it is possible to secure two displays from a single beam model electronically, using a special switch. A good example is the Heathkit Electronic Switch, Model S-3U, which costs £16.30 as a kit or £28.30 in ready-to-use form.

DISTORTION ANALYSER

For audio amplifier servicing of a serious nature an important instrument is the distortion analyser. Basically, this consists of a tunable notch filter through which a sinewave signal after passing through the amplifier is fed to a sensitive audio millivoltmeter. The sinewave signal fed to the input of the amplifier under test is obtained from a low distortion audio generator, and the idea is that the 'notch' deletes the fundamental leaving only the harmonics. These are measure by the audio millivoltmeter and their total voltage is then compared with that of the sinewave signal proper across the same output load in terms of percentage total harmonic distortion.

A laboratory instrument at reasonable cost—Model Si452—is made by J. E. Sugden & Co. Ltd. of Cleckheaton, Yorkshire. When complemented with a millivoltmeter and generator t.h.d. readouts to less than 0.1% are possible.

Integrated instruments (e.g., embodying the audio generator and readout) are also available. These are generally very costly instruments, but for less exacting work inexpensive Heathkit models are available, one for t.h.d. measurement (Model M-58U) and another for intermodulation distortion analysis (Model IM-48).

It is obviously impossible to survey the whole field of servicing test instruments in a supplement of limited space, but it is hoped that the foregoing, and the accompanying illustrations, will give a fair impression of the type of instruments currently on offer.

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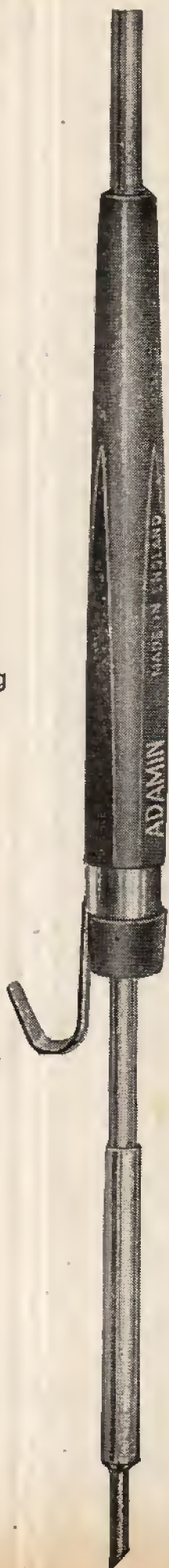
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2N1613	22p	BC138	40p	BYZ15E1	00
2N1711	25p	BC147	17p	GET102	30p
2N2147	75p	BC148	12p	GET111	40p
2N2160	65p	BC149	20p	GET880	37p
2N2218	30p	BC154	37p	GET882	25p
2N2219	32p	BC157	20p	MAT100	25p
2N2222	30p	BC158	17p	MAT101	30p
2N2222A	37p	BC159	20p	MAT120	25p
2N2369	20p	BC177	25p	MAT121	30p
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2N4053	17p	BD123	80p	OA73	10p
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2N4457	35p	BD125	50p	OA81	10p
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AC188	30p	BF152	30p	OC43	40p
AC197	30p	BF154	40p	OC44	17p
AC198	25p	BF158	30p	OC45	15p
AC199	25p	BF159	60p	OC70	12p
AC200	22p	BF167	25p	OC71	15p
AC221	22p	BF170	35p	OC72	25p
AC222	17p	BF173	30p	OC73	30p
AC239	50p	BF177	40p	OC74	30p
ADY40	15p	BF178	25p	OC75	25p
AD140	50p	BF179	40p	OC76	25p
AD149	50p	BF180	37p	OC77	40p
AD161	37p	BF181	37p	OC81	25p
AD162	37p	BF182	32p	OC82	25p
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AF125	20p	BF200	37p	OC171	30p
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AF180	62p	BFW91	20p	OC205	75p
AF181	42p	BFX13	25p	OC206	90p
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PL7004	400	25p	23p	21p	18p
PL7005	600	28p	24p	23p	20p
PL7006	800	27p	25p	24p	21p
PL7007	1000	30p	28p	26p	22p

MINIATURE POTTED BRIDGE RECTIFIERS (SILICON) SIZE 1 x 1 x 1/2 in.

Type	P.I.V.	rent	1-49	50+	100+	500+
502	50	2 amps	55p	50p	45p	40p
1002	100	2 amps	60p	55p	50p	45p
2002	200	2 amps	70p	65p	60p	55p
4002	400	2 amps	80p	75p	70p	65p
504	50	4 amps	60p	55p	50p	45p
1004	100	4 amps	70p	60p	55p	50p
2004	200	4 amps	75p	70p	65p	60p
4004	400	4 amps	85p	75p	70p	65p
1006	100	6 amps	75p	70p	65p	60p
2006	200	6 amps	80p	75p	70p	65p
4006	400	6 amps	£1.10	£1.00	90p	80p

R.C.A. INTEGRATED CIRCUITS

LINEAR TYPES	
CA3005	£1.20
CA3011	75p
CA3012	90p
CA3013	£1.10
CA3014	£1.45
CA3018	£1.10
CA3020	£1.25
CA3021	£1.55
CA3022	£1.30
CA3023	£1.25
CA3026	£1.00
CA3028A	£1.20
CA3035	£1.25
CA3036	90p
CA3039	85p
CA3041	£1.10
CA3042	£1.10
CA3043	£1.40
CA3044	£1.25
CA3045	£1.25
CA3046	85p
CA3048	£2.25
CA3051	£1.35

PRACTICAL WIRELESS

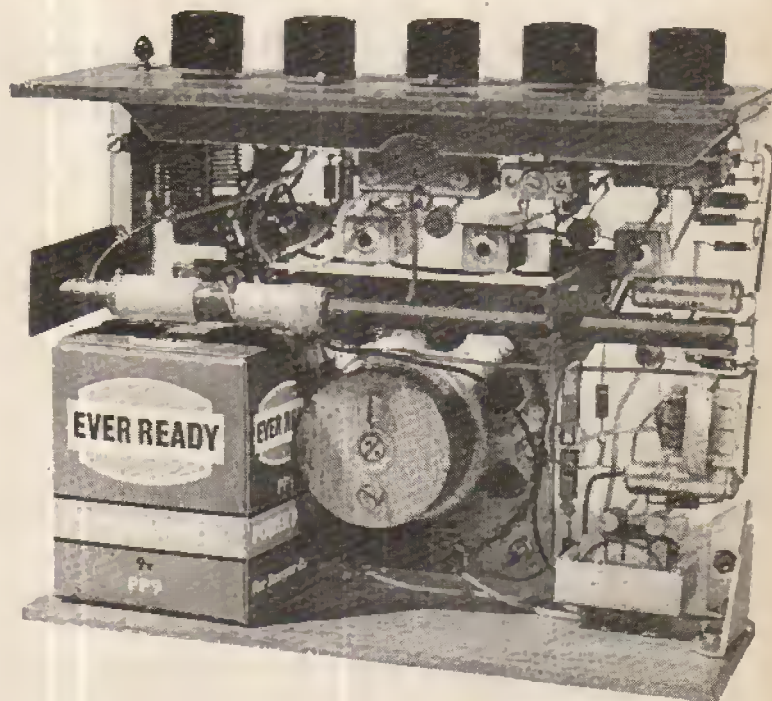
ALL IN THE
MAY ISSUE, ON
SALE APRIL 8th

'STATION FOCUS' SIX

At best the performance of the average superhet receiver depends largely upon the proper alignment of the various tuned circuits. In this 'no-compromise' medium and long wave receiver, the "Station Focus" Six, separate panel controls are included for the correct alignment of the critical circuits.

The prototype has been built on a clear perspex panel, as shown on the right, and the photographs included in the article will greatly assist the construction and later checking of the circuit.

An attractive but simple wooden cabinet completes the receiver which, because of its simplicity is ideal for the beginner but because of its performance is also suited to the more advanced constructor.



NEW SERIES... SERVICING AN INTRODUCTION TO FAULT-FINDING

There aren't many members of the electronic fraternity who haven't dabbled in servicing—even if it's only to change the battery or clean the earphone socket connections on a friend's radio.

This new series, starting from scratch takes the reader right through from basic principles to the more advanced aspects such as alignment of f.m. superhets and fault-finding on Hi-Fi systems.

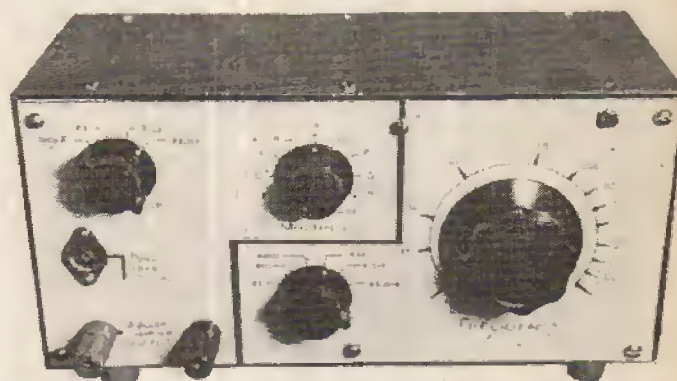
It is written by G. J. King and H. W. Hellyer, authors of previous popular series on servicing. Be certain not to miss the start of this new series.

AUDIO FANS ARE NOT FORGOTTEN IN THE NEXT ISSUE AND A 10W TRANSISTORISED AMPLIFIER INCLUDING PREAMP. IS DESCRIBED.

MANY OTHER ARTICLES INCLUDE THE POPULAR "TAKE 20" AND "I.C. OF THE MONTH" SERIES.

BE SURE NOT TO MISS THE MAY ISSUE—ON SALE APRIL 8th. PRICE 20p.

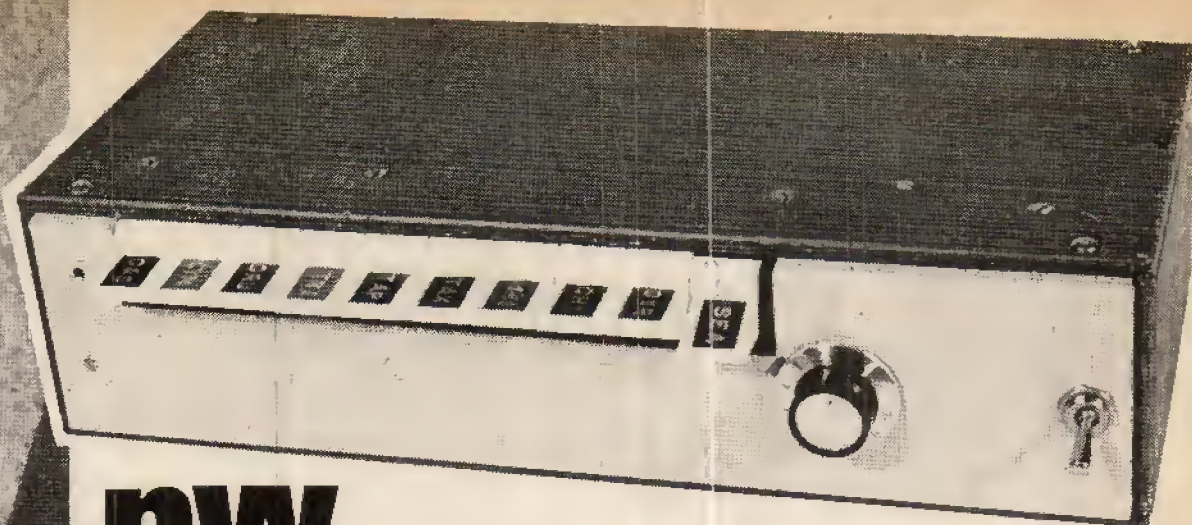
hi-fi SIGNAL GENERATOR



The high standards of modern audio amplifiers have made many older audio signal generators obsolete; it is obviously a waste of time trying to trace 0.1% distortion if the inherent distortion of the source is comparable.

Confidence in test gear is important and for this reason, starting in the May issue, the circuit and complete building instructions are given for a laboratory quality signal generator. Distortion at 1kHz is a mere 0.01% and output ranges run from 15Hz to 150kHz $\pm$ 1dB though an additional range goes up to 1.5MHz.

Output can be up to 12V peak-to-peak and either sine or square wave outputs can be selected.



pw sound effects SYNTHESISER

PART 2

THE general layout of the complete unit and the circuits for castanets, cymbal and snare drum were dealt with in Part 1. With the exception of the Bell Chime circuit, all the others can be constructed and operated individually as each has a fairly large signal output. If all the generators are to be used together i.e., as in the original unit, they must be finally connected together via a mixing output pre-amplifier which will be dealt with later.

The next circuits include the Triangle No. 4, Wood Block No. 5, Taxi horn No. 6, Train Whistle No. 7 and Bell Chime No. 8 and each is assembled on an s.r.b.p. board as those in part 1. As will be seen from the board layout diagrams given in this article, some boards are pretty full with components. For this reason the components used should be as physically small as possible.

Circuit for Triangle—No. 4

The sound of a triangle is clear and high pitched and the waveform almost sinusoidal. The circuit as in Fig. 11 therefore, employs a phase shift oscillator adjusted for a frequency of approximately 4500Hz. The output from the oscillator Tr1 is first attenuated via R21 and then taken to the control amplifier Tr3. This amplifier is triggered by Tr2 which generates a control voltage waveform as shown in the Triangle Circuit waveform B Fig. 21. When the key No. 4 is closed a pulse (Triangle Circuit waveform A) is generated which causes Tr2 to conduct. This brings the emitter of Tr2 almost up to the supply voltage and C9 becomes charged. Tr3 takes it's h.t. from C9 which then slowly discharges and produces the required decay effect. The sine-wave output from Tr1, although considerably attenuated, does slightly overdrive Tr3 and this helps to provide the characteristic metallic sound of a triangle. Note that the key click filter C7/R9 must be included. The resistor R14 in series with C9 reduces the otherwise very hard attack and C9 itself determines the decay time. If C9 is made larger the decay time will be larger and vice versa. The pitch should be adjusted as close as possible to 4500Hz and this can be done by either reducing the value of R1 slightly or by connecting another resistor in parallel as R1A. The circuit board layout is shown in Fig. 12.

Circuit for Wood Block—No. 5

This is a little less complicated than the other circuits and employs only two transistors. The circuit is shown in Fig. 13 and in this Tr1 is a phase shift oscillator biased to cut off and is turned on only when Tr2 conducts i.e., when the key (No. 5) is closed. The pitch and decay time are both very important if a realistic sound is to be produced. For instance, if the

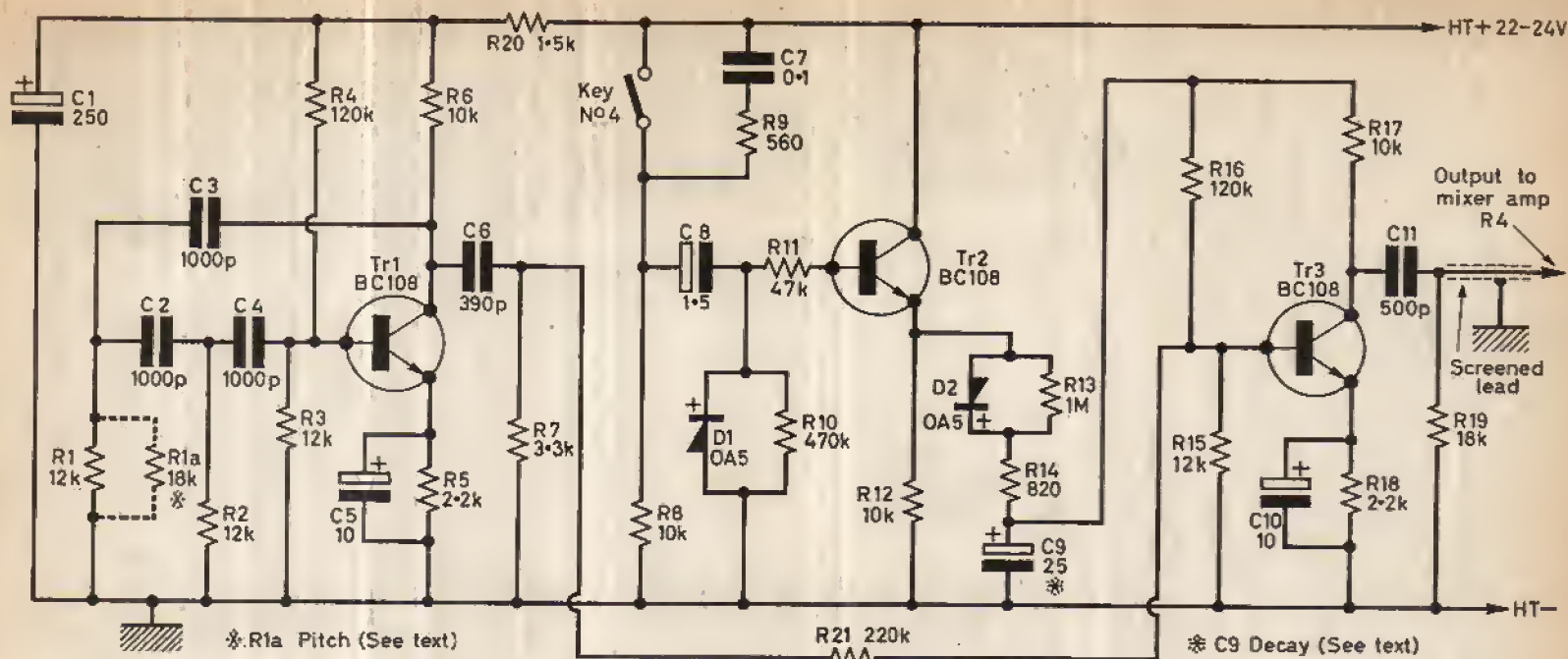


Fig. 11: The circuit of the triangle sound synthesiser.

decay time is too long the sound will be too much like a bell and if too short will sound like a click. Some adjustment of R9 may be necessary to achieve the right period of decay. Pitch can be altered by slight variation of R1 which is nominally 8.2k Ω . Adjustment of both decay time and pitch rather depends on aural estimation of the sound. The strike and decay control voltage and output waveforms are shown in Fig. 21. (Wood-block Circuit waveforms A and B respectively.) The circuit board layout is shown in Fig. 14.

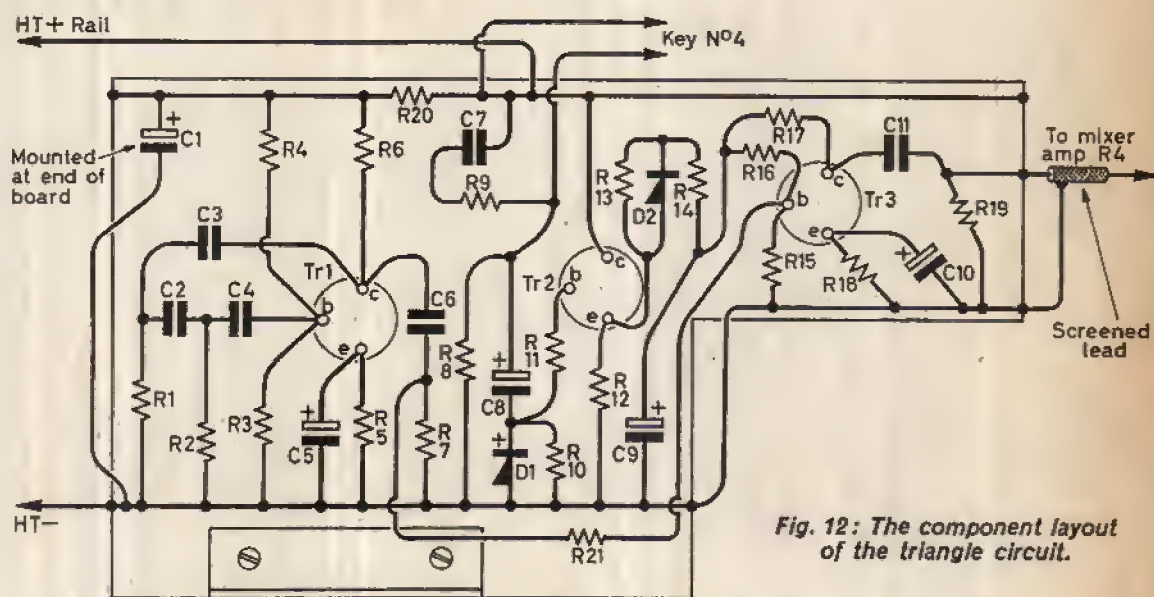


Fig. 12: The component layout of the triangle circuit.

Circuit for Taxi Horn—No. 6

This is another of the more complex circuits and employs four transistors as shown in Fig. 15. First however, note that the signal from the multi-vibrator

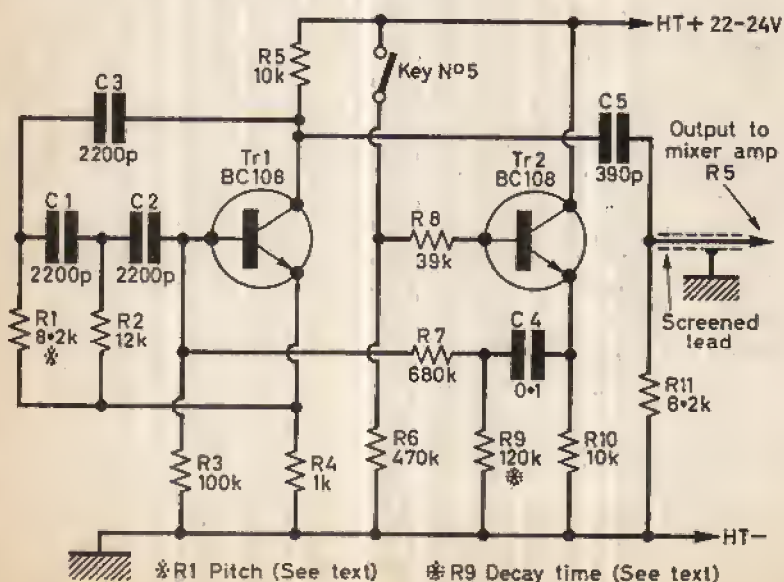
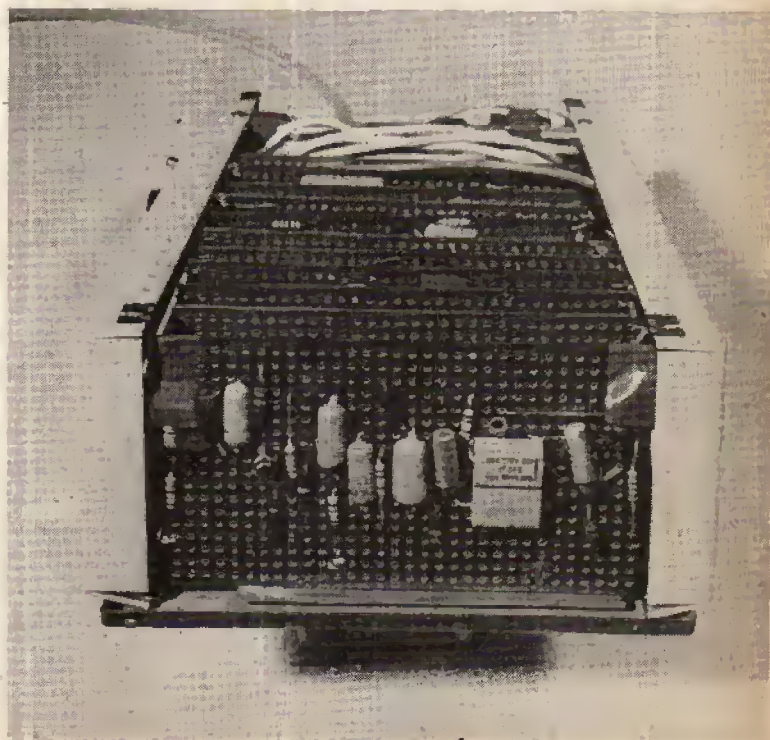


Fig. 13: The wood block sound circuit.



An internal view of the completed project. The board shown is for the castanets circuit.

[illegible]

Fig. 14: The component layout of the wood block synthesiser.

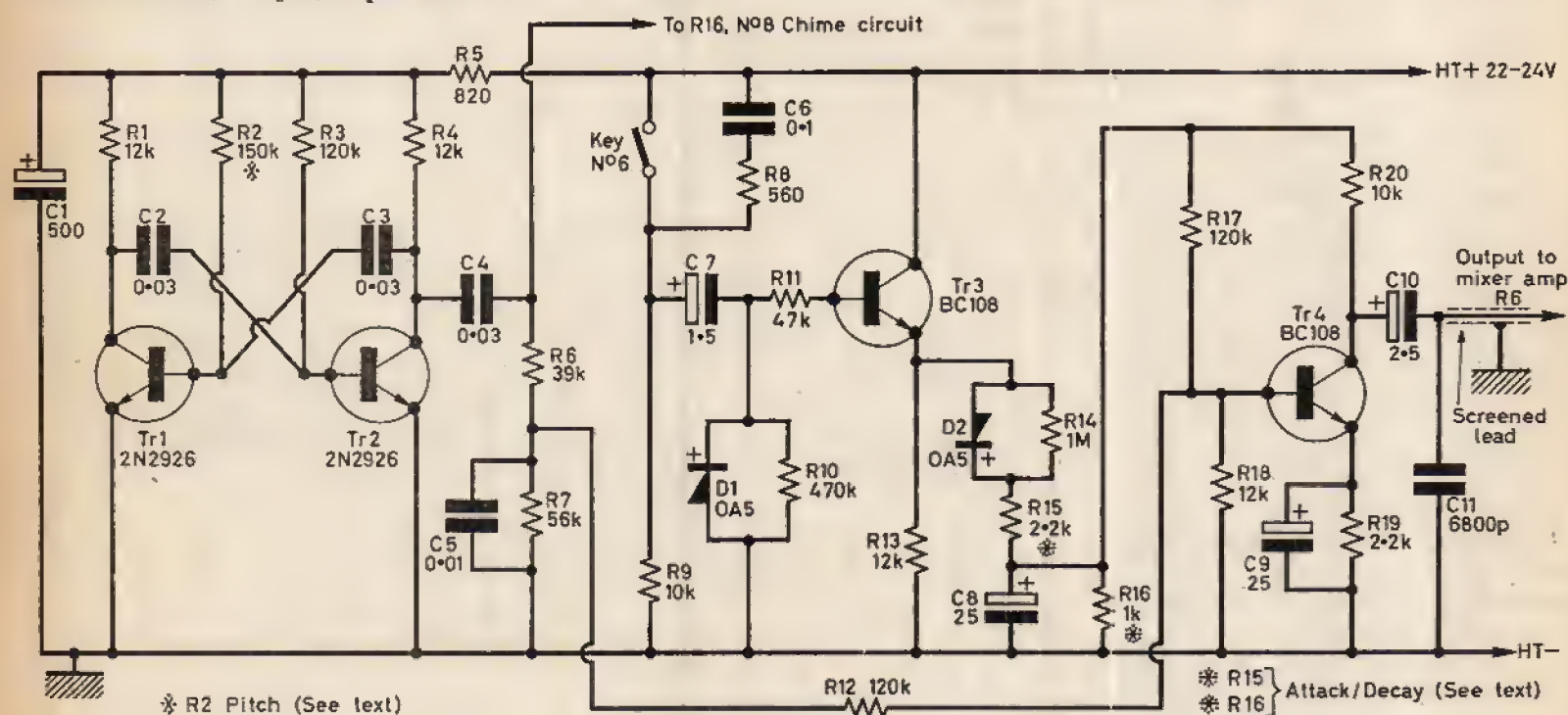


Fig. 15: The taxi horn sound synthesiser circuit. The various waveforms produced are shown in Fig. 21.

HT+ Rail

Key No 6

Output to mixer amp R6

Screened lead

HT-

Mounted at end of board

To R16 No 8 Chime circuit

Circuit for Train Whistle— No. 7

Two transistors and a noise diode type Z1J are required for this circuit as shown in Fig. 17 and which produces a typical steam train whistle complete with noise content and pitch

Fig. 16: The component layout of the taxi horn sound synthesiser.

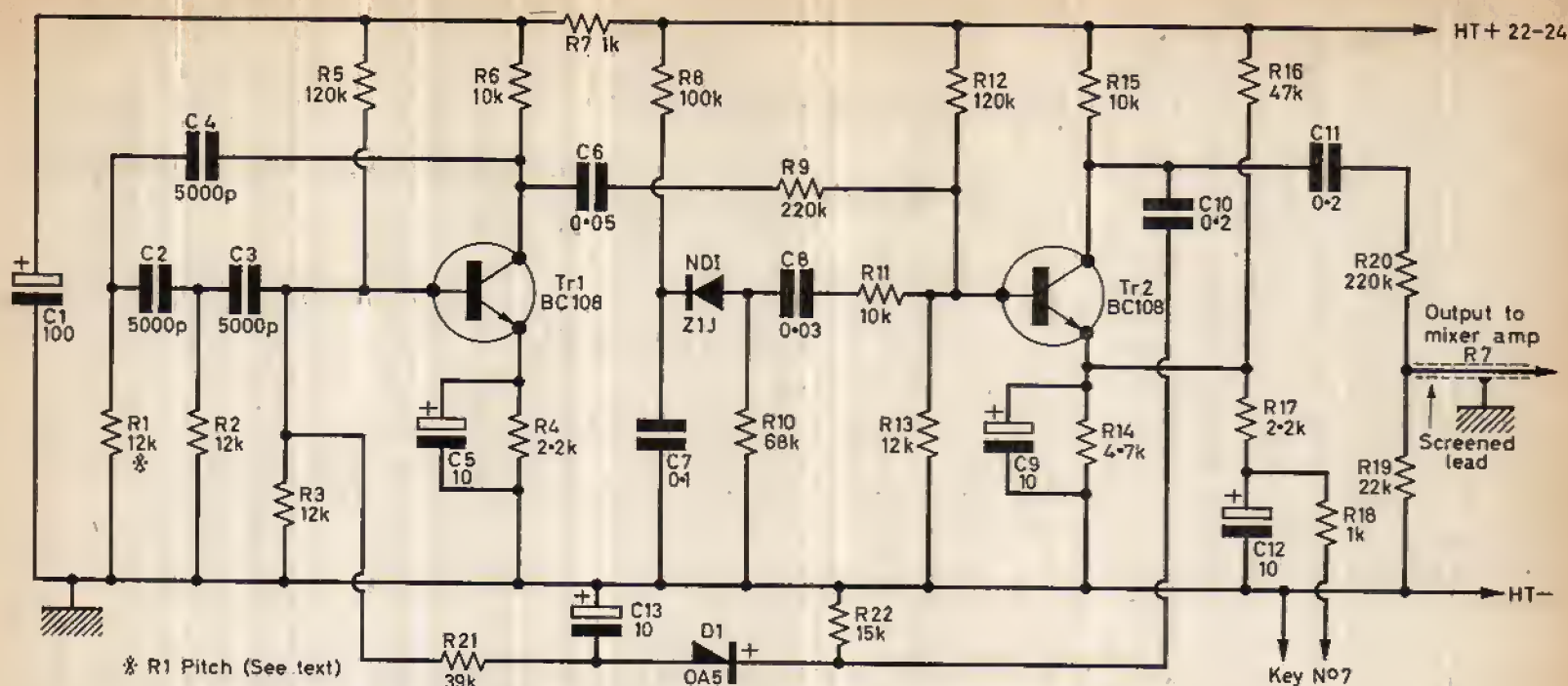


Fig. 17: The circuit used for simulating the train whistle sound.

variation. The transistor Tr1 is a phase shift oscillator, the output of which is attenuated via R9. The pitch should be approximately 1000Hz and adjustment to attain this can be made by slight variation of R1. The noise generator ND1 is the same as used for the cymbal and snare drum circuits and its output is slightly attenuated by R11. The transistor Tr2 takes the signal from Tr1 and ND1 simultaneously but is normally biased to cut off by R14/R16. When key No. 7 is depressed Tr2 conducts and passes the combined sine-wave and noise signals. However the signal output from Tr2 is also directed via C10 to the diode rectifier circuit R22, D1

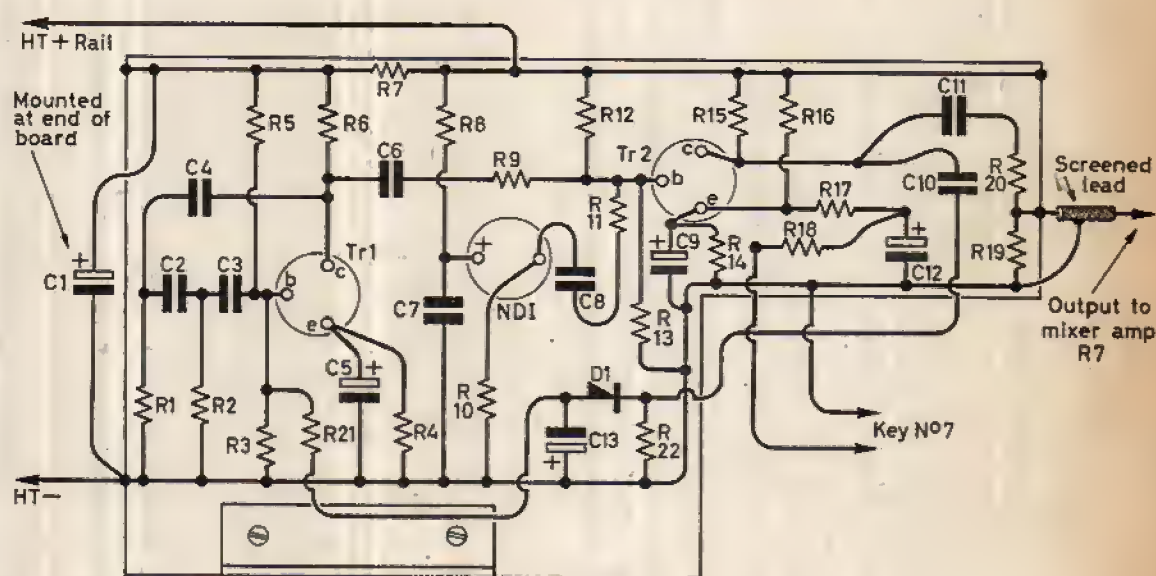


Fig. 18: The component layout for the circuit in Fig. 17, the train whistle synthesiser.

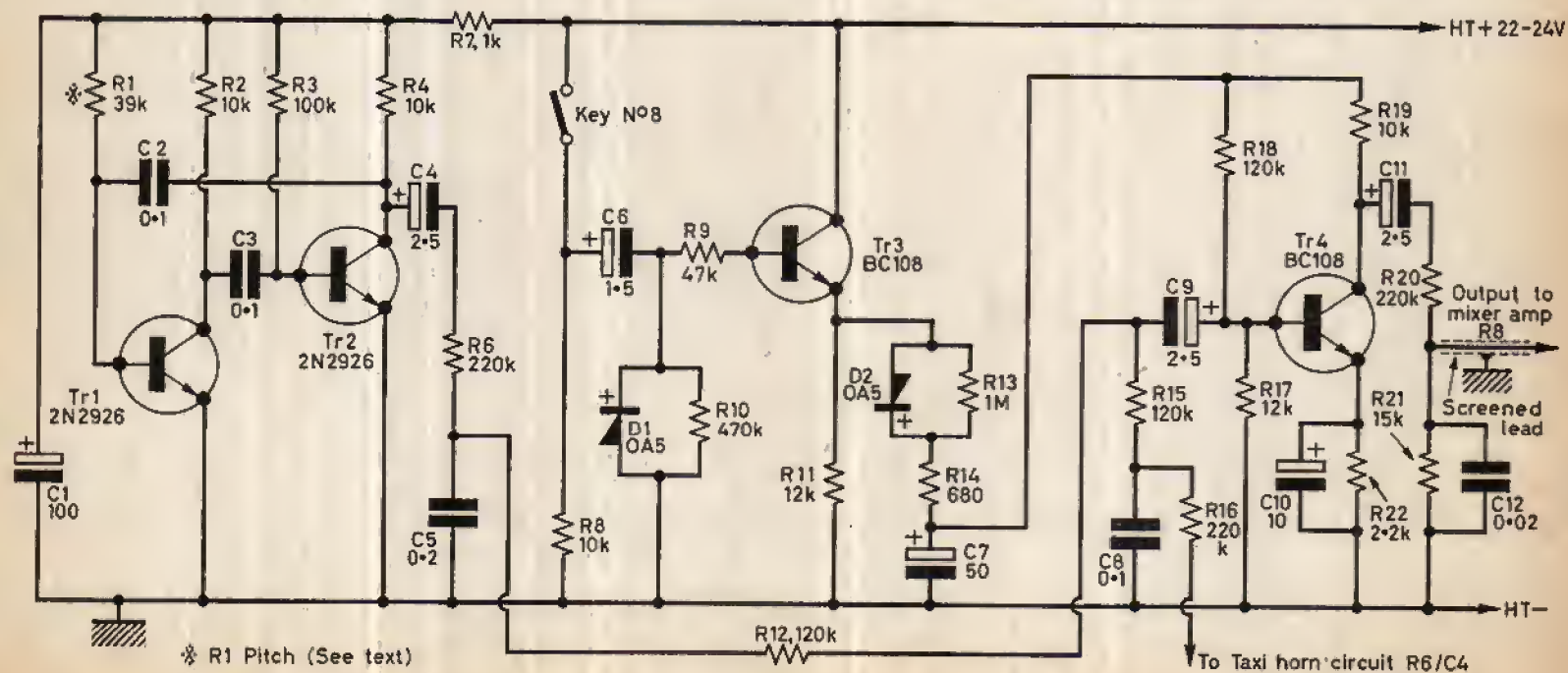


Fig. 19: The bell chime synthesiser. The waveforms of the various stages are shown in Fig. 21.

and C13. The negative voltage derived from this via R21 is applied to the base of Tr1 and produces a slight change in the pitch of the whistle frequency a fraction of a second after its initial sound. It is however, important that the white noise content of the whistle is not too great. The effect, which is that of hissing steam, should be only just apparent and should appear on the output waveform as shown in Fig. 21. (Train Whistle waveform B.) The output waveform should also appear slightly clipped at the top. Adjustment to the level of the white noise content can be made by altering the value of R1 slightly i.e., increase

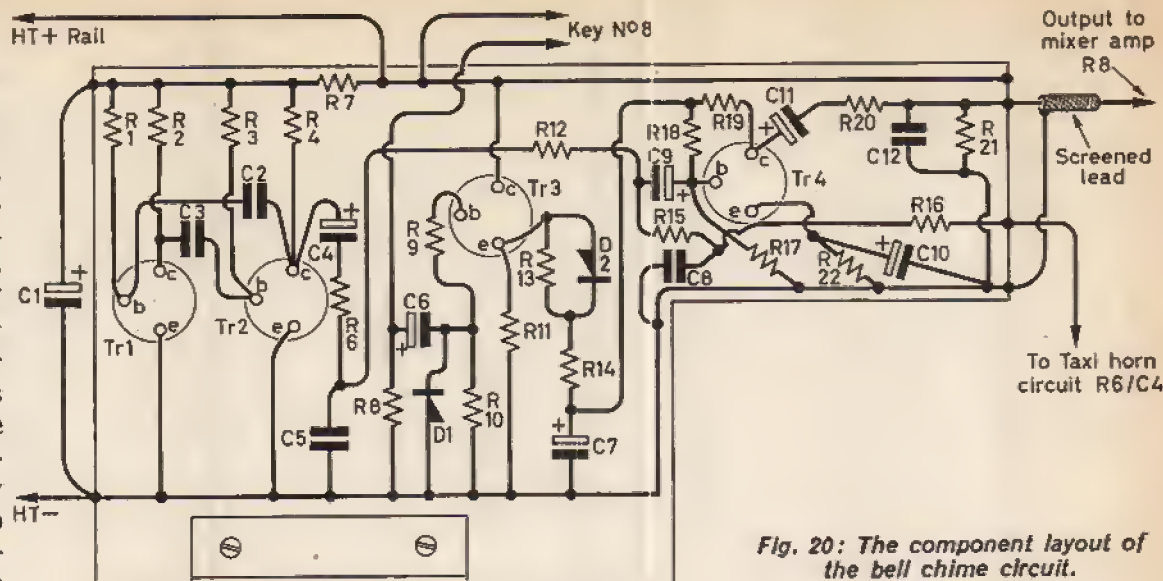
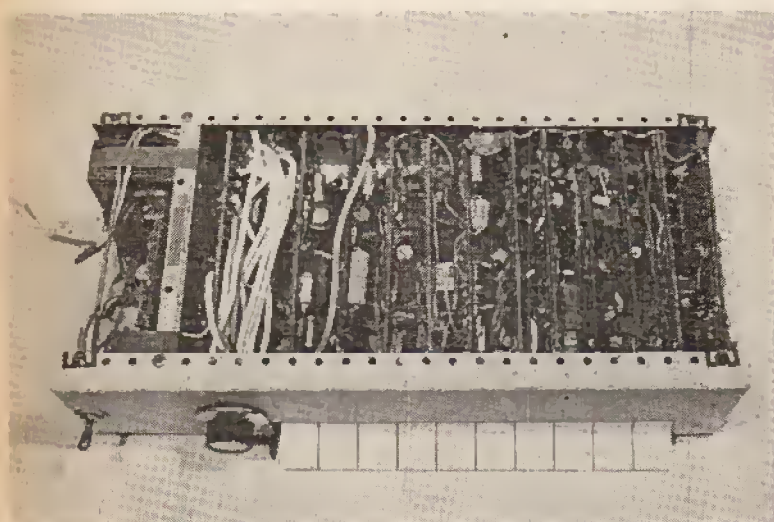


Fig. 20: The component layout of the bell chime circuit.



The various boards are shown at the centre and right, the power supply on the left.

R11 for a decrease in noise content and vice versa. The circuit board layout is given in Fig. 18.

Bell Chime Circuit—No. 8

A deep bell chime, similar to that produced by a large clock for instance, is a complex sound made up of an undulating fundamental and many overtones. To achieve a close approximation of this without having to resort to the use of filters and/or a number of tone generators, a multivibrator has been used for the fundamental pitch and overtones. A strong beating or undulating effect is produced by adding another signal at almost the same frequency as the fundamental. This extra signal is obtained from the taxi horn oscillator. The harmonics of this also add considerably to those produced by the bell chime oscillator and the result, after suitable attenuation and 'voicing,' is a deep undulating but strident clock chime. The triggering circuit for the bell chime is produced by Tr3 which is switched on by key No. 8. The action of the circuit is the same as that used for the cymbal and triangle circuits and the decay time about the same i.e., two to three seconds. The output from the bell chime oscillator Tr1-Tr2 is voiced by R6/C5 and attenuated

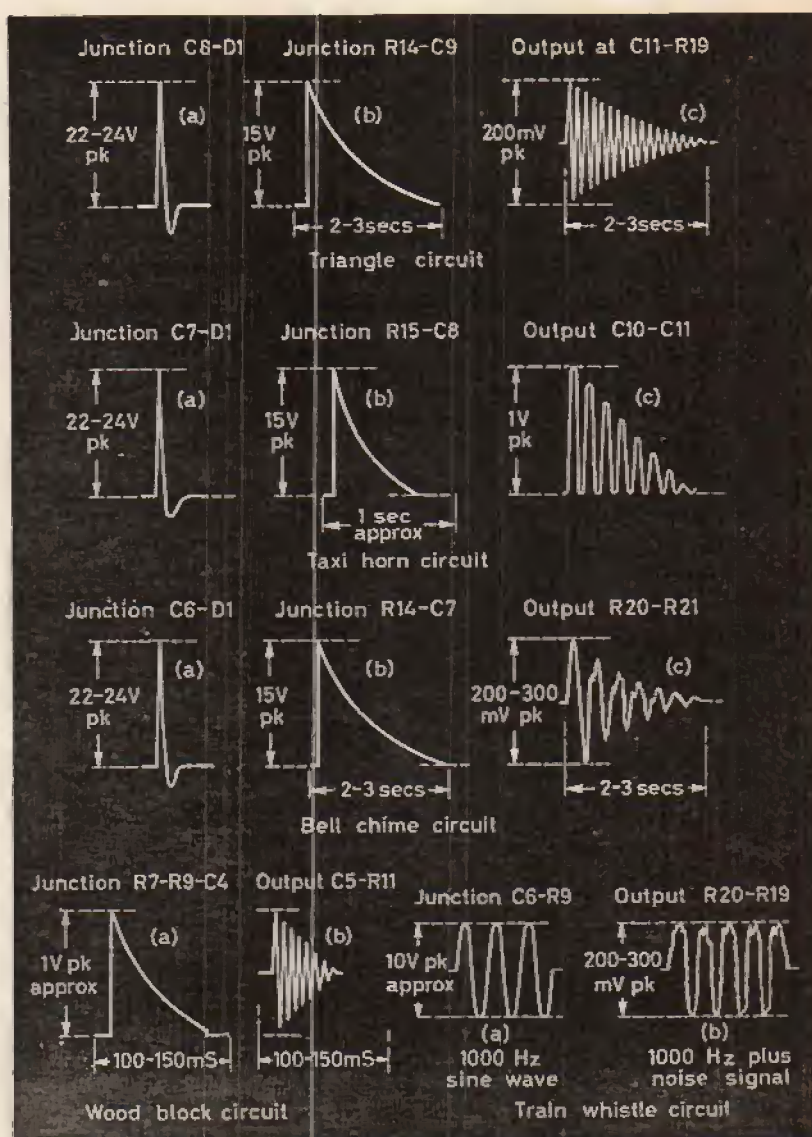


Fig. 21: The waveforms produced by the circuits described in Part 2. If possible these should be checked on an oscilloscope.

by R12. The signal from the taxi horn oscillator is treated in much the same way by R16, C8 and R15. Both signals are fed to the base of Tr4. Further attenuation and voicing is introduced at the output from Tr4. The frequency of the signal produced by Tr1 and Tr2 should be adjusted by slight variation of R1 so that a slow audible beating effect is obtained when the sound is keyed. Do not alter the pitch of

★ components list—part two

Triangle Circuit No. 4

Transistors

Tr1, Tr2, Tr3 BC108 Mullard

Diodes

D1, D2 OA5 Mullard

Resistors

R1 12k Ω	R8 10k Ω	R15 12k Ω
R1A 18k Ω	R9 560 Ω	R16 120k Ω
R2 12k Ω	R10 470k Ω	R17 10k Ω
R3 12k Ω	R11 47k Ω	R18 2.2k Ω
R4 120k Ω	R12 10k Ω	R19 18k Ω
R5 2.2k Ω	R13 1M Ω	R20 1.5k Ω
R6 10k Ω	R14 820 Ω	R21 220k Ω
R7 3.3k Ω		

All $\frac{1}{4}$ W, 10% tolerance

Capacitors

C1 250 μ F	C7 0.1 μ F
C2 1000pF	C8 1.5 μ F
C3 1000pF	C9 25 μ F
C4 1000pF	C10 10 μ F
C5 10 μ F	C11 500pF
C6 390pF	

Circuit for Woodblock No. 3

Transistors

Tr1, Tr2 BC108 Mullard

Resistors

R1 8.2k Ω	R6 470k Ω
R2 12k Ω	R7 680k Ω
R3 100k Ω	R8 39k Ω
R4 1k Ω	R9 120k Ω
R5 10k Ω	R10 10k Ω

All $\frac{1}{4}$ W, 10% tolerance

Capacitors

C1 2200pF	C4 0.1 μ F
C2 2200pF	C5 390pF
C3 2200pF	

Circuit for Taxi Horn No. 6

Transistors

Tr1, Tr2 2N2926
Tr3, Tr4 BC108 Mullard

Diodes

D1, D2 OA5 Mullard

Resistors

R1 12k Ω	R8 560 Ω	R15 2.2k Ω
R2 150k Ω	R9 10k Ω	R16 1k Ω
R3 120k Ω	R10 470k Ω	R17 120k Ω
R4 12k Ω	R11 47k Ω	R18 12k Ω
R5 820 Ω	R12 120k Ω	R19 2.2k Ω
R6 39k Ω	R13 12k Ω	R20 10k Ω
R7 56k Ω	R14 1M Ω	

All $\frac{1}{4}$ W, 10% tolerance

Capacitors

C1 500 μ F	C7 1.5 μ F
C2 0.03 μ F	C8 25 μ F
C3 0.03 μ F	C9 25 μ F
C4 0.03 μ F	C10 2.5 μ F
C5 0.01 μ F	C11 6800pF
C6 0.1 μ F	

Circuit for Train Whistle No. 7

Transistors

Tr1, Tr2 BC108 Mullard
ND1 Noise diode Z1J Semitron (see part 1)
D1 OA5 Mullard

Resistors

R1 12k Ω	R9 220k Ω	R16 47k Ω
R2 12k Ω	R10 68k Ω	R17 2.2k Ω
R3 12k Ω	R11 10k Ω	R18 1k Ω
R4 2.2k Ω	R12 120k Ω	R19 22k Ω
R5 120k Ω	R13 12k Ω	R20 220k Ω
R6 10k Ω	R14 4.7k Ω	R21 39k Ω
R7 1k Ω	R15 10k Ω	R22 15k Ω
R8 100k Ω		

All $\frac{1}{4}$ W, 10% tolerance

Capacitors

C1 100 μ F	C7 0.1 μ F	C13 10 μ F
C2 5000pF	C8 0.03 μ F	
C3 5000pF	C9 10 μ F	
C4 5000pF	C10 0.2 μ F	
C5 10 μ F	C11 0.2 μ F	
C6 0.05 μ F	C12 10 μ F	

Bell Chime Circuit No. 8

Transistors

Tr1, Tr2 2N2926
Tr3, Tr4 BC108 Mullard

Diodes

D1, D2 OA5 Mullard

Resistors $\frac{1}{4}$ watt 10%

R1 39k Ω (see text)	R9 47k Ω	R16 220k Ω
R2 10k Ω	R10 470k Ω	R17 12 Ω
R3 100k Ω	R11 12k Ω	R18 120k Ω
R4 10k Ω	R12 120k Ω	R19 10k Ω
R5 omitted	R13 1M Ω	R20 220k Ω
R6 220k Ω	R14 680 Ω	R21 15k Ω
R7 1k Ω	R15 120k Ω	R22 2.2k Ω
R8 10k Ω		

(Note: R5 omitted due to circuit modification)

All $\frac{1}{4}$ W, 10% tolerance

Capacitors

C1 100 μ F	C7 50 μ F
C2 0.1 μ F	C8 0.1 μ F
C3 0.1 μ F	C9 2.5 μ F
C4 2.5 μ F	C10 10 μ F
C5 0.2 μ F	C11 2.5 μ F
C6 0.5 μ F	C12 0.02 μ F

the taxi horn circuit which should have been adjusted to between 200 and 250Hz. The pitch of the bell chime oscillator is best adjusted by substituting R1 with a variable of say 100k Ω in series with a fixed resistor of not less than 18k Ω , to prevent the base of Tr1 being taken straight to h.t.+. Pitch should then be adjusted until it is very

close to that of the taxi horn oscillator frequency i.e., until a slow beat becomes audible. Check the amount of resistance in circuit and replace with an appropriate value fixed resistor. It might be better to replace R1 completely with a small pre-set of say 50k Ω in series with a fixed resistor of 18k Ω . Again the effectiveness of the sound is best

judged aurally but the output waveform, if displayed on an oscilloscope, should appear complex and with considerable fluctuation in the amplitude of the harmonics. The triggering and output waveforms are shown in Fig. 21 (Bell Chime circuit waveforms A, B and C.) The circuit board layout is shown in Fig. 20.

TO BE CONTINUED

practically wireless

commentary by HENRY

Tribology

NOT the study of rustic man, not a thesis on triple-ended anchorites, nor even a discourse on moonrock. Tribology is a word coined by the ball and roller bearing people, to mean the study of inter-acting surfaces in motion.

Passing lightly over the thought that some tribal rites, like "Top of the Pops," and the "Rolf Harris Show," would give Tribologists something to study, we nod sagely in the direction of the scientists and hark back to a reference we made when talking about headphones—computer-aided-design.

The thought is inspired by the news that the Science Research Council has given a grant of £9,730 to Bath University to further Dr. A. W. Keen's "Computer-Graphics-Aided Synthesis of Electronic Signal Processing Circuits. C.A.D. for short.

Down there in rural Bath, they argue that circuit design has "grown to the point where engineers tend to collect standard circuits from which they can draw when they are designing." Doctors Whipp and Martin, two lecturers on Dr. Keen's team, nod towards the increasing number of devices such as transistors used in instrument circuits and the growing need for some method which will allow not only the selection and assembly of standard circuits but also the automatic generation of new electronic circuit systems for a desired application.



Some tribal rites

Now that's a thought! Toss into the system for /50 computer—no, I am wrong, with the aid of this grant these lads hope to further their researches with a PDP 8 E complete with graphic display, early this year—well, toss an idea in SOMEWHERE, and what comes out? A completely packaged, plastic-clad, printed circuit, ergonomically engineered, probably deep-frozen to lock in the flavour of the multi-million bits.

Beautiful, shiny, perfectly concocted—but as neutral as a conscientious umpire. Bring in the tribological ergonomists and individuality flies out of the window! However, gone will be the kinky boards that could only be the dream-children of the Superstar factory, the panels from Messrs. Busbox with more lines to the inch than a miniature orchestral score; vanished those flexible, flimsy, finicky efforts that come from the Yoshi-Toshi Company. Disappeared like yesteryear's wiring harnesses, all dull colours and knotted string and bent as precise as the kink in a drill sergeants moustache. Declining like those dinky glass bottles with their warm and friendly glow...

Forgive an old engineer. Allow me to wipe away a nostalgic tear. The thought of some of our lost specialities makes me sad. The evocative whiff of burning transformers brings back memories and the pungency of toasted selenium is a haunting signpost to the days when apprentices listened when spoken to, customers put us on a par with the rent collector and a crossover was some form of token.

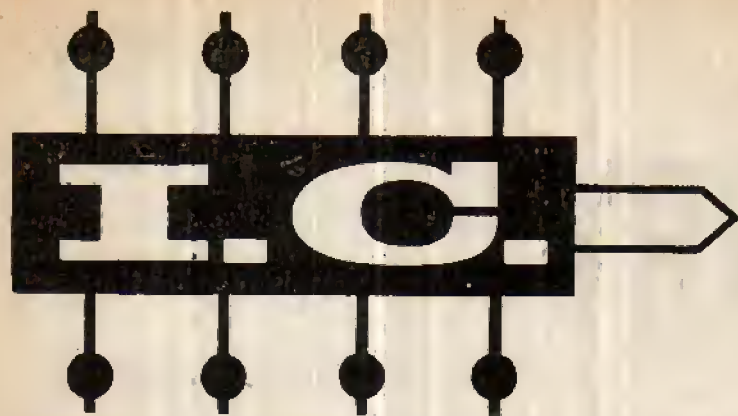
But although the keen Dr. Whipp or the whippy Dr. Keen would have us banish even more of the character that remains in radio, even though they would have "wireless" mean what it says, Henry suspects that the immutable obtuseness of the average computer will defeat them. To judge by our electricity bills, demands of the telephone company and the current computerised



Disappeared like yesteryear's wiring harnesses.

identity by which our friendly neighbourhood bank manager knows us, all that CAD will cough up for the boys of Bath is a row of inscrutable dots. Rationalising of circuitry is all very well, the aim to restrict the prolific growth of semiconductor devices is very commendable, but we suspect that the ultimate result will be to add a number of new integrated circuits to an already bewildering list. Take a look at some of those tuner amplifiers which already feature i.c.'s. Their overall circuitry is as complicated as before, their designer has taken advantage of a new device to extend his ideas within a certain budget. He could do even more with building brick circuits. Imagine the complexity that Bodgit & Co could produce from a handful of i.c.'s and some of the Bath-bricks, a bunch of wires and some presets. The trouble is that for every beautiful computerised block that condenses the Bath team's ideas there will have to be twenty modified versions to suit individual requirements or circuit designers.

And that's the trouble—there will have to be a bit off here and a bit off there until the poor old computer won't know what to disgorge. Computers are notoriously single minded. Those whip-keen laddies at Bath have been talking to computers so long that they think all designs can be divided into logical boxes. They should take a look at some of the articles for *Practical Wireless* that the Editor dares not publish.



OF THE MONTH

L.A.J. IRELAND

Number 18

Digital Counting and Display Devices

THIS month's article deals with a rather unusual topic in that we confine ourselves to the digital i.c. field which so far has not been considered in the present series. Yet the greatest advance in i.c. technology is being made in this field so that today relatively cheap m.s.i. (medium scale integration) circuits are on offer by many manufacturers making it possible for the amateur to construct low cost digital readout and counting circuits with a wide variety of uses.

It may appear at first approach that there are few possibilities of interest in this field. Indeed due to the inherent cost of constructing equipment using discrete components it was well beyond the range of the average constructor but once again mass production coupled with the mastering of m.s.i. technology has completely changed the picture.

Very compact decade counters can be built for less than £5 per decade which compares very favourably with the old dekatron units which proved very popular for any pulse counting requirements. In fact a maximum counting speed of around 20kHz was usually associated with such tubes whereas today there is little difficulty producing counting speeds in excess of 20MHz with t.t.l. logic circuits.

Within the SN74 series of i.c.'s are decade counters and decoder drivers. Two approaches are possible here depending on the type of display output required. One incorporates a cold cathode neon type tube using a common anode with ten separate cathodes formed in the shape of the 0-9 numerals and stacked behind one another.

An input pin is required for each cathode which in turn is usually connected to a decimal decoder circuit. Even though the gas filled readout tube may require around 200 volts for satisfactory operation, it is not necessary that the driver transistors be capable of withstanding this potential as the anode resistor will automatically reduce the voltage and limit the current through the driver transistors. Thus any transistor with a collector to emitter breakdown voltage around 60 volts will work quite well.

A complete decade counter using the new Bi-Pak SN series is shown in Fig. 1. Due to the complexity of the decoder and driver circuits only the logic symbols for the various units are illustrated and the amateur will have to get used to the black box approach to complex i.c. circuits as it would be virtually impossible to follow literally the hundreds of transistors and associated passive components in the present design.

One drawback of the above system is the high voltage required for the readout tube which neces-

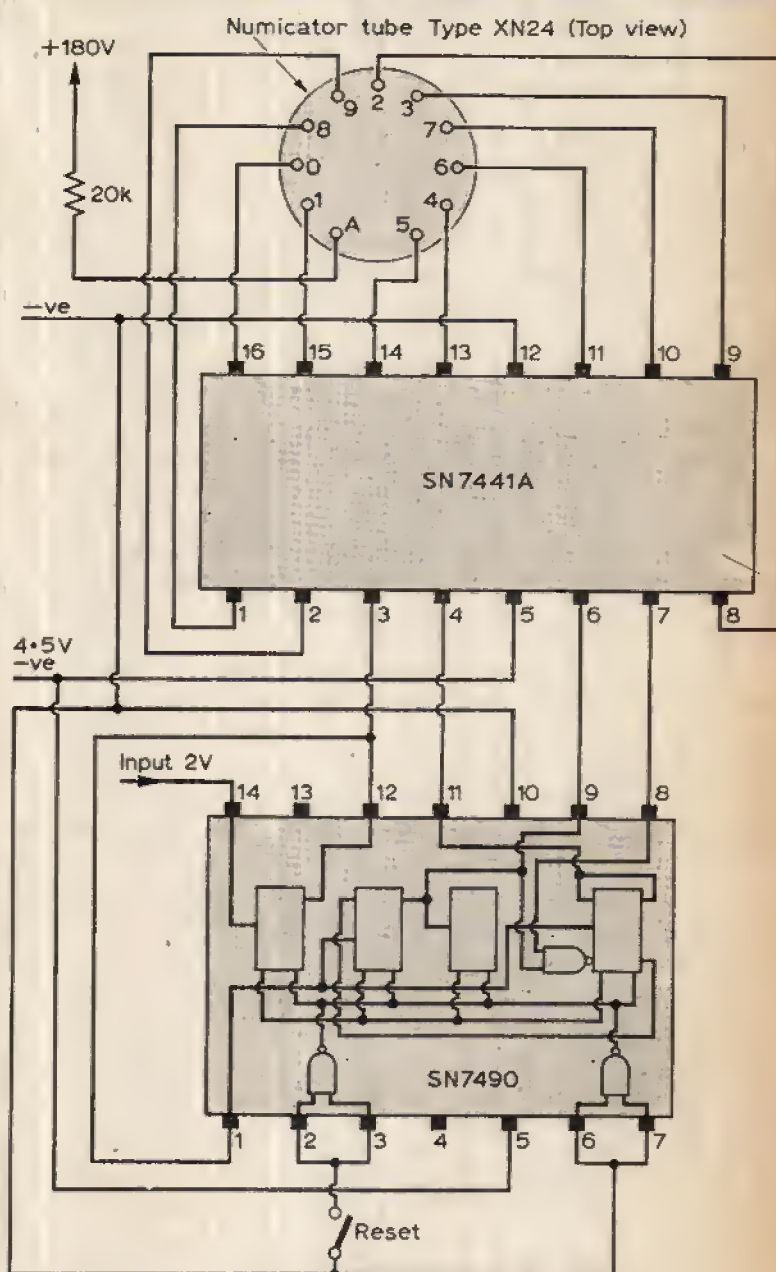


Fig. 1: A complete decade counter using the new Bi-Pak SN series.

sitates the use of some form of inverter if the unit is to be put to portable use. A more modern approach therefore to digital readout is the low voltage filament type of segmented tube consisting of seven independent strip filaments arranged in a figure eight pattern.

Any numeral between 0-9 can be found by illuminating the required segments. In fact eleven alphabet letters can also be created so to an extent the tube can be made to function as a limited alpha-numeric

display device with suitable decoding circuits. In the present design consideration will be given to the RCA numitron type DR2000.

The same decade counter with b.c.d. (Binary Coded Decimal) outputs as used in the first design will function here but a different decoding circuit is

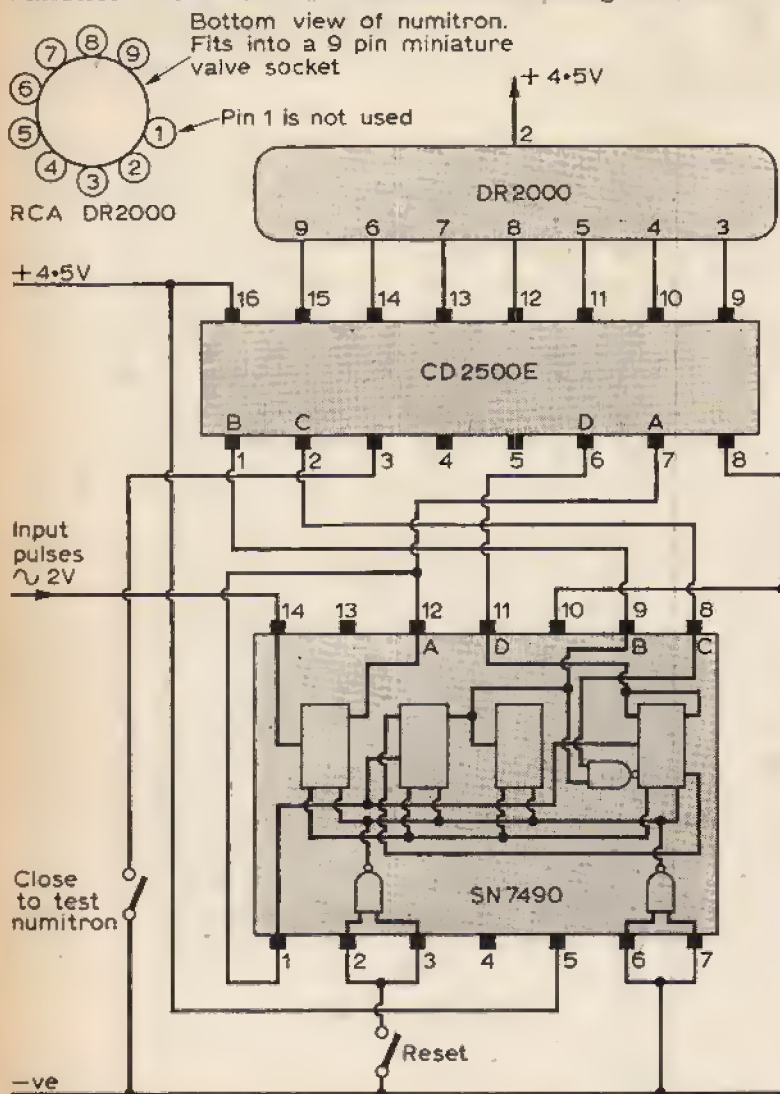


Fig. 2: Shows the interconnections of the units using the CD2500E decoder.

required. Whereas in the previous design a separate pin was needed for each numeral, here only seven are required and a b.c.d. to seven segment decoder is used—RCA type CD2500E.

Once again the complexity of the internal circuitry of this i.c. makes it impractical to draw so Fig. 2 shows the interconnections of the complete unit. A suitable printed circuit board pattern should not prove too difficult for the competent constructor and use could profitably be made of the new dual-in-line mounts advertised by some firms in this magazine. In addition to providing easy insertion and removal of the i.c.'s they also prevent damage to the i.c.'s from excessive heat in the soldering process.

Needless to say, numerous uses can be visualised for these counters. The 50Hz mains can be used as a frequency standard to make an accurate interval timer when coupled through an AND gate to the counter. Also interruptions in a beam of light or pulses from a geiger tube to determine the activity of a radioactive sample can be counted.

A very welcome development related to this field is the drop in prices of the new Gallium Arsenide solid state light emitting diodes. Single devices of this type can now be purchased for around £1.50. With no filament to worry about they are exceptionally robust and have an exceedingly long life span. Arrays using upwards of fifty of these arrayed in a 5 x 10 rectangular matrix are used in many alpha numeric readout systems and recently the first all electronic solid state wrist watch with digital readout has been released in the U.S. using four of these arrays. If the present trend continues they will certainly offer fascinating possibilities for the home constructor in the not too distant future.

IC type SN7441A and SN7490 are available from Bi-Pak Semiconductors.

IC type CD2500E and numitron DR2000 are available from:—Roberts Electronics Ltd., Hermitage Road, Hitchin, Herts.

Hivac Numicator type XN24 available from:—Hivac Ltd., Ruislip, Middlesex.

DECCA 3000 HI-FI SYSTEM WON BY BRISTOL READER OF 25 YEARS STANDING

A reader of Practical Wireless for 25 years has won the Decca Hi-Fi System Competition which was featured in our November Issue. He is Mr. Dyke of Bristol. At a recent lunch held by I.P.C. Magazines to congratulate Mr. Dyke, it was revealed that he had taken to reading the magazine after the excellent results he had found with a home-built 2-valve radio designed by F. J. Camm, an earlier Editor of P.W.—and he has hardly missed an issue since.

Mr. Dyke is a great fan of "Practically Wireless" by Henry and rates F. G. Rayer amongst his most popular authors. Being an 'old-timer' in the construction game he is also a keen follower of "Going Back".

The entry which secured the Hi-Fi System for Mr. Dyke was: 1-J, 2-K, 3-L, 4-E, 5-A, 6-D, 7-B and 8-C. The entry was the only correct one out of several thousands.

The Hi-Fi System was something Mr. Dyke had wanted for a very long time and it is the first prize of any value that he has ever won!

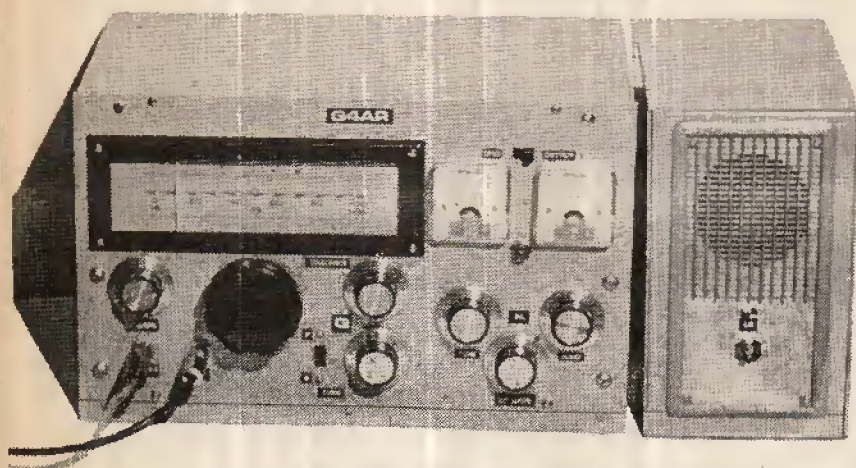


Norman Stevens on the left, Editor of Practical Wireless, congratulates Mr. and Mrs. Dyke on winning the Decca 3000 Hi-Fi System.

'Trojan' Top band Transceiver

ERIC DOWDESWELL
G4AR

PART TWO



Final Assembly When the two circuit boards and the panel are completed as far as is possible they can be fitted to the aluminium framework, shown in Fig. 7, forming the sides and back of the chassis. The back has a hole for the outlet of the power supply cable form and another to allow adjustment of the transmitter mixer anode coil L4. The co-axial aerial socket is the only fitting on the back member.

In practice only the side members were fitted initially the back not being fitted until the transceiver was completed and aligned, the co-axial socket being allowed to float in the meantime. This allowed full access to the chassis, another advantage of this method of construction.

headphone and key jacks. The four switching diodes D3-6 are mounted on a piece of Veroboard and fitted close to the key jack.

The main tuning capacitor VC2 is mounted on a small aluminium bracket across the cutout in the left hand board and a certain amount of "packing" with washers may be found necessary to ensure that the spindle lines up with the tuning drive coupler.

The wiring between the panel components and the boards may now be completed and a general check-over of all the wiring made for short circuits or errors.

Power Supply Unit The circuit of the supply unit, Fig. 3, shows that the transformer T1 provides the h.t., the negative bias for the transmitter and the relay operating voltage as well as the heater supply. On the h.t. side choke input is used in order to improve the regulation and to keep the voltage down to around 270V so avoiding the use of wasteful dropping resistors.

Switch S2 is mounted on the back of the unit and is essential during the alignment procedure for cutting the h.t. to the p.a. The speaker is a 4in. one with a matching transformer T2 and slide switch S3 cuts out the speaker when headphones are being used.

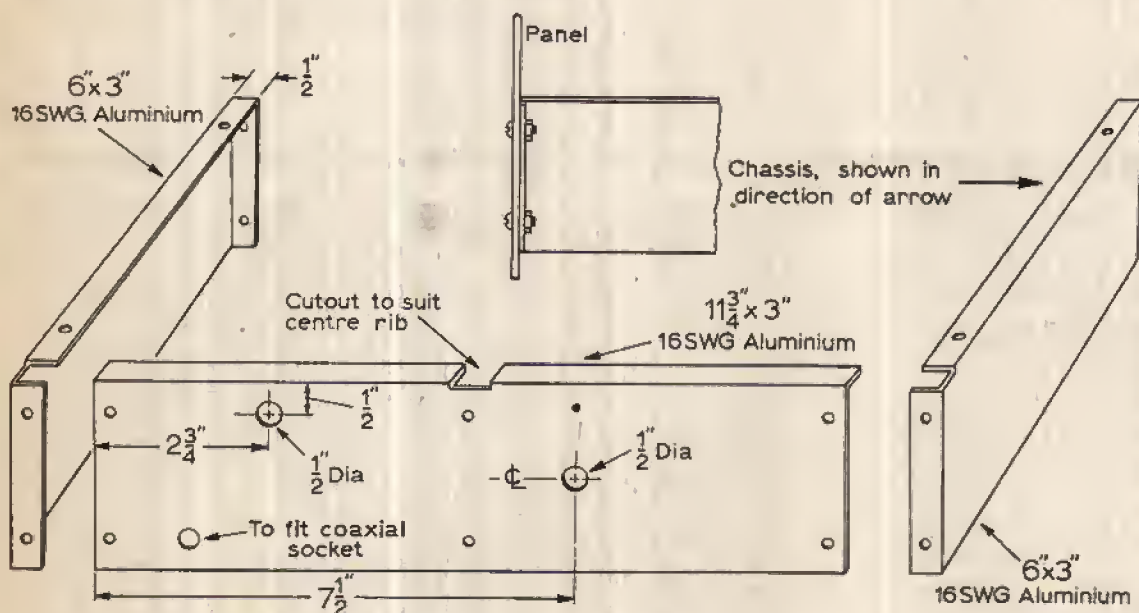


Fig. 7. Exploded view of chassis members. Note that panel extends below the bottom of the chassis, see Fig. 6. Part One. Since the rear member carries only the coaxial socket it can be left off until all wiring and constructional work is completed.

The boards are attached to the chassis with self-tapping screws, two along each edge except at the front. An aluminium bracket supports the two boards at the centre of the chassis and is bolted to the front panel and the back member. This can be seen clearly in the photograph of the underside of the completed transceiver.

The remaining components can now be fitted to the panel, namely the r.f. gain control VR1, Q multiplier tuning capacitor VC4, i.f. gain control VR2 and the

In wiring the two low voltage windings in series regard must be taken of their relative phase to ensure that the voltages are additive and reversing one winding if the relay operating voltage is low. The diodes and resistors are mounted on the bottom of the unit on a piece of Veroboard as can be seen in the photograph of the unit.

The eight leads from the transceiver are taped together and fitted to an octal plug, the leads being about twelve inches long. The receptacle on the power

unit is an ordinary octal valveholder. Note that the earth lead is duplicated to reduce the resistance of this lead.

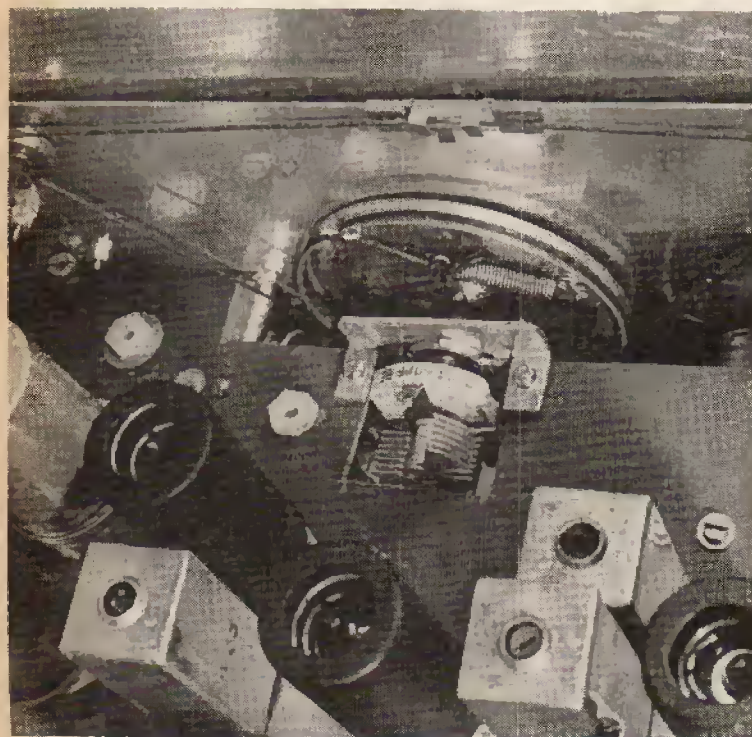
A speaker fret $6\frac{3}{4} \times 3\frac{1}{2}$ in. in grey plastic (G. W. Smith Ltd.) was bolted to the panel of the power unit, part of the fret being cut away as shown in the heading photograph in Part One of this article. The cabinet was finally sprayed with a grey enamel to match the transceiver cabinet and panel.

ALIGNMENT

Before alignment, checks should be made to ensure that the various h.t., bias and heater voltages are approximately correct. Initially the transmitter valves V5, V6 and V7 can be removed. The i.f. gain control is set at half way and the b.f.o. and first oscillator coils L2 and L3 shorted out, as is the diode D2 in the product detector. The Q multiplier valve V8 can also be removed temporarily.

Connect a low reading a.c. voltmeter across the primary of the output transformer via a blocking capacitor of about $0.1\mu\text{F}$. Feed a modulated signal at 465kHz from a signal generator to the grid of the second i.f. amplifier V4 and adjust the cores of i.f.t.3 for maximum output, at all times keeping the signal input as low as possible consistent with a reasonable output meter reading.

Transfer signal to grid of V3 and repeat tuning procedure with i.f.t.2 finally feeding the signal to V2 and peaking i.f.t.1. Without changing the frequency of the input signal on 465kHz switch off its modulation, remove the short circuit from the b.f.o. coil L3 and the diode D2 and tune the core of the b.f.o. coil until a beat note is heard which should be



A close-up of the main tuning mechanism. Note cut-away dial plate to clear potentiometers and mounting bracket for VC2.

adjusted to zero-beat with the input signal.

The next step is to adjust the first oscillator for full coverage of the Top Band, i.e. 1.8 to 2.0MHz. Remove the short circuit from the coil L2 and feed in a modulated signal of 1.8MHz to the grid of the mixer valve V2 again shorting out the b.f.o. coil and the diode D2. With the main tuning capacitor VC2

near to maximum capacity adjust the core of L2 until the signal at 1.8MHz is heard. The oscillator itself should now be on 2265kHz which must be checked with a dip oscillator.

Turn the dial so that the capacitor is near minimum and feed in a signal at 2.0MHz and adjust trimmer TC1 until the signal is heard. These last two steps must be repeated until the required coverage is obtained.

RF Stage With the r.f. gain control about half way feed in a signal to the aerial socket at 1.9MHz and swing the p.a. tuning capacitor VC1a-b remembering that this peaks both the p.a. circuit and the receiver mixer grid circuit. It will be found to peak the 1.9MHz signal at two points on the dial corresponding to these two circuits. Adjust the core of L1 until the two peaks coincide when VC1 will be found to be near maximum capacity.

Q Multiplier The Q multiplier valve V8 can now be replaced. With the receiver working normally choose a quiet spot on the band with no signals and with the Q multiplier tuning control VC4 at mid point and switch S2 in the "peak" position tune the core of L7 until the background noise is at its lowest pitch. The selectivity control VR3 should be set at minimum.

If VR3 is now rotated a point will be reached when the stage will go into oscillation. On tuning in a signal the Q multiplier tuning control can be adjusted to peak the beat note at the same time increasing the selectivity control to just below the point of oscillation.

Without altering the main tuning dial any signal in the passband can be peaked, the maximum selectivity being just about all that any c.w. operator could desire.

With S2 in the "null" position interfering signals can be severely attenuated with the Q multiplier controls.

Transmitter Mixer Valves V5, V6 and V7 may now be replaced. Since the b.f.o. and first oscillator are now on their correct frequencies it is very likely that an indication of grid current will be shown on pressing the key. Switch S1 must be set to read grid current and the h.t. to the p.a. switched off.

The cores of the transmitter mixer and buffer amplifier coils L4 and L5 can now be adjusted to peak the grid current at the centre of the band and should reach around 3mA. Check and double check that the output is on Top Band using an absorption wavemeter.

A dummy load carbon resistor of between 50 and 70 ohms should now be connected to the aerial socket. This resistor should have a power rating of at least 5 watts and may be made up of several higher value resistors in parallel but they must be of carbon and can be mounted on a coaxial plug for convenience.

Turn the p.a. loading capacitor VC3 to maximum and peak signals with the p.a. tuning control. On pressing the key the anode current will be about 45mA and the p.a. tuning should be quickly tuned for a dip in anode current to about 20mA. Decrease the value of the loading capacitor and re-dip the tuning. Repeat this until the dipped value of the anode current is about 35mA. This represents an input of about 10W, the legal maximum on Top Band. Check again that the output is on the correct frequency using the absorption wavemeter.

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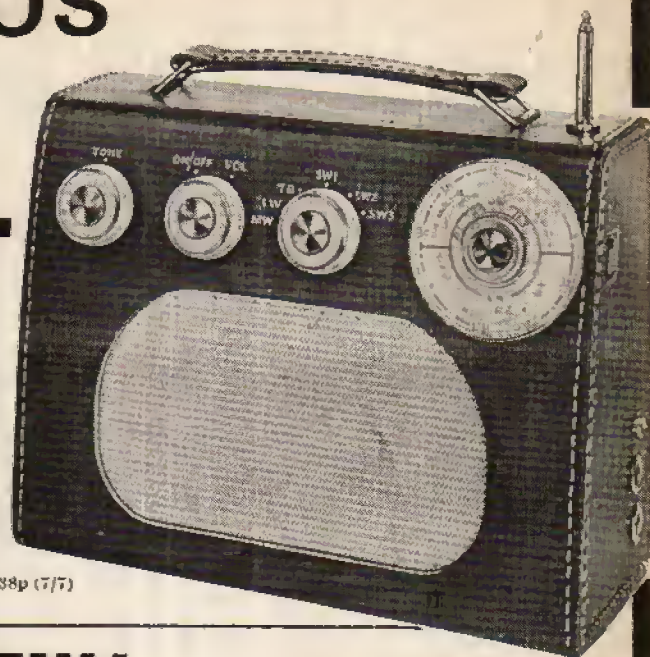
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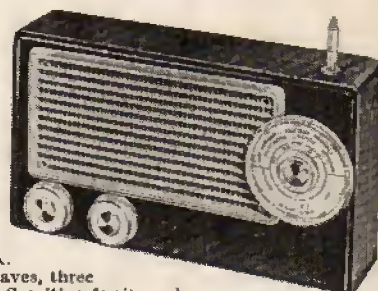
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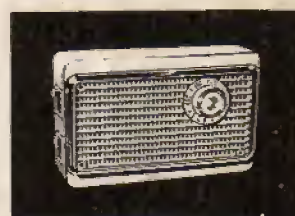


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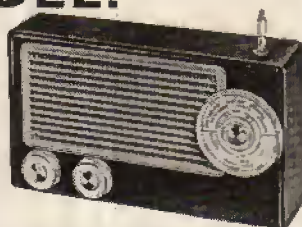
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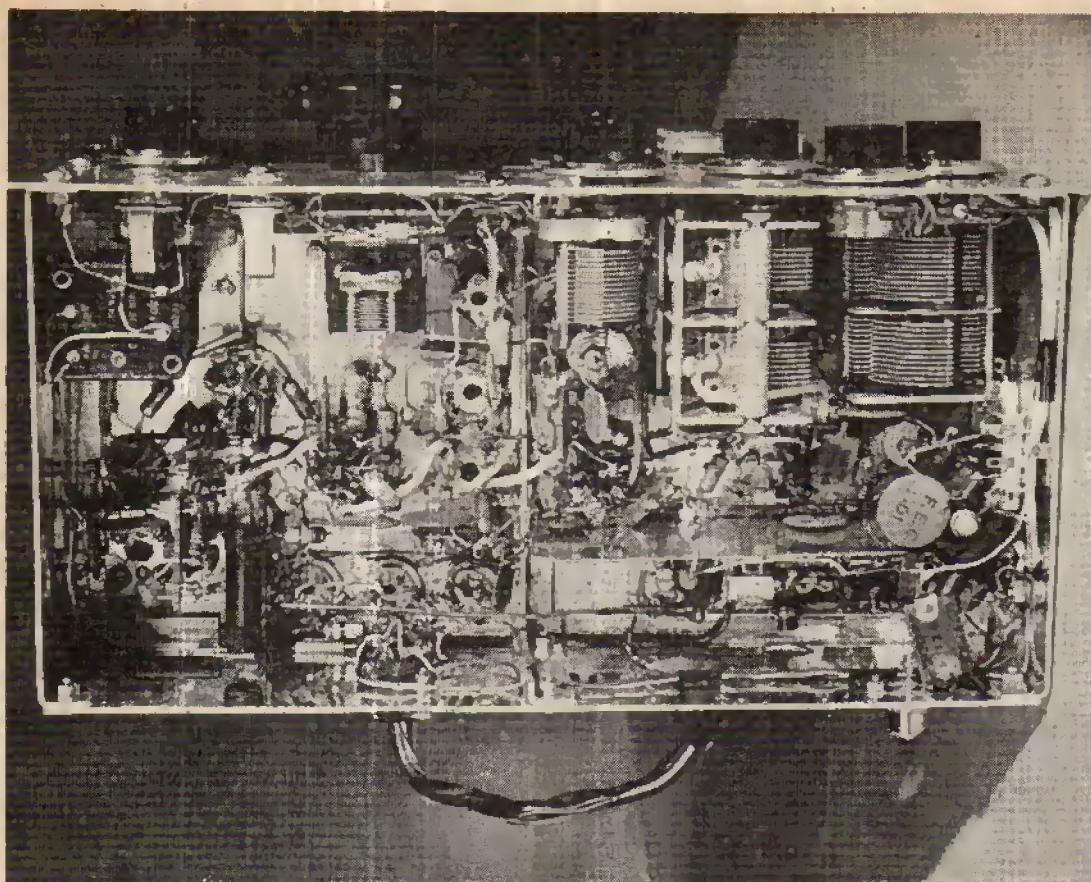
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2N1307	25p	2N3858A	30p	ACY19	25p	BDY28	97p	C111	75p		
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2N1309	30p	2N3859A	32p	ACY21	25p	BDY61	21-25	C425	55p		
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2N2369A	17p	2N5028	57p	AF279	47p	BFX29	30p	MJ481	21-25	OC75	22p
2N2410	42p	2N5029	62p	AF280	62p	BFX30	30p	MJ490	21-00	OC76	22p
2N2433	27p	2N5030	42p	AF211	32p	BFX42	37p	MJ491	21-87	OC77	30p
2N2434	32p	2N5172	12p	AFY26	25p	BFX44	37p	MJ1800	22-17	OC81	20p
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2N2712	25p	2N5265	23-25	AFY86	32p	BFX93A	70p	MPS3639	32p	OC200	37p
2N2713	27p	2N5266	23-75	ASZ20	37p	BFY10	32p	NKT0013	47p	OC201	47p
2N2714	30p	2N5267	23-62	ASZ21	42p	BFY11	42p	NKT124	42p	OC202	62p
2N2865	62p	2N5305	37p	AUX10	21-50	BFY17	22p	NKT125	27p	OC203	42p
2N2904	30p	2N5306	40p	BC107	12p	BFY18	32p	NKT126	27p	OC204	42p
2N2904A	32p	2N5307	37p	BC108	12p	BFY19	32p	NKT128	27p	OC205	62p
2N2905	37p	2N5308	37p	BC109	12p	BFY20	27p	NKT135	27p	OC207	75p
2N2905A	40p	2N5309	62p	BC113	27p	BFY21	42p	NKT137	32p	OC271	42p
2N2906	25p	2N5310	42p	BC115	40	BFY24	45p	NKT210	30p	ORP12	62p
2N2906A	27p	2N5354	27p	BC116A	37p	BFY25	25p	NKT211	30p	ORP41	50p
2N2907	30p	2N5355	27p	BC118	32p	BFY26	20p	NKT212	30p	P346A	22p
2N2923	15p	2N5356	32p	BC121	20p	BFY29	50p	NKT213	30p	T1834	62p
2N2924	15p	2N5365	47p	BC122	20p	BFY30	50p	NKT214	32p	T1843	40p
2N2925	15p	2N5366	32p	BC125	55p	BFY41	50p	NKT215	32p	T1844	12p
2N2926	15p	2N5367	57p	BC126	55p	BFY43	62p	NKT216	37p	T1845	12p
Green	14p	2N5457	37p	BC140	37p	BFY50	22p	NKT217	42p	T1846	12p
Yellow	12p	2N5005	75p	BC147	17p	BFY51	22p	NKT219	30p	T1847	12p
Orange	12p	2N5020	22-00	BC148	12p	BFY52	22p	NKT223	27p	T1848	12p
2N3011	30p	2N5102	50p	BC149	17p	BFY53	17p	NKT224	25p	T1849	12p
2N3014	32p	2N5103	25p	BC152	17p	BFY56A	57p	NKT225	22p	T1850	17p
2N3053	25p	2N5104	25p	BC157	20p	BFY76	30p	NKT229	30p	T1851	12p
2N3054	60p	2N5501	32p	BC158	17p	BFY78	42p	NKT237	85p	T1852	12p
2N3055	75p	2N5502	85p	BC159	20p	BFY77	57p	NKT238	25p	T1853	22p
2N3133	30p	2N5503	27p	BC160	62p	BFY90	67p	NKT240	27p	T1850	22p
2N3134	30p	2N5504	40p	BC167	15p	BFW58	27p	NKT241	27p	T1861	25p
2N3135	25p	2N5505	70p	BC168B	14p	BFW59	25p	NKT242	20p	T1862	27p
2N3136	25p	2N5506	77p	BC168C	15p	BFW60	25p	NKT243	62p	TIP29A	50p
2N3390	25p	2N5507	72p	BC169B	14p	BPX25	21-85	NKT244	17p	TIP30A	60p
2N3391	30p	2N5508	55p	BC169C	15p	BPX29	21-80	NKT245	20p	TIP31A	62p
2N3391A	30p	2N5509	87p	BC170	12p	BPX30	21-45	NKT261	20p	TIP32A	75p
2N3392	17p	2N5510	87p	BC171	15p	BRX39	47p	NKT262	30p	TIP33A	75p
2N3393	15p	R.C.A.	82p	BC172	15p	BRX19	17p	NKT264	20p		
2N3394	15p	40050	85p	BC175	22p	B8X20	17p	NKT271	20p		
2N3402	22p	40251	32p	BC182	12p	B8X21	37p	NKT272	20p		

Post



Below-chassis view of transceiver. The main components may be identified by referring to Fig. 5. Part One. The inner edges of the boards are supported by the aluminium bracket running vertically downwards in the centre of the chassis.

If it is found that the dip in the anode current on transmit does not quite coincide with the position of the p.a. tuning for maximum signals on receive, the transmitter should be carefully tuned and signals then peaked by adjusting the core of the receiver mixer coil L1. This should be done around 1.9MHz when it will be found that the alignment will hold over the whole band.

Once the transceiver has been aligned and the output frequency checked and found correct the r.f. output indicator can be used for tuning up the transmitter.

Final Alignment When the transceiver is working properly in all respects the whole alignment procedure should be repeated and although this may sound quite formidable in fact it takes only a few minutes.

In particular the tuning of i.f.t.1 will have been upset by the addition of the Q multiplier stage.

NOTES

As the finished chassis is a close fit in the cabinet the flanges on the sides of the cabinet must be cut away to provide clearance.

Holes are cut in the back of the cabinet, one to clear the power lead octal plug and the other for the co-axial aerial socket. Chassis cutters of 1½in. and ¾in. respectively were used for this purpose.

Aluminium angle trim was glued to the bottom front edge of the transceiver cabinet and the power supply cabinet, as a finishing touch, as well as to lift up the fronts of the units from the table. Conventional rubber or plastic feet can also be used to achieve the same effect.

Letraset was used to make up labels for identifying the various panel controls, switches etc.

If the receiver only is required there is no reason why this part of the transceiver should not form a project on its own. In this case the cathode returns of the r.f. stages should be returned to earth and the p.a. coil L6 replaced by a Denco Range 3 aerial coil.

The transmitter portion of the transceiver can be utilised on its own by feeding outputs from the first oscillator and the b.f.o. of a Top Band receiver into the transmitter mixer valve V5. Remember that any interference with these oscillators will affect their calibration. Other arrangements would have to be made for the changeover from receiver to transmit.

Although a higher voltage on the p.a. would be desirable from the point of view of efficiency by using a capacity input filter in the power supply it was decided to stick to choke input for the better voltage regulation that it provides.

The importance of using a calibrated absorption wavemeter for checking the transmitter output cannot be too highly stressed. It must be remembered that the r.f. output indicator will respond to any r.f. output including any spurs which may occur during alignment.

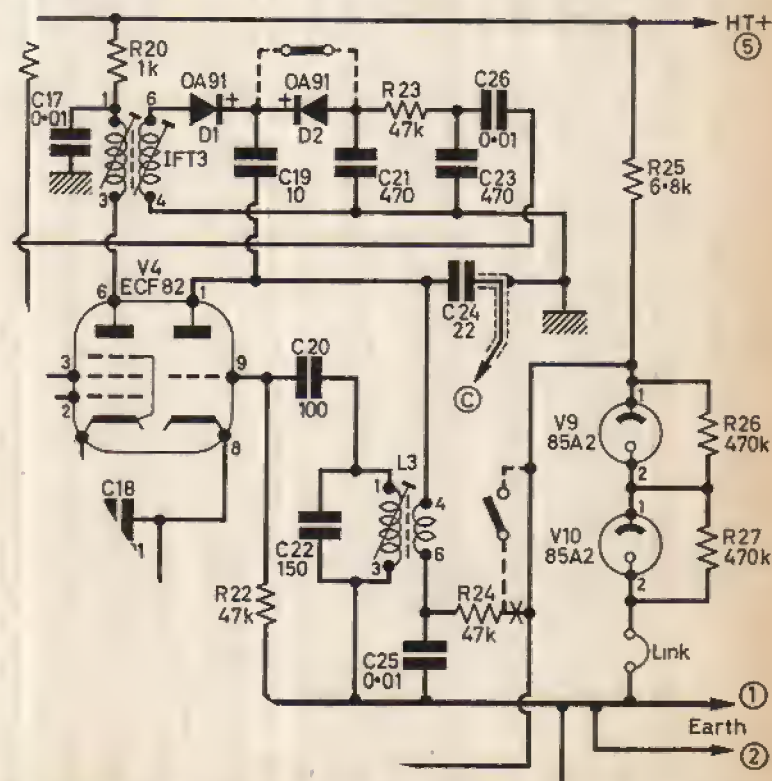


Fig. 8. Modification for reception of a.m. signals. One pole of a slide switch shorts out diode D2, the other pole opens the h.t. feed to the b.f.o., V4. Existing feed to b.f.o. must be broken at point X.

MODIFICATIONS

Since completing the transceiver the following modifications have been made to improve its versatility.

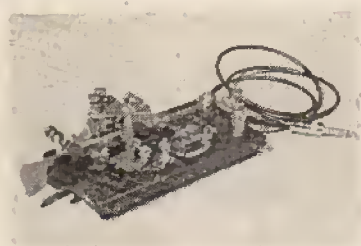
AM Reception As it stands the transceiver can be used to receive a.m. signals by tuning the carrier to zero-beat. This is not entirely satisfactory so a double-pole changeover slide switch was fitted to the panel. One pole is wired in series with the h.t. line to the b.f.o. and the other is wired across the product detector diode D2 which is shorted out on a.m. Thus on a.m. the b.f.o. is off and D1 becomes a normal diode detector, Fig. 8.

AM Transmission In order to be able to use a.m. telephony an open circuit jack socket was fitted to the back panel of the power supply unit and connected in parallel with the transmitter h.t. supply switch S2.

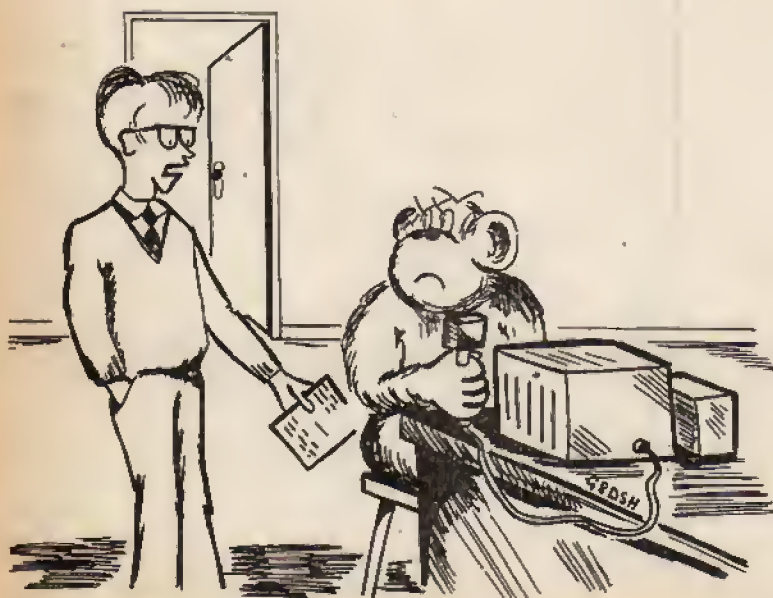
With the switch open the output of a small modulator can be plugged into the socket and the transmitter adjusted for proper modulation in the usual way.

When receiving a.m. signals the Q multiplier selectivity control may need backing off to obtain adequate bandwidth for reasonable speech quality.

It is important to note that when transmitting in the a.m. mode the b.f.o. must be on. The slide switch, mentioned above, must be moved to the "on" or "c.w." position before pressing the key to transmit. ■



MAXWELL



"It's the man from the G.P.O. about your party-political broadcast"

THE MW COLUMN

CENTRAL USSR and its Asiatic Republics to the south are usually neglected by the medium wave enthusiast. Local broadcasting in this area is on European frequencies and since the time zones are ahead of GMT, the majority of stations will have signed off before interference from Western Europe subsides for the night. Although there are a few all-nighters to be heard the best time for DX is at sign on, which occurs between 0100hrs and 0300hrs GMT. Saturday night is unfavourable owing to the extended schedules of many Europeans. **Harold Emblem** of Mirfield, Yorkshire, has been DXing this region and reports reception of Gorki on 827kHz; Simferpol Crimea 1313kHz (which was heard behind Stavanger at 1800hrs); Kharkov 1322kHz at 0240hrs; Saransk 1061kHz. DX logged recently by the writer includes Murmansk Lapland 656kHz at 2330hrs GMT; Ufa Bashkir 692kHz at 0106hrs; Kuybyshev 809kHz at 0140hrs; Garm Tadzhikistan 980kHz at 0050hrs; Baku Azerbaijan 1016kHz at 0130hrs. Those heard signing on at 0200hrs GMT were Yerevan Armenia 863kHz; Stavropol Caucasus 881kHz and Tbilisi Georgia 1043kHz. Others logged later in the night are Astrakhan 791kHz at 0206hrs; Markhagkala Dagestan 917kHz at 0205hrs; Tashkent Uzbekistan 1025kHz at 0230hrs. From nearby Iran, Tabriz 645kHz is often strong when it signs on at 0228hrs with a haunting Iranian melody played on a vibraphone, followed by a 3-pip time signal and the call 'Radio Iran.'

Identification can sometimes be a problem with USSR stations. Those that do identify locally use the word *Govarit* if in Russian, *Geplevar* in Turkmenian, *Danishir* in Azerbaijanian, *Khosum* in Armenian followed in each case by the place name. Radio Tashkent identifies in Uzbek with *Tashkentdan Gapi ramis*. Harold points out that the BBC transmissions in Russian on 809kHz might be mistaken for Kuybyshev, but USSR stations usually transmit the 'Midnight in Moscow' interval signal two minutes before the hour or half hour, followed by a 6-pip time signal, while many carry the '*Proprogramma Mayak*' which is mentioned in the identification. Sometimes a station broadcasts on one of the Tropical Bands as well as on the MWs. The writer has checked Ashkhabad 200kHz on the long waves against Ashkhabad 4825kHz on the 60 metre band and found the same local programme on each frequency.

Medium wave stations in the Caribbean are often prominent at this time of year. Listen between midnight and 0100hrs GMT for JBC 750kHz Point Galina, Jamaica; ZFY 760kHz Georgetown, Guyana; 4VEC 830kHz Cap Haitien, Haiti, in French; Radio Belize 834kHz in British Honduras; Radio Caribbean 840kHz in St. Lucia in French; WBMJ 1190kHz San Juan, Puerto Rico in English; ZBM1 1235kHz Hamilton, Bermuda; PJD2 1295kHz St. Martin in Dutch and English; Martinique 1310kHz in French.

Charles Molloy

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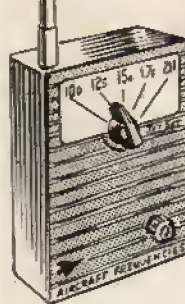


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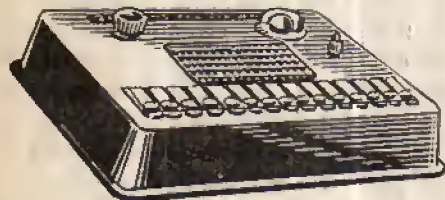
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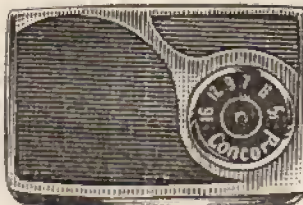
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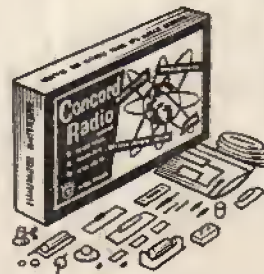
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	OC29	62p	IN21	17p	2N3731A1	25p	AF118	32p	CR81/20	37p	
OA5	12p	OC35	50p	IN21B	25p	2N5109A2	60p	AF127	17p	CR81/30	32p
OA10	30p	OC38	42p	IN25	60p	40362	67p	AF139	37p	CR81/35	42p
OA70	10p	OC44	20p	IN43	10p	82303	50p	AF178	47p	CR81/40	47p
OA71	10p	OC45	12p	IN70	7p	3F100	67p	AF186	45p	CR83/65	30p
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OA211	37p	OC81DM	20p	I2T10	63p	10D1	16p	BC118	37p	GEX66	75p
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OA2313	32p	OC139	25p	2N1306	25p	AC127	21p	BS05	37p	SD988	46p
OA2323 1a	10p	OC140	37p	2N1307	25p	AC128	20p	BS	45p	V406A	33p
OA2225	50p	OC170	25p	2N1247	75p	AC176	25p	BS2	46p	Z Range	
OC16	42p	OC171	30p	2N2904A	37p	ACY17	25p	BSY29	17p	Zener diodes	
OC22	42p	OC172	37p	2N3053	25p	ACY28	80p	BU100	£1.80p	17p ea	

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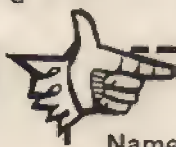
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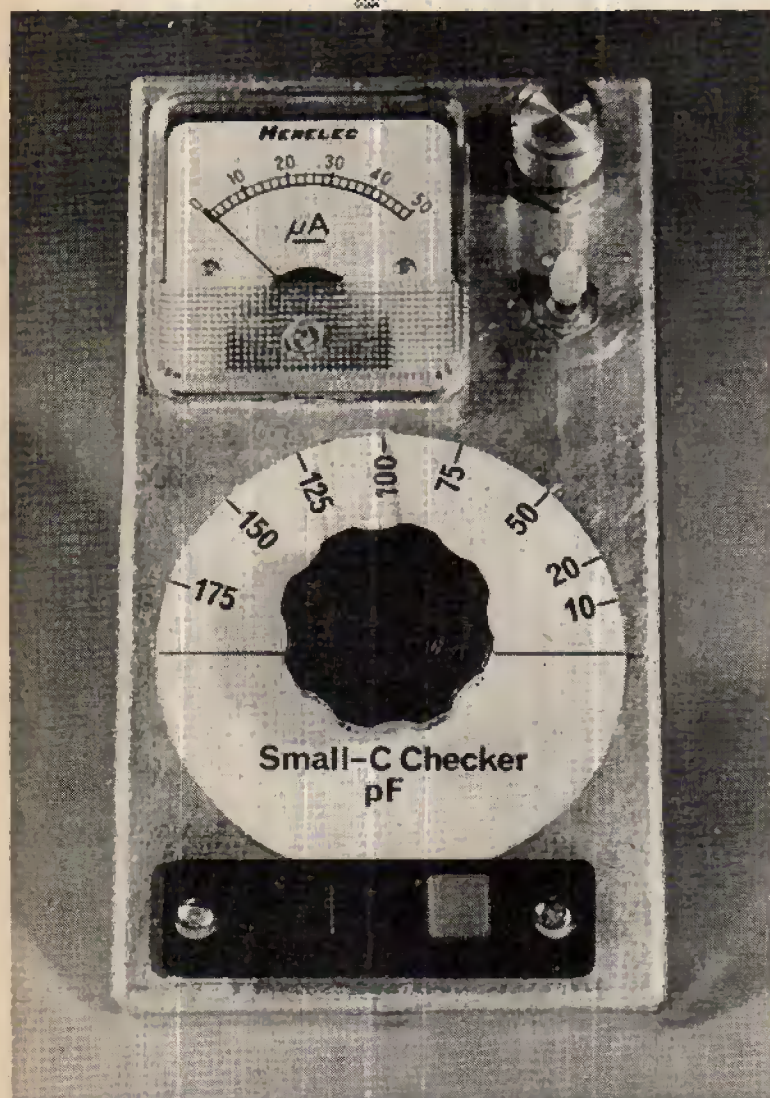
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A SMALL-C CHECKER

ARTHUR DOW



IN the course of time the average constructor accumulates quite a lot of odd small-value capacitors which eventually lose their markings and identity either by constant handling or by just being jostled around in the junk box. In any case they are then virtually useless and a positive menace and might just as well be thrown away. A 10pF capacitor used inadvertently with a tuned circuit instead of 100pF can cause an awful lot of trouble.

However by using this simple checker these capacitors can be rescued and re-marked and an hour spent in this way can be very rewarding.

The usual method of measuring capacity is with a bridge using an integral a.f. or r.f. oscillator to power the bridge. It occurred to the writer that since most constructors have a seldom used 1MHz crystal calibrator sitting on the workbench this could be put to good use as a signal source for a capacity checker.

In the event the checker proved so useful and was used so often that it was decided to integrate the oscillator and capacity measuring circuitry. This second unit is also described below.

METHOD

The usual bridge circuit has not been used. Instead a tuned circuit is resonated with the signal source at 1MHz, the unknown capacitor connected in parallel with the circuit and the tuning capacitor reduced in value until resonance is restored.

If the tuning capacity is calibrated (in pF) the decrease in its capacity to maintain resonance is equal to the value of the unknown capacitor.

The range of capacity that can be checked is approximately equal to the value of the calibrated capacitor, in this case up to about 200pF.

CIRCUIT MK I

The signal source at 1MHz is fed via a short coaxial lead to the input socket Sk1, Fig. 1, across which is connected the tuned circuit L1, VC1. With VC1 at maximum capacity the slug of L1 can be adjusted until the circuit resonates with the 1MHz source.

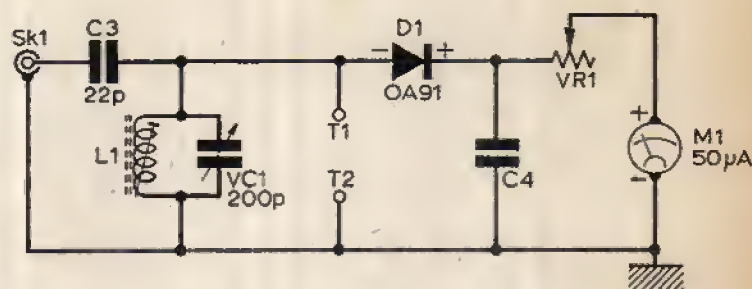


Fig. 1: Circuit of the Mk I capacitor checker.

Resonance is indicated by maximum deflection on the 50μA f.s.d. meter M1 fed from the rectifier circuit D1 and C4 connected across the tuned circuit. The f.s.d. of the meter can be adjusted over a wide range by the potentiometer VR1 to cater for differing input signal levels.

The capacitor to be measured is connected to the terminals T1 and T2. The range can be extended by increasing the value of VC1 but the accuracy of the read-out will be less.

SIGNAL SOURCE

The author had a 1MHz-100kHz-10kHz crystal calibrator available so this was used originally as a signal source for the checker, at 1MHz. There is no reason why an ordinary signal generator tuned to 1MHz should not be used but it should be stable in frequency and be fitted with an attenuator or other output level control.

CONSTRUCTION

All the components are mounted on the lid of a small aluminium box 5 $\frac{1}{4}$ x 2 $\frac{3}{4}$ in. and 2in. deep. A suggested layout is shown in Fig. 2 (the circuit-board and switch S1 being ignored), but there is nothing

critical in the placement of the few components. Care must be taken to ensure that terminal T1 is properly insulated from the lid, the two-terminal strip specified being fixed to the lid with 6BA bolts with a spacing nut between the strip and the lid, the wire from T1 being taken through a clearing hole in the lid.

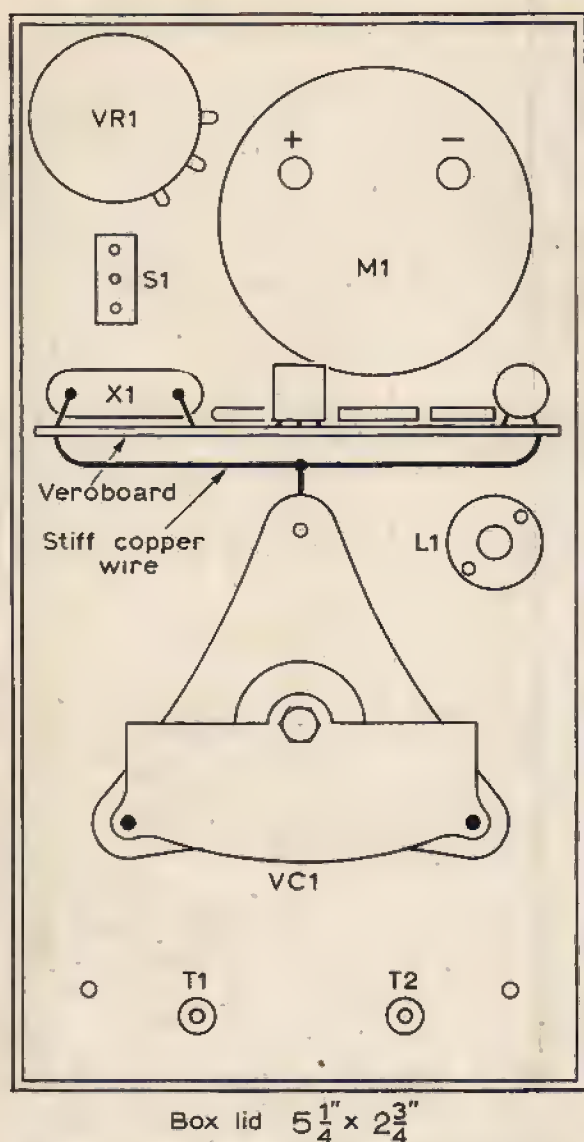


Fig. 2: Layout of the checker Mk II. In the Mk I version the circuit board and switch S1 are omitted and an input socket fitted.

These terminals are spring loaded which considerably facilitates the gripping of the wire ends of small capacitors.

The inductor L1 has its own fixing nut through which the slug can be adjusted with a conventional hexagonal trimming tool or it may be fixed in position with Araldite. Diode D1 and capacitor C4 are wired directly between components.

A stiff white cardboard dial, 2 1/2 in. diameter, is clamped underneath the retaining nut of VC1. A thin perspex pointer with a hairline scribed on it is stuck to the underside of the knob on VC1.

CALIBRATION

After checking the wiring, such as it is, set VC1 to maximum capacity and adjust the pointer to the zero line on the dial. Feed in a signal at 1MHz from the crystal calibrator and adjust VR1 for a reasonable deflection on the meter.

Adjust the slug in L1 for a peak on the meter reducing the signal input or increasing VR1 until the

★ components list

Resistors:

R1 220k Ω $\frac{1}{4}$ W

R2 1k Ω $\frac{1}{4}$ W

VR1 470k pot.
(miniature)

Capacitors:

C1 1000pF SM

C3 22pF SM

C2 820pF SM

C4 0.01 μ F disc

VC1 200pF variable (Jackson Type 87/057)

Semiconductors:

Tr1 AF117 D1 OA91

Miscellaneous:

X1 1MHz crystal, type HC6U and holder (Henrys)

L1 Inductor, HQ4 (Electronic Techniques (Anglia) Ltd., Viking Works, Kirton, Ipswich, Suffolk.

M1 Meter, 50 μ A f.s.d. (Henrys Type MRA38)

Battery 9V, (PP3) and connectors

Terminals, black and red (Henrys SLT2)

Piece of Veroboard. Knobs. Miniature on/off switch

Aluminium box 5 1/4 x 2 3/4 x 2 in. (H.L. Smith) or similar

peak deflection coincides with the f.s.d.

Using a series of capacitors of known value, preferably of 1% tolerance, connect each in turn across the terminals. When this is done the meter reading will drop as the tuned circuit is no longer resonant at 1MHz but it may be peaked again by reducing VC1 at which point the scale should be marked with the value of the known capacitor. Some constructors may wish to use the preferred range of values such as 22, 47, 68pF etc., when calibrating the dial.

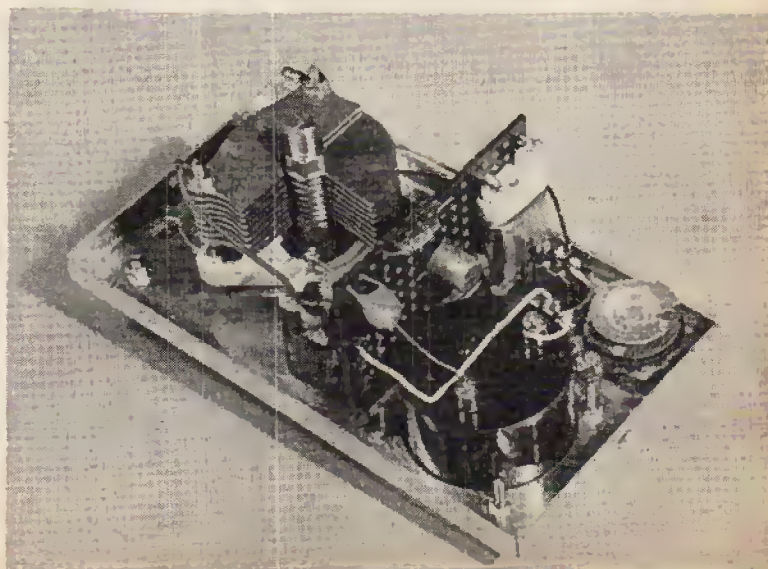
In use VC1 is set to zero on the dial and VR1 adjusted for full scale deflection. The unknown capacitor is connected to the terminals and VC1 rotated to restore full scale deflection on the meter. The dial reading at this point being the value of the capacitor under test.

If, with the unknown capacitor in circuit, it is found that it is not possible to regain f.s.d. it is likely that the capacitor insulation is down although it may still be of the order of megohms.

CIRCUIT MK II

In view of the great use to which the checker was put it was decided to integrate the 1MHz oscillator and the capacity measuring circuitry to obviate the necessity of connecting the two units together every time a capacitor was to be checked.

The original crystal calibrator was a valved job so



—continued on page 1066

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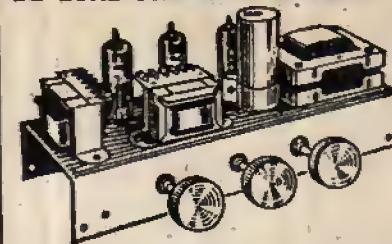
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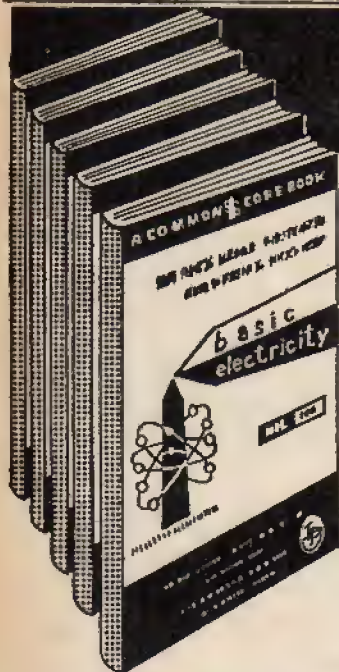
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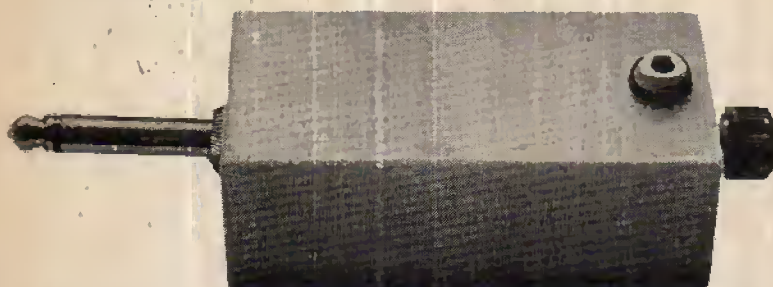
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PLUG-IN TUNER

RICHARD COLLINS



THIS simply constructed crystal tuner has many advantages to offer. It is easy to construct, compact and does not require any power source.

In this article the construction of a crystal diode tuner is described. It can be used to provide a signal that can be fed into a tape recorder, amplifier, or just a pair of high impedance headphones, so becoming a simple crystal receiver. Full constructional details are given so that a complete beginner may build the project.

The layout of the tuner is by no means critical and constructors can position the components to suit the box in which the unit is to be built.

The prototype was constructed in a small plastic case obtained from one of the advertisers in this magazine but any small box of similar size, be it made from plastic, metal, wood, etc., is suitable.

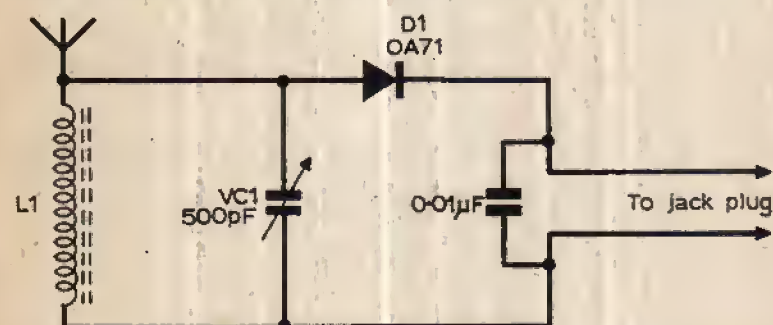


Fig. 1: Circuit of the crystal tuner. A resistor R1, 10kΩ, should be shown across the 0.01μF capacitor, but see text.

The complete circuit is shown in Fig.1 and from this it can be seen that very few components are employed; a coil, trimmer capacitor slightly modified, diode and resistor together with an aerial socket and the "business" end of a jack plug. The use of a jack plug helps to eliminate any losses of signal strength and reduces any hum that may occur.

There are only three holes to make in the case and the sizes of these are determined by the particular types and makes of components employed. One of these is for the aerial socket, one for the tuning capacitor and the third for the jack plug. The coil may be either glued to the casing or held in its position by employing fairly thick wire for connecting (bell wire from Woolworths will be ideal for this).

Before construction begins, the tuning capacitor or trimmer VC1 must be modified somewhat so that it can be used with a knob.

As can be seen from Fig. 2b, the original bolt has

been removed and a longer bolt inserted, (a 1in. 6BA round-headed bolt will do). This should be screwed through the trimmer from the back. The trimmer should then be set in the "open" position and the end of the bolt snipped off so that about 1/4in. is left for fixing the "knob." This knob shown in the prototype was a small perfume bottle cap with a nut glued inside it. When the glue had set, a small amount of glue was spread onto the thread of the nut. After a while, the knob was screwed onto the thread and a good solid fixture was made. This knob can be fabricated from the lid of an old toothpaste tube or anything of similar size.

When the trimmer capacitor has been modified, a hole of suitable size should be drilled in one end of the case as shown in Fig. 3. Should constructors wish, they can use a small 500pF variable capacitor—the size being dependent on the size of case em-

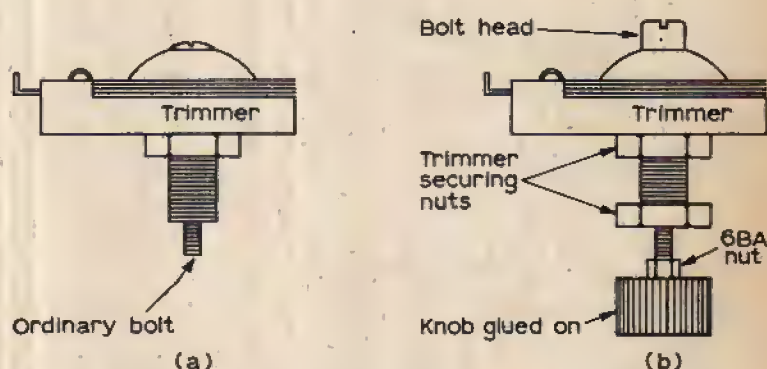


Fig. 2: Tuning capacitor modification.

ployed. Another hole to fit the aerial socket through should be drilled in a suitable position (if the case is made of metal, this socket should be of the insulated lead-through type).

The third hole, for the jack plug, should then be made. This, being the largest is best started off with a hot soldering iron in the case of plastic or wood (a drill and file are best used to make a neat job in a metal box).

If this hole is made slightly smaller than the thread on the shank of the jack plug, it can be screwed into the actual case for a tight fit rather than have a securing nut fitted. This is a preferred way of mounting as a securing nut may foul the jack connecting tags.

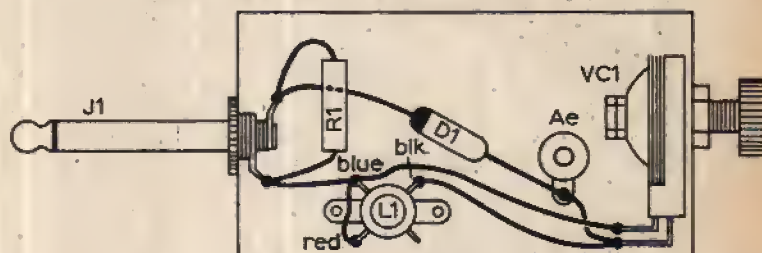


Fig. 3: Component layout and wiring diagram.

The three items may then be fitted in their respective positions (see Fig. 3) and the wiring commenced.

The coil, a Repanco DRX1 employed in the prototype was a medium/long wave component but only the medium wave winding was connected. A piece of wire should be taken and connected to the blue and red tags on the coil L1. This wire should then

be taken to one of the tags on the trimmer capacitor VC1. Another wire should be taken from the other tag of VC1 to the black tag on the coil. From the blue and red connections on the coil, a wire should be taken to the centre connection on the jack plug. Resistor, R1 should be connected across the centre tag and the other tag and the black end of the crystal diode should be connected also. The positive or red end of the diode should then be connected to the aerial socket. A wire should then be taken from this to the tag on the capacitor VC1 that goes to the black tag on the coil. Some constructors may wish to employ the long-wave winding on this coil and if this is so, a suitable on/off type switch may be mounted in any convenient position in the case. The tuner may now be tested and an aerial should be plugged into the socket and the jack plug connected to an amplifier input. Wires may be secured with Sellotape while testing takes place. When the tuning capacitor VC1 is rotated, a station should be heard. If two stations are heard simultaneously, a capacitor about 100 pF value should be inserted between the aerial and the aerial socket—this should help separation.

It has always been the author's policy that the best aerial is one that has as much wire up as high as possible and this is certainly the case as far as crystal receivers go. A length of wire between 50-100ft. should suffice.

If it is wished to build up this circuit just for use as a crystal set, the 10kΩ resistor may be omitted. ■

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PRACTICAL WIRELESS, APRIL 1971

PLUG-IN TUNER—continued from page 1062

it was thought better this time to employ a transistor oscillator and to put it and the battery supply in the original box with the tuned circuit etc.

This version of the checker is therefore ready for instant use.

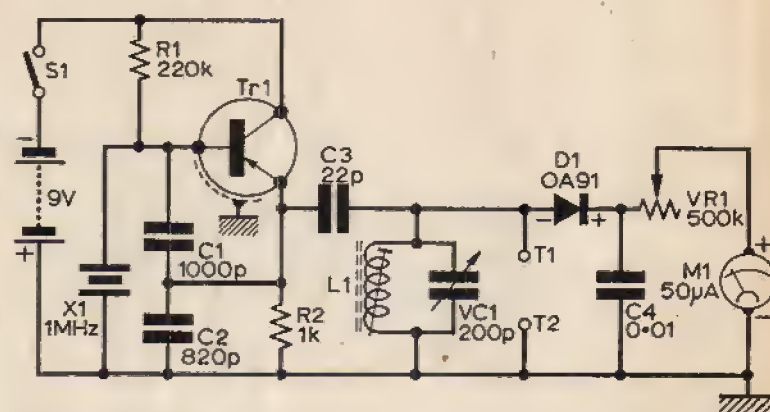


Fig. 3: Circuit Mk II incorporating a 1MHz oscillator signal source

The oscillator is straightforward and uses an AF117 p.n.p. germanium transistor and an HC6U style 1MHz crystal unit, Fig. 3, and is constructed on a small piece of Veroboard, Fig. 4. The board is mounted between the meter and the tuning capacitor VC1 by a stiff copper wire soldered to the earth side of VC1, as can be seen in the photograph.

The output of the oscillator is connected to the original tuned circuit by C3.

The method of measuring the value of an unknown capacitor is the same as before except that initially the step of adjusting the core of L1 should be repeated since the permanent capacity across the tuned circuit will now be different.

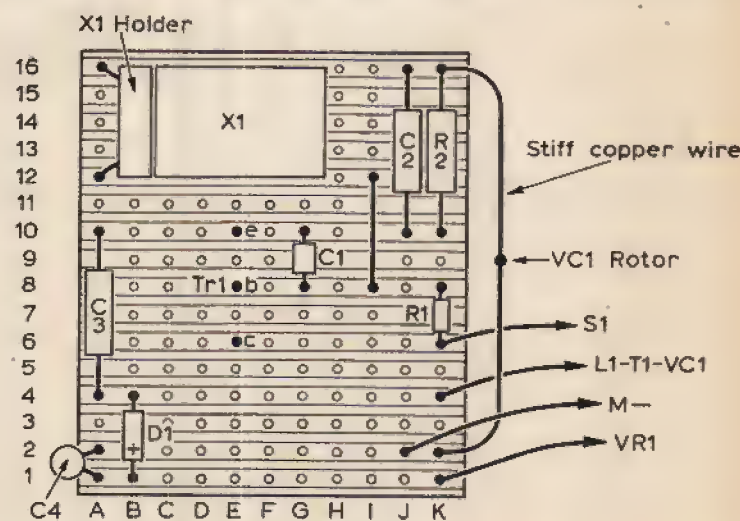


Fig. 4: Circuit board of the 1MHz oscillator built on Veroboard, 0.15 x 0.15in. matrix.

The miniature switch S1 could very well be part of the potentiometer VR1 which would save some space. If this is done make sure that the pot. is wired so that clockwise rotation of the pot. decreases its resistance.

The checker will be found very useful indeed in matching small values of capacitance where precise values are not important. In practice changes of less than 1pF can be detected.

Don't forget that the Small-C Checker can still be used as a frequency spotter with its internal 1MHz oscillator. Connect a short stiff wire to the live terminal and harmonics can be found up to at least 30MHz. ■

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600	7p	16p	10p	23p	34p	45p	21.85		
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U17	30 Germanium PNP AF Transistors TO-5 like ACY17-22	50p
U18	8 4-Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	50p
U19	25 Silicon NPN Transistors like BC108	50p
U20	12 1-5 amp Silicon Rectifiers Top-Hat up to 1,000 PIV	50p
U21	30 AF Germanium alloy Transistors 2G300 Ser. & OC71	50p
U23	30 Mad's like MAT Series PNP Transistors	50p
U24	20 Germanium 1-amp Rectifiers GJM up to 300 PIV	50p
U25	25 300Mc/s NPN Silicon Transistors 2N708, BSY27	50p
U26	30 Fast Switching Silicon Diodes like 1N914 Micro-min.	50p
U28	Experimenters' Assortment of Integrated Circuits, untested. Gates, Flip-Flops, Registers, etc. 8 Assorted Pieces	21
U29	10 1-amp SCR's TO95 can up to 600 PIV CR81/25-600	21
U31	20 Sil. Planar NPN trans. low noise Amp 2N3707	50p
U32	25 Zener diodes 400mW D07 case mixed Volts, 3-18	50p
U33	15 Plastic case 1 amp Silicon Rectifiers 1N4000 series	50p
U34	30 Sil. PNP alloy trans. TO-5 BCY23, 28302/4	50p
U35	25 Sil. Planar trans. PNP TO-18 2N2906	50p
U37	25 Sil. Planar NPN trans. TO-5 BFY50/51/52	50p
U37	30 Sil. alloy trans. SO-2 PNP, OC200 28322	50p
U38	20 Fast Switching Sil. trans. NPN 400 Mc/s 2N3011	50p
U39	30 RF Germ. PNP trans. 2N1303/5 TO-5	50p
U40	10 Dual trans. 6 lead TO-5 2N2060	50p
U41	25 RF Germ. trans. TO-1 OC45 NKT72	50p
U42	10 VHF Germ. PNP trans. TO-1 NKT667 AF117	50p

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

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BP40 7440N	Dual 4-Input BUFFER GATE	23p 20p 15p
BP41 7441N	BCD to decimal decoder and N.I.T. Driver	21.21 21.00 87p
BP42 7442N	BCD to decimal decoder (TTL O/P)	87p 77p 87p
BP50 7450N	Dual 2-Input AND/OR/NOT GATE—expandable	23p 20p 15p
BP53 7453N	Single 8-Input AND/OR/NOT GATE—expandable	23p 20p 15p
BP60 7460N	Dual 4-Input—expandable	23p 20p 15p
BP70 7470N	Single JK Flip-Flop—edge triggered	35p 32p 28p
BP72 7472N	Single Master Slave JK Flip-Flop	35p 32p 28p
BP73 7473N	Dual Master Slave JK Flip-Flop	43p 40p 37p
BP74 7474N	Dual D Flip-Flop	43p 40p 37p
BP75 7475N	Quad Bistable Latch	55p 50p 47p
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BP92 7492N	Divide by 12 4 Bit binary counter	87p 77p 87p
BP93 7493N	Divide by 16 4 Bit binary counter	87p 77p 87p
BP94 7494N	Dual Entry 4 Bit Shift Register	87p 77p 87p
BP95 7495N	4 Bit Up-Down Shift Register	87p 77p 87p
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UIC04	= 12 x 7404N	50p	UIC80	= 5 x 7480N	50p
UIC05	= 12 x 7405N	50p	UIC82	= 5 x 7482N	50p
UIC10	= 12 x 7410N	50p	UIC83	= 5 x 7483N	50p
UIC20	= 12 x 7420N	50p	UIC86	= 5 x 7486N	50p
UIC40	= 12 x 7440N	50p	UIC90	= 5 x 7490N	50p
UIC41	= 5 x 7441AN	50p	UIC92	= 5 x 7492N	50p
UIC42	= 5 x 7442N	50p	UIC93	= 5 x 7493N	50p
UIC50	= 12 x 7450N	50p	UIC94	= 5 x 7494N	50p
UIC51	= 12 x 7451N	50p	UIC95	= 5 x 7495N	50p
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BP702C—SL702C	TO-5	8	OP Amp Direct O/P	83p 50p 45p
BP703—72702	D.I.L.	14	G.P. OP. Amp (Wide Band)	53p 45p 40p
BP709—72709	D.I.L.	14	High OP Amp	53p 45p 40p
BP709P—μA709C	TO-5	8	High Gain OP Amp	53p 45p 40p
BP741—72741	D.I.L.	14	High Gain OP. Amp (Protected)	75p 60p 50p
μA703C—μA703C	TO-5	6	R.F.—IF Amp	43p 35p 27p
TAA263	TO-72	4	A.F. Amp	70p 60p 55p
TAA293	TO-74	10	G.P. Amp	80p 75p 70p

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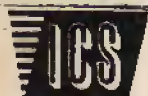
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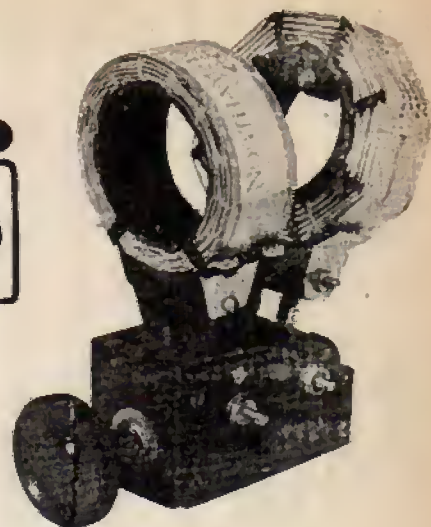
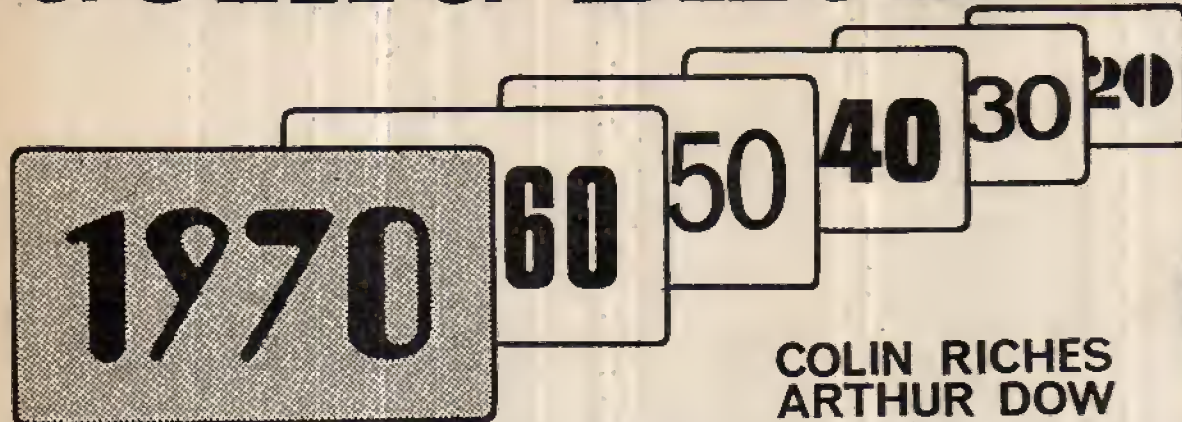
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GOING BACK...



COLIN RICHES ARTHUR DOW

EVERY day of the week, except when there is a postal strike, we receive letters from readers interested in the Going Back article. The Reverend R. J. Mantle, M.A., from Aberdeen writes that he has a B.T.H. crystal wireless dated 1924 and another B.T.H. valve/crystal set with two crystals and one valve dated about 1927. He says that amongst his books on wireless, his most precious is a book entitled "A Beginner in Wireless" by E. Alexander, published in 1923. It has many interesting photographs like Marconi's Timed Spark c.w. Generator, the Brown Microphone Amplifier and Fleming's thermionic valves.

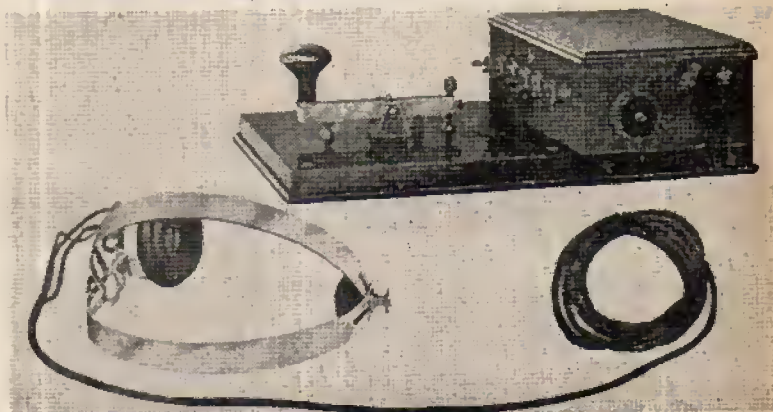
One suggestion that Reverend Mantle makes is that wireless of the 1920's should be known as "Veteran Radio" and that of the 1930's should be known as "Vintage Radio".—Any comments?

C. Langton Kirk writes to say that he has seen the name of N. Gilbertson mentioned in our August 1970 issue and wonders if this is the same one that he knew as a very good friend back in 1925-26. Both were interested in wireless as a hobby in those days. So, Mr. Gilbertson, if you worked in a cinema in Leicestershire in 1925, you are the correct man and Mr. C. Langton Kirk, 137 Hubert Road, Bournbrook, Birmingham, 29 6ET would like to hear from you.

Mr. W. G. Rumbold, M.I.E.E., tells us how he used to listen to the "shipping bands" on 600m where there was a constant stream of traffic in readable Morse always on tap. A little higher up in wave-

length (frequency was not spoken of then) were Croydon Airport, Castle Bromwich and Le Bourget with R/T on 900m.

Mr. F. C. Burgess, 58 Beaconsfield Drive, Beacons Bay, East London, C.P., South Africa, writes to say that he has in his possession an old Marconiphone two-valve set. He estimates its year of manufacture at approximately 1923. The set is still in good condition with its two plug-in coils and a small name-plate is affixed bearing the inscription "Marconiphone V2."



Marconi Morse practice buzzer.

Type R.B.I.A., A.S.206B Inst. No. C-A-7618." If any readers have any idea of the exact date of manufacture, will they drop a line to Mr. Burgess please?

A photograph we received the other week is of a Marconi Morse Practice Buzzer. Vintage is 1912. Slightly different from a modern transistor Morse oscillator, this one boasts a highly finished teak board on which is mounted an operating key and other parts. Enclosed in a case on the same board is a battery, high note buzzer and induction coils, one of which is provided with a convenient handle, by means of which the strength of signals in the telephone can be varied. The buzzer is arranged in a practically sound-proofed box, but can be removed for easy adjustment. A single head piece telephone was provided with the instrument, but a double head piece could be supplied if required at slightly increased cost.

Keith Cummins—better known to our sister magazine "Television" readers for his 625-line TV Receiver articles, sends us a photograph (left) of a receiver he has recently put in working order. It employs two valves and a 4.5V battery has been used for the i.t. supply giving each valve 2.25V in a series circuit. Keith says this helps since they are so ancient—and he is highly delighted by the performance. Date is approximately 1925.

Mr. Cummings' receiver and speaker (1925).



Wireless Experiments on an Aeroplane



Flanders' monoplane on which experiments with wireless were carried out in 1912.

One of our vintage radio enthusiasts, Mr. Leonard Adlard of Essex recently loaned us some copies of an old magazine called *The Marconigraph*—the official organ of the Marconi Co. All dated 1912, these magazines have some real gems of information in them and below we publish an extract which tells the story of an early exploit with an airborne transmitter.

"One of the applications of wireless is telegraphing from aeroplanes, airships and balloons. The advantage of being able to communicate with land or other stations whilst in the air has been well exemplified on many occasions.

On March 16th, 1912 when some wireless experiments were being carried out on Mr. Howard Flanders' monoplane at Brooklands Aviation Grounds near Weybridge, a curious incident occurred. On the previous evening a trial flight was made after the wireless apparatus had been fitted to the machine and everything seemed in perfect working order. On the Saturday morning, as the weather was exceedingly favourable for flying, the machine was taken out again, but it was then that the mishap occurred. The aviator was flying very low at the time, and on

landing his first skid apparently struck the ground owing to a too sudden descent and to the speed at which the aeroplane was moving at the time—approximately 60 miles per hour—the machine turning completely over. The aviator was thrown out of his seat, and when picked up was unconscious. The fuselage of the machine was smashed to two places and the propellor was also damaged. The wings had apparently escaped unhurt, but had to be stripped of their fabric and thoroughly overhauled. The exhaust pipes, radiators, and lubricating pipes on the engine were also damaged and the front skid of the aeroplane was broken in two. Amidst the debris, it would not have been surprising if the wireless apparatus had been smashed, especially as the oil tank beside which the wireless apparatus was fitted had been severely battered and was leaking badly. After removing the sand and dirt with which everything was covered, it was found, however, that the wireless apparatus had escaped quite undamaged and was in working order; even the aerial wire, which was attached to the broken fuselage remained intact!"
—Amazing!

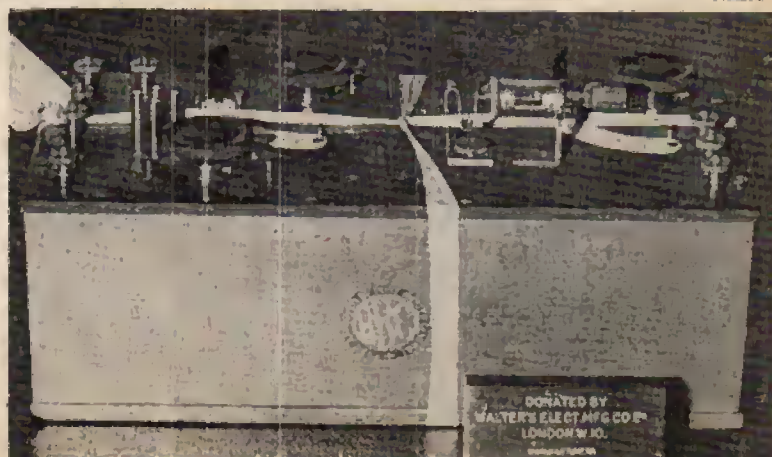
CQ! CQ! CQ! CQ! CQ!

If you have a Vintage CQ you would like included in Practical Wireless, drop a line to Colin Riches and Arthur Dow who will include it in the earliest available issue.

APPARATUS REQUIRED

... ex-Cable and Wireless Morse Operator (now alas teletype) wishes to acquire two early Morse keys (brass) to cherish and use on the amateur bands.—J. A. Van Walwyk, G3YRW, 321 Parkside Avenue, Barnehurst, Kent.

... I am interested in knowing if anyone has any Telsen baseboard components which were produced in 1933. They include the dual-range coil, the combined dual-range short wave coil unit, the h.f. coil, screened tuning coils (pair or singles) and the twin tuning condenser with the built-in trimmer to match the coils. Also the 4, 5 and 7 pin valve holders.—G. Beasley, 31 York Avenue, Bedworth, Nr Nuneaton, Warks.



For those readers who have asked to see a close-up of the Walters Receiver (News . . . Jan. 1971).

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40362	68p	2N2924	20p	40362	68p	BC149	15p	BFX88	26p
2N696	20p	2N2925	22p	AC107	46p	BC153	19p	BFY50	23p
2N697	22p	2N2926	11p	AC126	20p	BC154	20p	BFY51	20p
2N706	12p	2N3053	27p	AC127	20p	BC157	19p	BFY52	23p
2N930	29p	2N3055	75p	AC128	20p	BC158	17p	BSX20	18p
2N1131	36p	2N3702	13p	AC158K	25p	BC159	18p	CA07	17p
2N1132	40p	2N3703	13p	AC176	27p	BC167	13p	MC140	25p
2N1302	19p	2N3704	13p	AC176	27p	BC168	11p	MP86531	35p
2N1303	19p	2N3705	18p	AC176	27p	BC169	13p	MP86534	30p
2N1304	23p	2N3706	13p	AD140	50p	BC177	17p	NKT211	25p
2N1305	33p	2N3707	13p	AD142	50p	BC178	19p	NKT212	25p
2N1306	33p	2N3708	13p	AD149	60p	BC179	17p	NKT214	23p
2N1307	36p	2N3709	13p	AD161	40p	BC182L	13p	NKT274	18p
2N1308	36p	2N3710	13p	AD162	40p	BC183L	11p	NKT403	65p
2N1309	36p	2N3711	13p	AF114	30p	BC184L	13p	NKT405	79p
2N1613	23p	2N3794	15p	AF115	30p	BC212L	25p	OC71	29p
2N1711	26p	2N3819	35p	AF117	23p	BC213L	25p	OC81	25p
2N1893	54p	2N3906	35p	AF124	30p	BC214L	25p	OC81D	25p
2N2147	95p	2N4058	20p	AF127	23p	BOY70	19p	ZTX300	17p
2N2218	23p	2N4059	20p	AF139	43p	BOY71	83p	ZTX301	17p
2N2218A	43p	2N4060	20p	AF239	45p	BOY72	15p	ZTX302	22p
2N2219	33p	2N4061	20p	ASY26	27p	BF115	23p	ZTX303	22p
2N2219A	53p	2N4062	20p	ASY28	27p	BF167	27p	ZTX304	23p
2N2270	62p	2N4124	13p	BC107	14p	BF173	31p	ZTX500	25p
2N2369A	19p	2N4126	27p	BC108	12p	BF194	17p	ZTX501	25p
2N2483	35p	2N4284	15p	BC109	12p	BF195	18p	ZTX502	20p
2N2484	42p	2N4286	15p	BC125	15p	BFX29	31p	ZTX503	25p
2N2646	54p	2N4289	15p	BC126	22p	BFX84	25p	ZTX504	60p
2N2904A	42p	2N4291	15p	BC147	15p	BFX85	34p		
2N2905	44p	2N4292	15p						

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	7	6-5	6
C	1/8W	5%	4.7Ω-330KΩ	E24	1	0-8	0-7
C	1/4W	10%	4.7Ω-10MΩ	E12	1	0-8	0-7
C	1/2W	5%	4.7Ω-10MΩ	E24	1-2	1	0-9
C	1W	10%	4.7Ω-10MΩ	E12	2-5	2	1-8
MO	1/2W	2%	10Ω-1MΩ	E24	4	3-5	3
WW	1W	10% ± 1/20Ω	0.22Ω-3.9Ω	E12	7	7	6
WW	3W	5%	12Ω-10KΩ	E12	7	7	6
WW	7W	5%	12Ω-10KΩ	E12	9	9	8

Codes: C = carbon film high stability low noise
MO = metal oxide ElectroSil TR5 ultra low noise
WW = wire wound Pleassey.

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.

INTEGRATED CIRCUIT AMPLIFIERS

SINCLAIR IC10 complete with instruction book giving amplifier circuit details and range of applications.

£2.95 nett.

Components pack for stereo inc. mains transformer, controls etc. £4.75 nett.

FLESSEY SL403A Now only £2.10 nett 3W into 7-5Ω for 18V supply. Application data sent with two more.

WAVECHANGE SWITCHES LONG SPINDLES

1P 12W; 2P 6W; 3P 4W; 4P 3W

24p each

SLIDER SWITCHES D.P.D.T.

15p each

NEON INDICATOR LAMPS

all 200/250V. Square bezel, red only

19p

Round chrome bezel red, amber, clear

24p each

Toggle switches, 250V a.c. 1-5A.

chrome dolly and chrome milled nut S.P.S.T. 19p, S.P.D.T.

22p D.P.D.T. 29p; S.P.D.T. centre off 20p

S-DeC's put an end to "birdnesting". Components just plug in. Saves valuable time. Use components again and again. S-DeC (70 points) only £1. Compact T-DeC, increased capacity, may be temperature-cycled. T-DeC (208 points) only £2.50. Full range stocked.

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

MULLARD polyester C280 series

250V 20% 0-01; 0-222; 0-033; 0-047 3p ea. 0-068; 0-1; 0-15 4p; 0-22 5p; 10%; 0-33 7p; 0-47 8p; 0-68 11p; 1μF 14p; 1-5μF 21p; 2-2μF 24p.

MULLARD SUB-MIN ELECTROLYTIC

C426 range axial lead 6p each
Values (μF/V): 0-04/64; 1/40; 1-6/25; 2-5/16; 2-5/64; 4/10; 4/40; 6/64; 0-4/6-4; 6-4/25; 8/4; 8/40; 10/2-5; 10/16; 10/64; 12-5/25; 16/40; 20/16; 20/64; 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 28p; 1000/50 41p; 1000/100 52p; 2000/25 37p; 2000/50 57p; 2000/100 £1.44; 2500/64 77p; 2500/70 88p; 5000/25 68p; 5000/50 £1.20; 5000/100 £2.91; 10000/16 85p; 10000/25 £1.22; 10000/50 £2.20.

MEDIUM RANGE ELECTROLYTICS

Axial leads: 50/50 9p; 100/25 9p; 100/50 13p; 250/25 13p; 330/25 13p; 360/50 19p; 500/25 19p; 500/50 21p; 1000/25 20p; 1000/50 30p; 2000/25 30p; 2000/50 48p.

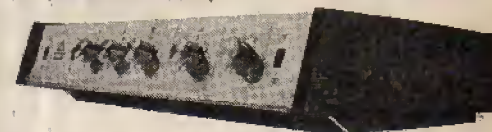
SMALL ELECTROLYTICS

Axial leads: 4-7/10; 4-7/25; 5/50 5p ea. 10/10; 10/25; 10/50; 33/10; 50/10 5p ea. 22/25; 25/50; 47/25; 100/10; 220/10 6p ea.

ENAMELLED COPPER WIRE even No S.W.G. only.
20s reels 16-22 S.W.G. 25p; 24-30 S.W.G. 30p; 32-34 S.W.G. 33p; 26-40 S.W.G. 35p; 40s reels 16-22 S.W.G. only 42p.

PEAK SOUND PRODUCTS

ENGLEFIELD 12 + 12 WATT AMPLIFIER



Stereo amplifier in modular kit form 12 watts per channel
£33-45; Cabinet kit only £6. These prices nett.
As reviewed in leading hi-fi publications

BAXANDALL SPEAKER SYSTEM

Designed by Peter Baxandall.
Superb reproduction for its size. Handles 10 watts with ease. Uses ELAC 15Ω 59RM109 speaker Unit Kit £13-90 nett; built £19-40 nett.



MAINLINE AMPLIFIER KITS

RCA/808 designed main amplifier kits.

Input sensitivity 500-700mV for full output into 8Ω.

Power	Kit price including components	Suitable unreg. power supply kit
12W	£2-40 nett	£4-60
25W	£9-50 nett	N/A
40W	£10-50 nett	£5-75
70W	£12-60 nett	£8-94

30 WATT BAILEY AMP. PARTS

Sensitivity 1.2V for full output into 8Ω
Transistors and PCB for one channel £6-40
Transistors and PCB for two channels £12-80
Capacitors and resistors (metal oxide) £2-00 per channel
Complete unregulated power supply kit £4-75

ZENER DIODES

5% full range E24 values; 400mW: 2-7V to 30V 15p each
1W: 6-8V to 82V 33p each 1-5W: 4-7V to 75V 80p each
Clip to increase 1-5W rating to 3 watts (type 256F) 4p.

CARBON TRACK

POTENTIOMETERS, long spindles

Double wiper ensures minimum noise level.
Single gang linear 220Ω to 2-2MΩ 12p
Single gang log 4-7KΩ to 2-2MΩ 12p
Dual gang linear 4-7KΩ to 2-2MΩ 42p
Dual gang log 4-7KΩ to 2-2MΩ 42p
Log/antilog 10K, 47K, 1MΩ only 42p
Any type with 1A D.P. mains switch, extra 12p

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 5p each.

THIS MONTH'S HIGHLIGHT OFFER

High grade audio transistor TYPE 2N3055—Max. dissipation 115 watts at 25°C. Max. volts 100 Vbeo. The lowest priced of its kind. Ideal for up to 20KHz and heavy duty switching. 75p complete with insulating set, ea. suggested complementary drivers BFX29/BFX84 per matched pair 84p.

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 10p if under. Overseas orders welcome: carriage charged at cost.

PAYMENT BY CHEQUE

To avoid delay and comply with the law cheques must be drawn in decimal currency in U.K.

ELECTROVALUE

(Dept. PW.371) 28 ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY

Hours: 9-5.30: Sat. 1 p.m. Tel.: Egham 5533 (STD 0784-3) Telex 264475

R+TV

RADIO & TV COMPONENTS (Acton) Ltd.

Post to

21c HIGH STREET, ACTON, LONDON W.3. 6NG
Personal shoppers to 323 Edgware Road, London, W.2.
ALL ORDERS BY POST TO OUR ACTON BRANCH
Terms C.W.O. All enquiries S.A.E.

Complete Stereo System £43

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



This superb stereo system is a real price break through. It comprises the VISCOUNT F.E.T. Mk I amplifier on which full details are given below, the famous Garrard SP 25 Mk III (including teak veneer base and transparent cover) with diamond cartridge or 2025 TC and the very successful DUO type 2 speakers. Measuring 17½in x 10½in x 6½in, the Duo type 2 speakers are teak finished with matching Vynair grills. They incorporate a 3 ohm, 13in x 8in drive unit and Parasitic tweeter. Max. power handling 10 watts. Price £13.50 per pair plus p. & p. £1.50.

Complete stereo system £43 plus £2.50 p. & p. or with Mk II Amplifier and Magnetic Cartridge £48 & £2.50 p. & p.

The Viscount

F.E.T. Mk I £14.25 + 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 10 watts r.m.s. into 3 ohms. Frequency bandwidth 20 Hz to 20 kHz + 1db at 1 watt. Total distortion at 1 kHz at 9 watts 0.5% Input sensitivities CER. P.U. 100mV into 3 meg ohms. Tuner 100mV into 100K ohms. Tape 100mV into 100K ohms. 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 volume controls for left and right channels. Bass ± 14db at 60 Hz. Treble (with D.P.S. on off) ± 12 db at 10 KHz. Tape recording output sockets on each channel. Size 12½in. 6in. 2½in. in simulated teak case. **BUILT & TESTED.**

MkII (MAG P.U.) £15.75 plus 50p. p. & p.

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

The £25 Stereo system

The Duetto is a good quality stereo amplifier, attractively styled and finished. It gives superb reproduction previously associated with amplifiers costing far more.

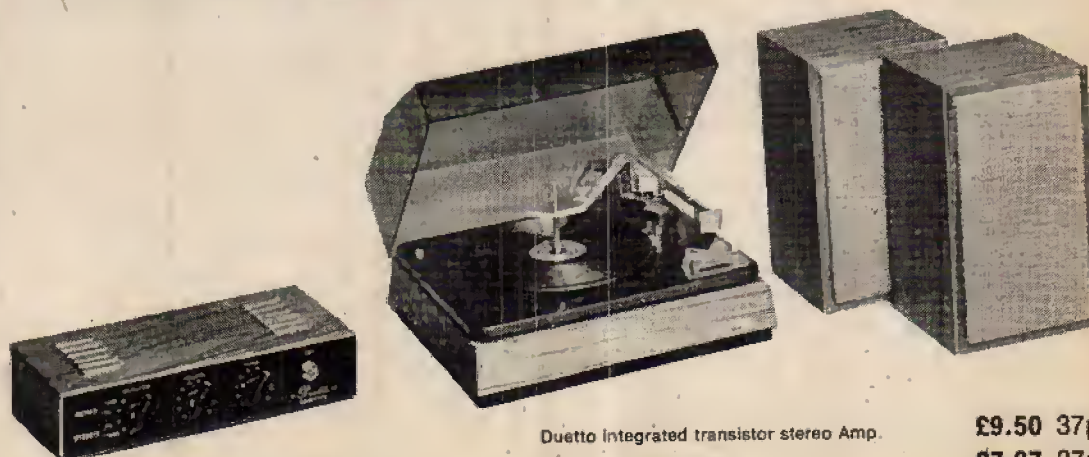
SPECIFICATION—

R.M.S. power output 3 watts per channel into 10 ohms speakers.

INPUT SENSITIVITY. Suitable for medium or high output crystal cartridges and tuners. Cross-talk better than 30dB at 1Kc/s.

CONTROLS: 4-position selector switch (2 pos. mono and 2 pos stereo) dual ganged volume control.

TONE CONTROL Treble lift and cut Separate on off switch. A preset balance control.



Duetto integrated transistor stereo Amp.

Garrard Changer from

Cover and teak finish plinth

Duo Type I speakers (see opp. page)

The above items purchased together

£9.50 37p

£7.97 37p

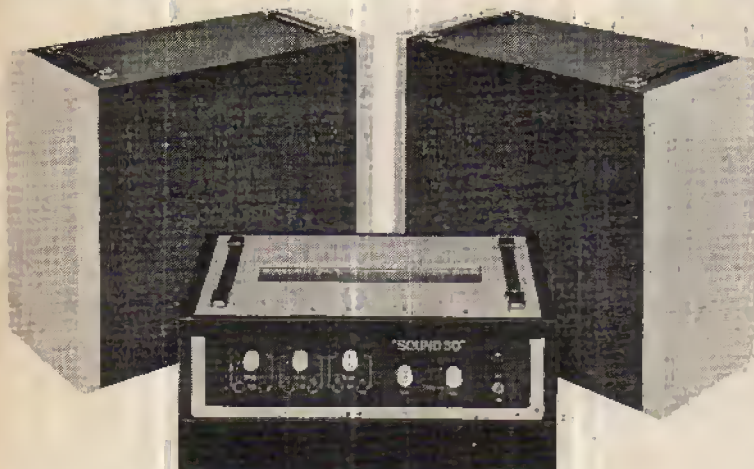
£4.75 37p

£4.20 37p

£25 £1.50

SOUND 50

50 WATT AMPLIFIER & 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 30Hz at 18KHz. 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: ± 13 dB at 60Hz. Treble Control Range: ± 12 dB at 10 KHz. Inputs: 4 inputs at 5mV into 470K. Each pair of inputs controlled by separate volume control. 2 inputs at 200mV into 470K.

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

SPEAKERS! Size 20" x 20" x 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 £50 Plus £4 P. & P.
Sound 50 amp and 2 speakers

or available separately.

Amplifier £28.50 plus £1.50 P. & P.

Speakers £12.50 each plus £1.75 P. & P.

LIQUIDATED STOCK 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.

Originally sold completely built for £15.4.6 (£15.23) Pre-aligned I.F. module and tuner together with comprehensive instructions guarantees success first time. 12 volts negative or positive earth. Size 7in x 2in x 4½in deep.

See top of previous page for address

SET OF PARTS

£6.30

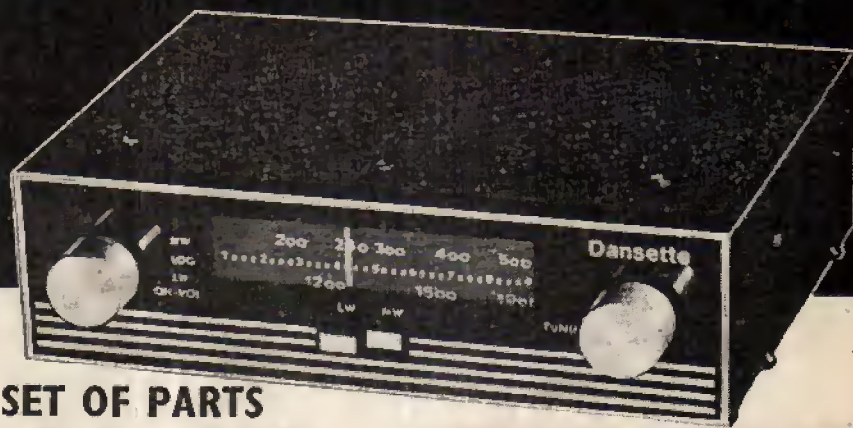
plus P. & P. 37p.

Circuit diagram 13p. Free with parts

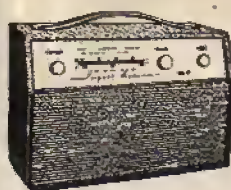
Speaker, baffle and fixing kit

£1.25 extra plus 20p. p. & p.

Postage free when ordered with parts.



The ELEGANT SEVEN Mk. III (350m W Output)



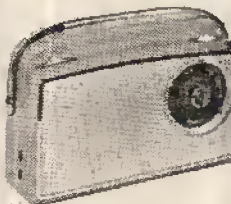
7 transistor fully-tunable M.W.—L.W. superhet portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.

MAINS POWER PACK KIT: 47p extra.

Price £5.25 plus 37p. P. & P.

Circuit 13p FREE WITH PARTS.

The DORSET (600m W Output)



Price £5.25 plus 37p P. & P.

Circuit 13p

FREE WITH PARTS

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 x 8 x 3in.

MAINS POWER PACK KIT: 47p extra.



THE RELIANT Mk III SOLID-STATE GENERAL PURPOSE AMPLIFIER

in simulated teak case £7.25 plus P. & P. 37p

SPECIFICATIONS

Output ± 10 watts.

Output impedance—3 to 4 ohms.

Inputs 1. -xtal mic 10mV Tone Controls—Treble control range ± 12 dB at 10KHz. 2. -gram/radio 250mV. Bass control range ± 13 dB at 100Hz.

Frequency Response—(with tone controls central) Minus 3dB points at 20Hz and 40KHz. Signal to Noise Ratio—better than —60dB. Transistors—4 silicon Planar type and 3 Germanium type. Mains input—220/250V. A.C. Size of chassis—10½in. x 4½in. x 2½in. For use with Std. or L.P. records, musical instruments, all makes of pick-ups and mikes. Built and tested.

THE DUO SPEAKER SYSTEM

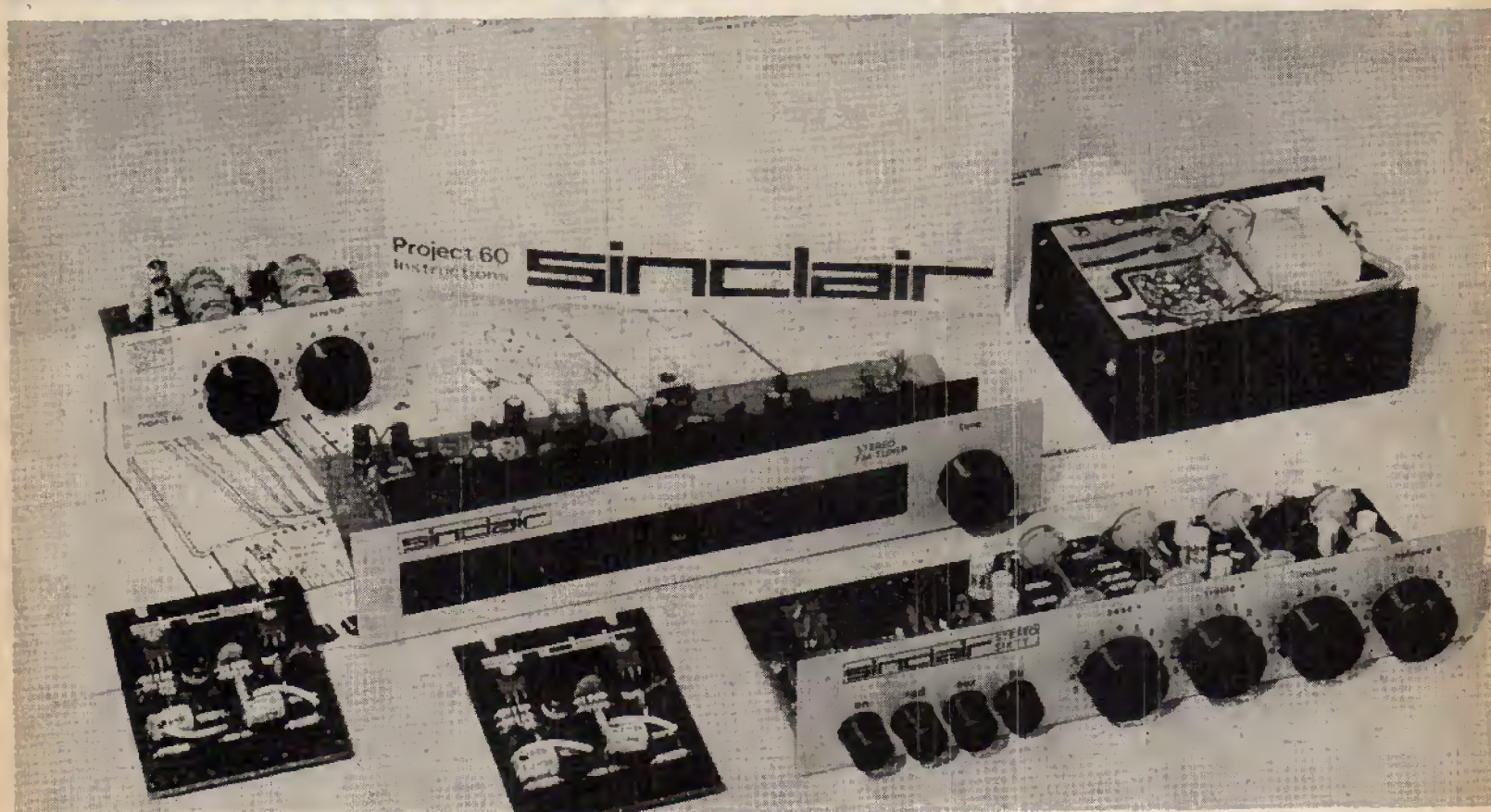
Similar in design to those on the previous page the 2-way speaker system is beautifully finished in polished teak veneer. It is ideal for wall or shelf mounting either upright or horizontally.

Type 1 SPECIFICATION:—

Impedance 8 or 10 ohms (please state requirement). It incorporates high flux 7in. x 3½in. speaker and 2½in. speaker. Teak finish 11½in. x 6in. x 5½in. £4.20 each. 37p P. & P.

RADIO & TV COMPONENTS
R+TV
(ACTON) LIMITED

Sinclair Project 60



the world's most advanced high fidelity modules

Sinclair Project 60 presents high fidelity in such a way that it meets every requirement of performance, design, quality and value and now that the remarkable phase lock loop stereo FM tuner is available, it becomes the most versatile of high fidelity systems. With Project 60, it is possible to start with a

modest mono record reproducer and expand it to a sophisticated stereophonic radio and record reproducing system of fantastically good quality to hold its own with any other equipment, no matter how expensive. Project 60 is a unique high fidelity module system where compactness and ease of assembly are combined with

circuitry that is far in advance of any other manufacturer in the world. Thus it is extraordinarily easy to assemble any combination of modules using nothing more complicated than the simplest of tools, and you certainly do not have to be experienced to build with complete confidence. The 48 page manual free with Project 60 equipment makes everything easy and you can house your assembly in an existing cabinet, motor plinth, free standing cabinet or virtually any arrangement you wish. Once you have completed your assembly you will have superlatively good equipment to give you years of service and enjoyment. You will have obtained superb value for money because Project 60 is the best selling modular system in Europe and can therefore be produced at extremely competitive prices and with excellent quality control.

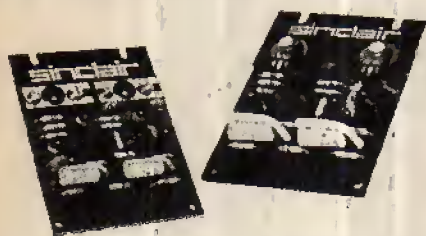
Sinclair Radionics Ltd., London Road, St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

sinclair

System	The Units to use	together with	Cost of Units
A Simple battery record player	Z.30	Crystal P.U., 12V battery volume control	£89/6 (£4.47½)
B Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U. volume control etc.	£9.9.0 (£9.45)
C 20+20 W. R.M.S. stereo amplifier for most needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., most dynamic speakers, F.M. tuner etc.	£23.18.0 (£23.90)
D 20+20 W. R.M.S. stereo amplifier with high performance spkrs.	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc.	£26.18.0 (£26.90)
E 40+40 W. R.M.S. de-luxe stereo amplifier	2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr	As for D	£32.17.6 (£32.87½)
F Outdoor P.A. system	Z.50	Mic., up to 4 P.A. speakers controls, etc.	£5.9.6 (£5.47½)
G Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£17.8.6 (£17.42½)
H High pass and low pass filters	A.F.U.	C, D or E	£5.19.6 (£5.97½)
J Radio	Stereo F.M. Tuner	C, D or E	£25.0.0

Sinclair Project 60

Z.30 & Z.50 power amplifiers



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

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

Power Outputs

Z.30 15 watts R.M.S. into 8 ohms using 35 volts; 20 watts R.M.S. into 3 ohms using 30 volts.

Z.50 40 watts R.M.S. into 3 ohms using 40 volts; 30 watts R.M.S. into 8 ohms, using 50 volts.

Frequency response: 30 to 300,000 Hz ± 1 dB

Distortion: 0.02% into 8 ohms

Signal to noise ratio: better than 70dB unweighted.

Input sensitivity: 250mV into 100 Kohms.

For speakers from 3 to 15 ohms impedance.

Size $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ in.

Z.30

Built, tested and guaranteed with circuits and instructions manual **89/6** (£4.47½)

Z.50

Built, tested and guaranteed with circuits and instructions manual **109/6** (£5.47½)

Power Supply Units



Designed specially for use with the Project 60 system of your choice.

Illustration shows PZ.5 to left and PZ.8 (for use with Z.50s) to the right. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ-5 30 volts unstabilised **£4.19.6** (£4.97½)

PZ-6 35 volts stabilised **£7.19.6** (£7.97½)

PZ-8 45 volts stabilised

(less mains transformer) **£5.19.6** (£5.97½)

PZ-8 mains transformer **£5.19.6** (£5.97½)

Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost

Stereo 60 pre-amp/control unit



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

SPECIFICATIONS

Input sensitivities: Radio—up to 3mV, Mag. p.u. 3mV; correct to R.I.A.A. curve ± 1 dB: 20 to 25,000 Hz. Ceramic p.u.—up to 3mV; Aux—up to 3mV.

Output: 250mV.

Signal-to-noise ratio: better than 70dB.

Channel matching: within 1dB.

Tone controls: TREBLE + 15 to -15dB at 10KHz; BASS + 15 to -15dB at 100Hz.

Front panel: brushed aluminium with black knobs and controls.

Size: $8\frac{1}{2} \times 1\frac{1}{2} \times 4$ ins.

Built, tested

and guaranteed.

£9.19.6 (£9.97½)

Active Filter Unit



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

Built, tested and guaranteed

£5.19.6 (£5.97½)

Stereo FM Tuner



first in the world to use the phase lock loop principle

Before production of this tuner, the phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio over other systems. Now, for the first time, the principle has been applied to an FM tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Sensitivity is such that good reception becomes possible in difficult areas. Foreign stations can be tuned in suitable conditions and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

SPECIFICATIONS:

Number of transistors: 16 plus 20 in I.C.

Tuning range: 87.5 to 108 MHz.

Capture ratio: 1.5dB

Sensitivity: 2µV for 30dB quieting; 7µV for full limiting.

Squelch level: 20µV.

A.F.C. range: ± 200 KHz

Signal to noise ratio: >65dB

Audio frequency response: 10Hz—15KHz (± 1 dB)

Total harmonic distortion: 0.15% for 30% modulation

Stereo decoder operating level: 2µV

Pilot tone suppression: 30dB

Cross talk: 40dB

I.F. frequency: 10.7 MHz

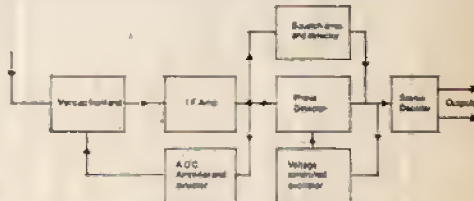
Output voltage: 2 x 150mV R.M.S.

Aerial impedance: 75 Ohms

Indicators: Mains on; Stereo on; tuning indicator

Operating voltage: 25-30 VDC

Size: 3.6 x 1.6 x 8.15 inches: 91.5 x 40 x 207 mm



Price: **£25** built and tested. Post free

To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send

Name

Address

for which I enclose cash/cheque/money order.

PW.471

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 a very low level of distortion. The IC10 is primarily intended as a full performance high fidelity power and pre-amplifier, 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.

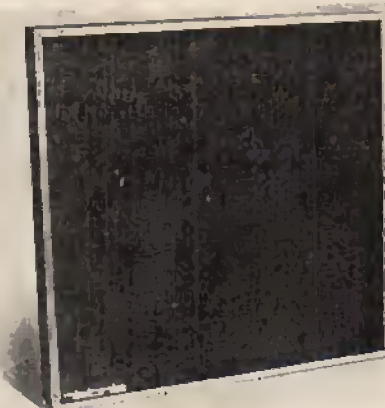
Circuit Description

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. There is 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 ± 1 dB.
Total harmonic distortion: Less than 1% at full output.
Load impedance: 3 to 15 ohms.
Power gain: 110 dB (100,000,000,000 times) total.
Supply voltage: 8 to 18 volts. (A Sinclair power unit, PZ.7 is available for mains operation).
Size: 1 x 0.4 x 0.2 in. plus heat sink and tags.
Sensitivity 5 mV.
Input impedance: Adjustable externally up to 2.5 Mohms.
Price (with manual): 59/6 (£2.97½) post free.

Q16



High fidelity loudspeaker

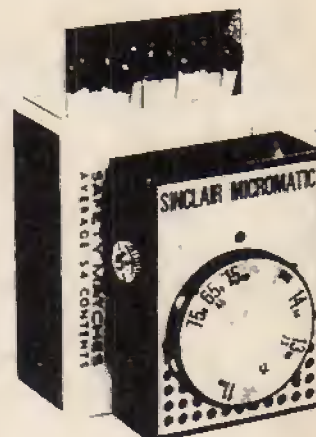
The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much 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 elegantly designed shelf mounting 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 TMS.
Input impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz, 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 a special cone suspension for excellent transient response.
Size and styling: 9½ in square on face x 4½ in. deep with neat pedestal base. Black all-over cellular foam front with natural solid teak surround.
Price £8.19.6, (£8.97½).

Micromatic



Britain's smallest radio

Considerably smaller than an ordinary box of matches, this is a multi-stage AM receiver brilliantly designed to provide remarkable standards of selectivity, power and quality for its size. 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: 36 x 33 x 13 mm (1¼ x 1⅓ x ½ in.)
Weight: including batteries, 28.4 gm (1 oz.).
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies, (550 to 1,600 Hz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder 49/6 (£2.47½).
Ready built, tested and guaranteed, with earpiece 59/6 (£2.97½).
Two Mallory Mercury batteries type RM675 required. From radio shops, chemists, etc.

To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send

Name

Address

for which I enclose cash/cheque/money order.

PW.471

Sinclair Radionics Ltd., London Road,
St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

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LINEAR RANGE OF SOLID STATE A.C. MAINS AMPLIFIERS

Employing only high grade components and transistors.



LT55 6 WATT AMPLIFIER
A HIGH FIDELITY UNIT PROVIDING EXCELLENT RESULTS AT MODEST OUTPUT LEVELS.

Recommended Retail price **£11**
Size 9½ x 2½ x 5½ in. Approx.
Controls (5) Volume, Bass, Treble, Mains Switch, Input Selector Switch.

Sensitivity 5 mv (max).
Frequency Response 30-20,000 cps—2dB
Harmonic Distortion 0.5% at 1,000 cps
Output Rating I.H.F.M. 6 Watt
Input Sockets for "Mike," Gram and Radio Tuner/Tape Recorder.
Suitable for speakers 3-15 ohms.

LT66 12 WATT STEREO AMPLIFIER

A TWIN CHANNEL VERSION OF THE LT55 PROVIDING UP TO 6 WATTS I.H.F.M. HIGH FIDELITY OUTPUT ON EACH CHANNEL.
Switched Input Facilities
Socket (1) Tape or crystal PU
(2) Radio Tuner (3) Ceramic PU Microphone.

Controls (6) Volume, Bass, Treble, Balance, Mains Switch, Input Selector Switch, Stereo/Mono Switch.

Facia Plate Rigid Perspex with black/silver background and matching black edged knobs with silver finish centres.



Recommended Retail price **£21**
Size 12 x 3½ x 6 in. Approx.

If required 'an attractive wood cabinet with veneer finish can be supplied for any model

Prices From **£3.50**

PLEASE SEND A STAMPED ADDRESSED ENVELOPE FOR FULL DETAILS OF ABOVE UNITS

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LINEAR PRODUCTS LTD, Electron Works, Armley, Leeds

P.W. COMMUNICATIONS RECEIVER

(P.W. DEC. '70)

Was built entirely from parts supplied by us.

Kits of parts exactly to spec:—

2nd Converter/I.F. Kit.....	£7.90
Product Det. (with V/C).....	£2.90
Audio Amp	£1.80
Pre Sel./1st Con.....	£5.50
Power Supply	£2.50
COMPLETE KIT All of above plus sub chassis material and F/T capacitors	£20.00

OTHER W. CAMERON DESIGNS

F.M. Tuner (Feb. 1969)	£8.20
F.M. Stereo Decoder (May '70)	£4.80
Stereo Amp (Dec.-Feb. '68).....	S.A.E. for list.

Post and packing per order 15p (Post free on complete kits)

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IR5	27	30PL14	67	EBC33	23	EL33	46	PCF805	64	R19	31
IS6	21	CCH35	65	EBF89	30	EL84	24	PCF806	63	U26	63
IT4	16	DAC32	33	ECC81	17	EY51	35	PCL82	33	U26	63
384	28	DAP91	21	ECC82	20	EY86	31	PCL84	35	U191	60
3V4	37	DAP96	35	ECC83	28	EZ80	22	PCL85	42	U251	70
6/30L2	57	DF33	37	ECC80	28	EZ81	23	PCL86	40	U329	70
6AQ5	25	DF91	16	ECC82	28	KT61	46	PEL200	54	UABC80	30
6BW7	57	DF96	35	ECH35	27	KT66	32	PL36	49	UBF69	81
6F23	71	DK32	33	ECH81	28	N78	85	PL81	48	UCC85	36
6F25	60	DK91	27	ECL80	33	PC88	49	PL82	29	UCH81	32
25L6GT	22	DK92	41	ECL82	31	PC88	49	PL83	84	UCL82	84
30C15	62	DK96	36	ECL86	27	PC97	87	PL84	30	UCL83	49
30C18	63	DL35	23	EF39	23	PC900	35	PL500	84	UF69	30
30F5	72	DL92	28	EF80	24	PCC84	41	PL504	85	UL84	32
30FL1	62	DL94	37	EF85	23	PCC89	46	PY32	64	UY85	27
30L15	63	DL96	36	EF86	31	PCCL89	50	PY33	64	Z77	18
30L17	71	DY86	26	EF89	23	PCF80	29	PY81	25		
30P4	60	DY87	26	EF91	12	PCF86	45	PY82	25		
30P19	60	EABC80	31	EF183	27	PCF801	32	PY800	35		
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Postage on 1 valve 5p, on 2 or more valves 3p per valve extra. Any parcel insured against damage in transit 3p extra. Office address, no callers.

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*NO MORE COSTLY OUTDOOR AERIALS!
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MINI-TELE **FIRST CLASS MAKERS!**

with **BIG 12" SCREEN!**

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*12 months written guarantee.

OUR FANTASTIC DISCOUNT PRICE
ONLY £51.97 **BOX CARR. P ETC. £1** **RECOMMENDED RETAIL PRICE £83.47½p**

First Class Makers—We Must Not Mention Name!

THIS OFFER ONLY FROM US! Due to Shopertunities' sensational scoop purchase of entire advance shipment for cash not only do you get this fabulous, brand spanking new 1971 model, fully transistorised, portable/main, 625-line TV with BIG 12" SCREEN well ahead of everyone else but you **SAVE £31.50 AS WELL!** Even if you've got the biggest, most expensive colour TV already—you'll love this! And at our amazing price you could even afford to buy one as a second set! Brilliantly designed incorporating the very latest techniques and refinements! Beautifully made and finished. Superb performance! Carry it from room to room as desired, simply plug in—no waiting, no "warming-up," no old fashioned outside aerials—perfect sound and crystal clear vision almost instantly! Control sound from a whisper to a roar—no image rejection, even on maximum volume! Full range of simple controls. Extra smooth station selection dial. Size overall approx. 15½" x 11" x 11½". Weight 19½lbs approx. 220/240v AC. Yes, only £51.97 carr. etc. £1. (Certified guarantee sent with every set.) No more to pay! This fantastic offer may never be repeated—so why not get two or more, while the going's good? Get one for grandma! Get one for the children! Get one for the bedroom! Get one as a gift! At Shopertunities Incredible price you just can't lose! Send or call.

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BRAND NEW 1971 Model! **RUSSIAN WORLD BEATER!** **WE COULDN'T EVEN MAKE THEM FOR THIS PRICE!**

6 WAVEBAND 10 TRANSISTOR PLUS 3 DIODES PORTABLE RADIO

WORLD WIDE RECEPTION **£9.97** **BOX POST ETC. 43p**

THOUSANDS OF TRANSMISSIONS, AND STATIONS THE WORLD OVER!

NOT JUST A RADIO—BUT TECHNOLOGICAL MAGIC!

What everyone's been waiting for—THE LATEST 1971 MODEL, SUPERSEDING ALL PREVIOUS MODELS:—THE FANTASTIC BRAND NEW RUSSIAN "MERIDIAN" 6-WAVEBAND PORTABLE RADIO. DESIGNED FOR WORLD WIDE RECEPTION. Only finally put into production after incorporation of every conceivable possible up-to-date technological improvement had been carefully considered and thoroughly examined. So advanced it will probably make your present radio seem like a "crystal set"! It's far better than any 6-wave radio even they have produced! Finest value we've ever offered! We're almost giving them away at £9.97—a mere fraction of even today's Russian miracle price! We challenge you to compare performance and value with that of £34 radios! *You can't lose. Instant refund if you are not astounded! Purer and sweeter tone than ever! Much wider band spread than hitherto for "pin-point" station selection! Once again the Russians have proved their fantastic ability in the field of electronics—brilliantly reflecting their advanced micro-circuitry techniques in the field of spaceship and satellite communications. YOU GET THIS AMAZING SET FROM US AT A PRICE THAT BEARS NO RELATION TO ITS TRUE VALUE! Yes, 6 separate wavebands, including Standard Long, Medium and Short Waves to cover the world! Unique slide control waveband selection unit gives incredible ease of station tuning! Thousands of different transmissions and stations at your fingertips 24 hours a day, even ships at sea and messages from all over the world—nothing is secret! The radio enthusiast can have the world in the palm of his hand! Superb, sweet tone—controlled from a whisper to a roar that will fill a hall! Genuine push-pull output! Separate ON/OFF volume and Treble/Bass tone controls! Take it anywhere—runs economically on standard batteries. Internal ferrite rod aerial plus built-in telescopic aerial extending to full 33½ in. length. It's also a fabulous **CAR RADIO**—any speed, requires no additional aerial. **UNIQUE!** Elegant Black, White and Chrome finish case. SIZE 10½" x 8" x 3½" overall approx. Magnificently designed and made to give years of perfect service. With **WRITTEN GUARANTEE**, manual with simple operating instructions and circuit diagram. **ONLY £9.97, POST ETC., 43p.** Standard batteries 25p extra. Can also be used through extension amplifier, tape recorder or public address. Send or call.

SHOPERTUNITIES LTD. S.L. Dept. WP/4, 184 UXBRIDGE ROAD, (facing Shepherd's Bush Green), LONDON, W12 8AQ (Thurs. 1, Fri. 7). Also 37 High Holborn, London, W.C.1 (Wed. 1, Thurs. 7). Both stores open from MON.-SAT. from 9 a.m. until 6 p.m.

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DRIVE-IN CAR PARK



Rec. Retail Price Comet Price

STEREO AMPLIFIERS

ARMSTRONG 521	58.00	44.50
DULCI 207	25.00	17.00
*DULCI 207M	30.00	21.00
FERROGRAPH F307	59.00	48.00
GOODMANS Maxamp	54.00	38.00
LEAK Stereo 30 Plus	56.50	44.75
LEAK Stereo 30 Plus, in teak case	62.50	49.50
LEAK Stereo 70	69.00	55.00
LEAK Stereo 70, in teak case	75.00	59.50
*LINEAR LT 68	21.00	17.00
METROSOUND ST20	36.00	28.00
PHILIPS RH 591	76.75	59.00
PHILIPS RH 590	51.75	39.50
PHILIPS RH 580	28.00	22.00
PIONEER SA500	62.10	43.00
PIONEER SA700	98.00	70.00
PIONEER SA900	134.10	97.00
PIONEER Reverberation	45.50	33.00
ROGERS Ravensbourne	59.50	47.00
ROGERS Ravensbourne (cased)	64.00	50.00
ROGERS Ravensbrook Mk. II	47.50	38.00
ROGERS Ravensbrook (cased)		
Mk. II	52.50	42.00
*SINCLAIR 2000	30.45	23.00
SINCLAIR PROJECT 60/2 X Z30/		
PZ5	23.90	17.00
SINCLAIR PROJECT 60/2 X Z50/		
PZ8/trans.	32.88	23.50
SINCLAIR Neoteric	61.95	46.00
SINCLAIR 3000	45.00	38.00
TELETON 203E	28.75	20.00
TELETON GA 101 30w RMS	37.50	28.50
VOLTEX 100w Stereo Discotheque,		
8 electronically mixed inputs	185.00	139.00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

TUNERS

*ARMSTRONG 523 AM/FM	53.76	45.00
*ARMSTRONG 524 FM	41.89	35.00
ARMSTRONG M8 Decoder	9.50	8.00
*DULCI FMT.7 FM	22.05	18.00
DULCI FMT.7S Stereo	31.00	25.25
GOODMANS Stereomax	82.52	49.95
LEAK Stereofetic Chassis	65.50	52.00
LEAK Stereofetic in teak case	72.50	59.00
PHILIPS RH 690	44.50	35.50
PHILIPS RH 691	89.00	75.50
PIONEER TX500 AM/FM	77.94	64.00
PIONEER TX900 AM/FM	153.69	125.00
ROGERS Ravensbourne	61.89	50.00
ROGERS Ravensbrook	45.01	40.00
ROGERS Ravensbrook (cased)	51.26	43.00
*SINCLAIR 2000	26.73	19.25
SINCLAIR Project 60	25.00	21.00
TELETON GT 101	45.50	34.00
TELETON 201X FM	36.00	30.00

All above Tuners are complete with MPX Stereo Decoder except where starred.

TUNER/AMPLIFIERS

AKAI 6600	142.53	112.00
ARENA R500	82.00	67.00
ARENA 2400	90.30	72.00
ARENA 2600 Stereo AM/FM	111.30	94.00
ARENA 2700	105.00	85.00
ARENA T1500F	72.45	60.00
ARENA T9000	303.45	258.00
ARMSTRONG M8 Decoder	9.50	8.00
ARMSTRONG 525	91.89	77.00
ARMSTRONG 526	104.71	87.00
GOODMANS 3000	77.73	53.00
*PHILIPS RH 781	74.98	55.00
PHILIPS RH 790	135.00	109.00
PIONEER KX330 AM/FM/SW	78.62	63.00
PIONEER SX770 AM/FM	160.43	128.00
PIONEER SX990 AM/FM	194.74	150.00
*TELETON F2000	51.50	32.00
TELETON 7 AT 20	105.00	80.00
TELETON 10AT1 150w. RMS	160.00	109.00
TELETON TFS50	75.50	58.00
*TELETON R.8000 with Speakers	63.25	50.00
TELETON CR55	120.00	95.00
WHARFEDALE 100.1	131.25	105.00

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

All the above Tuners and Tuner/Amplifiers include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

PICKUP ARMS

GOLDRING Lenco L75	12.33	10.50
GOLDRING Lenco L69	9.29	7.00
SME 3009 with S2 Shell	31.31	26.00
SME 3012 with S2 Shell	33.36	29.00

CARTRIDGES

GOLDRING 800	13.00	7.50
GOLDRING 800H	10.69	8.00
GOLDRING 800E	18.86	12.25
GOLDRING 800 Super E	26.01	20.00
*GOLDRING CS90 Stereo	5.20	4.25
*GOLDRING CS91/E	7.81	6.25
GOLDRING G850	6.50	5.25
EMPIRE 100ZE/X	63.00	52.50
EMPIRE 999VE/X	44.50	36.00
EMPIRE 999TE/X	27.60	22.50
EMPIRE 999SE/X	21.00	17.50
EMPIRE 999E/X	16.50	13.00
EMPIRE 999/X	11.50	9.25
EMPIRE 909E/X	12.85	10.25
EMPIRE 909X	9.00	7.50
EMPIRE 90EE/X	9.75	8.00
ORBIT Magnetic NM 22	Special Price 2.00	
PICKERING V15 AC2	8.40	7.00
ORTOFON SL15E	29.65	23.75
ORTOFON 2X15K Transformer	7.00	5.25
SHURE M3DM	7.41	5.25
SHURE M31E	12.05	9.50
SHURE M32E	11.10	8.75
SHURE M32-3	10.20	8.00
SHURE M44-5	11.10	8.50
SHURE M44-7	10.20	8.00
SHURE M44C	10.20	8.00
SHURE M44E	12.05	9.50
SHURE M55E	12.95	10.25
SHURE M75G	17.60	14.00
SHURE M75-6	16.70	13.00
SHURE M75EJ	19.45	16.00
SHURE M75E-95G	23.15	18.00
SHURE M75E	21.30	16.00
SHURE M75E/D19	23.15	19.00
SHURE V15-11	40.76	30.00
SHURE V15-11-7	38.90	29.00

Starred cartridges above are ceramic. All others are magnetic.

TURNABLES

GARRARD SP25, fully wired with Goldring G800 Magnetic Cartridge. Complete with base, plinth and cover—Special Price	20.98	
DUAL 1219 transcription	60.40	50.00
DUAL 1208 transcription	42.62	35.00
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GARRARD SL85 B	21.25	15.90
GARRARD SL75 B	38.95	28.50
GARRARD SL95 B	53.27	38.50
GARRARD 401	38.07	29.50
GARRARD SL72 B	32.77	26.90
GARRARD 3500, with GKS Cartridge	17.23	12.90
Base and Cover to fit GARRARD SP25, SL55, SL65B and 3500	Special Price 4.00	
GARRARD 408	13.84	10.97
GARRARD AP 76	28.88	21.50
GOLDRING 705/P with 850 Cartridge and Cover	26.00	23.90
GOLDRING GL69 Mk. II	26.63	22.50
GOLDRING GL69 P Mk. II	35.14	29.50
GOLDRING GL75	36.41	33.90
GOLDRING GL75 P	46.94	41.90
GOLDRING Covers for 69P and 75P	4.21	3.50
GOLDRING C99—plinth and cover for G99	11.45	9.90
GOLDRING G99	26.00	23.90
GOODMANS 3025	37.74	26.90
MCDONALD MP 60	15.75	12.25

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Pictured, Service Dept at Clough Rd, Hull also at Leeds, Goole, Wakefield, Doncaster, and Bridlington



Rec. Retail Price Comet Price

MCDONALD 610	20.00	15.90
Base and Cover for MCDONALD MP 60 and 610	Special Price 4.50	
PHILIPS 228	20.00	17.00
PHILIPS GA 146	31.50	25.00
PHILIPS 217	33.00	28.00
PHILIPS 202 Electronic	69.00	57.50
PIONEER PL 12A	50.90	39.95
PIONEER PL11	57.90	39.00
THORENS TX 25 cover	8.22	6.53
THORENS TD125	75.89	62.00
THORENS TD150A Mk. II	43.63	33.00
THORENS TD125AB	120.20	100.00
THORENS TD150AB Mk. II	47.43	41.00
THORENS TX11 Cover	4.11	3.75

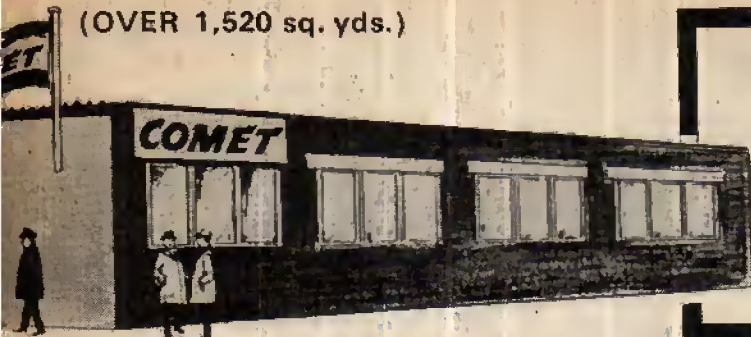
SPEAKERS

ARENA HT 16	13.00	10.95
B & W Model 70	139.50	115.00
B & W DM3	63.00	53.00
B & W DM1	32.00	25.50
CELESTION Dilton 120	24.00	18.00
CELESTION Dilton 15	29.00	23.00
CELESTION Dilton 25	59.85	47.00
GOODMANS Minister	22.45	19.00
GOODMANS Magister	57.00	45.00
GOODMANS Maxim	20.39	16.75
GOODMANS Mezzo 3	30.90	23.90
GOODMANS Magnum K2	40.10	29.90
KEF Celeste	29.00	21.50
KEF Concord	43.50	33.00
KEF Concerto	53.50	42.00
KEF Cresta	22.17	18.00
KELETRON KN 654/3 3 speaker system (pair)	19.00	14.97
KELETRON KN 824/3 3 speaker system (pair)	23.00	18.97
KELETRON KN 104/3 3 speaker system	16.75	12.97
KELETRON KN 123/3 3 speaker system	18.75	15.97
KELETRON KN 120/4 4 speaker system	24.50	18.97
LEAK 200	24.95	17.90
LEAK 300	32.50	23.50
LEAK 600	49.50	36.90
LOWTHER Acousta (with PM6)	45.50	38.50
LOWTHER Acousta (with PM7)	53.00	46.00
LOWTHER Ideal Baffle	35.50	30.00
METROSOUND HFS 20	18.50	13.50
PHILIPS RH481	11.00	9.25
PHILIPS RH482	18.00	15.00
SINCLAIR Q16	8.98	8.00
STE-MA 275 3 speaker system	23.10	15.00
WHARFEDALE Speakers		
Airedale	69.50	56.00
Denton	19.95	15.90
Super Linton	24.95	20.50
Melton	32.50	25.50
Dovedale 3	42.50	32.50
Rosedale	65.00	52.50
Triton (pair)	59.90	48.90
Unit 3 Speaker Kit	13.00	10.50
Unit 4 Speaker Kit	18.00	14.25
Unit 5 Speaker Kit	26.00	20.50

CHASSIS SPEAKERS

GOODMANS Axiote 8	7.48	6.00
GOODMANS Twinaxlette 8	8.44	7.00
GOODMANS Axiom 10	8.84	7.00
GOODMANS Axiom 80	26.07	21.75
GOODMANS Axiom 201	13.45	10.00
GOODMANS Axiom 301	19.25	14.50
GOODMANS Audiom 8P	5.50	4.25
GOODMANS Audiom 10P	6.00	3.58
GOODMANS Audiom 51	12.15	9.50
GOODMANS Audiom 61	17.60	13.00
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GOODMANS Twin Axiom 10	9.42	7.75
GOODMANS ARU 172	3.89	3.00
GOODMANS Trebax 100	7.45	5.50
GOODMANS Trebax 5K/20XL	8.40	6.50
GOODMANS Midax	11.20	8.50
GOODMANS Attenuator	3.07	2.25
GOODMANS Crossover Networks		
XO/950/5000	8.43	6.25
GOODMANS Crossover Networks		
XO/950	6.39	4.75
GOODMANS Crossover Networks		
XO/5000	2.30	1.75
WHARFEDALE 8 in. Bronze/RS/DD	5.00	4.00
WHARFEDALE Super 8/RS/DD	8.50	7.00
WHARFEDALE Super 10/RS/DD	14.00	11.50
WHARFEDALE WMT 1 Matching Transformer	0.84	0.75

LOW COST AUDIO SYSTEMS (complete)

ALBA UA552	47.50	35.98
ALBA UA682	62.99	47.98
ARENA MR 15	145.00	115.98
BUSH System 749/746/764	102.65	82.75
DECCA Sound 803	72.50	60.00
DECCA Sound 804	72.50	61.00
DECCA Sound 1203	97.50	80.00
DECCALIAN 5, complete with stand	65.50	53.00
EKCO S.R.G. 609	88.50	70.00
FERGUSON 2065	117.00	80.00
FERGUSON 3422	84.70	69.00
GOODMANS 3000 Suite	140.45	96.00
HMV 2416	129.70	105.00
HMV 2404/5/6	202.85	170.00
KB KA1250	72.00	56.00
KB KA1250/651	83.00	63.98
MARCONI Unit 4	77.45	67.00
MARCONI Unit 3	86.00	70.00
METROSOUND Stereo 1010	77.32	66.00
PHILIPS GF 823	49.50	39.98
PHILIPS GP 824	67.50	55.98
PHILIPS RF 833	67.50	55.98
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TELETON 8-track Stereo	52.25	46.00
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TELETON CMS400	102.50	70.00
TELETON 2S60F	75.00	56.00
TOSHIBA SP8507	248.00	181.00
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ALBA R22 Twin Track Battery/Mains	50.25	24.98
AKAI M10L	245.05	189.99
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FERGUSON 3245 Twin track	37.05	30.00

FERGUSON 3246 4-track	43.00	34.00
FERGUSON 3247 4-track	48.45	39.00
FERGUSON 3248 4-track	54.30	42.00
FERGUSON 3249 4-track	64.30	50.00
FERROGRAPH 722	242.54	199.00
FERROGRAPH 724	242.54	199.00
FERROGRAPH 702/W 2 track tape deck	207.35	175.00
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GRUNDIG TK 141 (4-track)	61.85	50.00
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GRUNDIG TK 146 (4-track Auto)	68.14	53.98
GRUNDIG TK 124 Twin-track	44.90	35.00
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PHILIPS 2202	29.90	24.00
PHILIPS 2205 Cassette Tape Recorder	43.15	34.98
PHILIPS 4404 4-track stereo recorder	95.00	73.98
PHILIPS 4407 4-track stereo recorder	110.00	89.98
PHILIPS 4302 Twin Track Auto	39.00	32.00
PHILIPS 4307 4-track	49.50	39.00
PHILIPS 4500 4-Track Stereo Tape Deck	126.00	99.00
PHILIPS 4408 4-Track Stereo	139.00	109.00
PHILIPS N4404 4-Track Stereo	83.00	70.00
PHILIPS N4308	60.50	50.00
PYE Cassette Recorder/Radio (Batt./Mains)	45.50	37.00
TELETON FXB 510 D 4-track Stereo	62.50	48.00
TELETON SL40 Twin Track Battery/Mains	38.50	25.00
TELETON TRC 130 cassette, with VHF/AM radio battery/mains twin motors	39.50	29.98
TELETON TC110 cassette battery/mains	27.50	19.98
TOSHIBA GT 840 S	110.00	80.00
TOSHIBA GT 601v Twin Track	45.15	30.00
TOSHIBA 850 SA	94.00	60.00

PHILIPS 2205 Cassette Tape Recorder	43.15	34.98
PHILIPS 4404 4-track stereo recorder	95.00	73.98
PHILIPS 4407 4-track stereo recorder	110.00	89.98
PHILIPS 4302 Twin Track Auto	39.00	32.00
PHILIPS 4307 4-track	49.50	39.00
PHILIPS 4500 4-Track Stereo Tape Deck	126.00	99.00
PHILIPS 4408 4-Track Stereo	139.00	109.00
PHILIPS N4404 4-Track Stereo	83.00	70.00
PHILIPS N4308	60.50	50.00

PYE Cassette Recorder/Radio (Batt./Mains)	45.50	37.00
TELETON FXB 510 D 4-track Stereo	62.50	48.00
TELETON SL40 Twin Track Battery/Mains	38.50	25.00
TELETON TRC 130 cassette, with VHF/AM radio battery/mains twin motors	39.50	29.98
TELETON TC110 cassette battery/mains	27.50	19.98
TOSHIBA GT 840 S	110.00	80.00
TOSHIBA GT 601v Twin Track	45.15	30.00
TOSHIBA 850 SA	94.00	60.00

BASES AND COVERS

GARRARD WB1 Base	3.86	3.25
GARRARD WB4 Base	5.69	4.75
GARRARD SPC 1 Cover	3.74	3.00
GARRARD SPC 4 Cover	4.44	3.75

SPECIAL OFFER OF BASE AND COVER TO FIT

GARRARD SP25, SL55, SL65B and 3500	Special Price	4.00
GOLDRING Plinth 75	8.52	7.00
GOLDRING Plinth 69	8.52	7.00
GOLDRING Covers for 69P and 75P	4.21	3.50
THORENS TX25 (for TD125AB)	8.22	6.50
THORENS TX11 Cover	4.11	3.75
Base and Cover for TD 125	15.18	12.50
SME Plinth System 2000	39.20	31.25
MOTORBOARDS only	4.95	3.00

HEADPHONES

AKAI	6.50	5.25
AGK K60	13.50	10.75
KOSS ESP-9 Electrostatic	69.00	53.50
KOSS ESP-6 Electrostatic	45.00	36.00
KOSS PRO-4AA	28.00	22.50
KOSS PRO-4A	23.00	18.50
KOSS KO-727B	16.50	13.50
KOSS K-8	12.50	9.95
KOSS SP-3XC	9.50	7.50
MIDLAND SH700	Special Price	3.95
SHIRO	Special Price	4.00
TELETON	5.00	3.25

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Leak 70/30 Amp. case	7.17	6.25
Leak Tuner case	7.17	6.25
Leak Double case for amp. & tuner	9.93	8.50

COMPLETE HI-FI SYSTEMS

Completely wired, mounted and ready for use

TELETON Stereo 8 track tape Audio system complete	52.25	46.00
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GARRARD SP 25, mounted in base, plinth and cover with GOLDRING G800 Cartridge. Teleton 203 Stereo Amplifier 12 watts RMS, and 2 KELETRON 654/3 Speakers, each speaker is a 2 speaker system	84.33	56.00
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GOLDRING GL 69P Mk. 11 mounted in base with hinged lid, GOLDRING G800 Cartridge, Rogers Ravensbrook Amplifier in Teak case. Two Wharfedale Super Linton Speakers	151.25	115.95
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GOLDRING GL 75P mounted in teak base with hinged perspex cover complete with GOLDRING G800E Cartridge, Leak Stereo 30 Plus Amplifier in Teak case. 2 GOODMANS Mezzo 3 Speakers	194.30	149.00
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THORENS TD 150AB Mk. II with TX11 dust cover, SHURE M55E Cartridge, LEAK Stereo 70 Amplifier in Teak case. 2 Wharfedale Dovedale 3 Speakers	224.50	175.00
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THORENS TD 125AB Electronic Turntable complete with cover. SHURE V15-11 Cartridge, GOODMANS Maxamp, GOODMANS Stereomax AM/FM Tuner, 2 GOODMANS Magister Speakers	419.65	319.00
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F.A.L. PHASE 50 MK.II AMPLIFIER PR. FANE POP 50 L/SPEAKERS Terms: Deposit £10.50 and 9 monthly payments of £5 (Total £55.50)	£28.50 £21	PACKAGE PRICE £49.50 carr. £1
F.A.L. PHASE 100 AMPLIFIER PR. L125 50W L/S in cabinets Terms: Deposit £22 and 9 monthly payments of £11 (Total £121)	£62.95 £59.80	PACKAGE PRICE £110 carr. £1.50
F.A.L. PHASE 100 AMPLIFIER 4 FANE POP 50 L/SPEAKERS Terms: Deposit £14 and 9 monthly payments of £10 (Total £104)	£62.95 £42	PACKAGE PRICE £94 carr. £1.50
	£104.95	

AUDIOTRINE HI-FI SPEAKER SYSTEMS

Consisting of matched 12in. 11,000 line 15 Watt 15 ohm high quality speaker, cross-over unit and tweeter. Smooth response and extended frequency range ensure surprisingly realistic reproduction. **£5.75**

OR SENIOR 15 WATT INC. HF126
15,000 LINE SPEAKER carr. 35p **£6.75** Carr. 30p

AUDIOTRINE HIGH FIDELITY LOUDSPEAKERS

Heavy construction. Latest high efficiency ceramic magnets. Treated Cone surround. "D" indicates Tweeter Cone providing extended frequency range up to 15,000 c.p.s. Impedance 3 or 8-15 ohms. Please state choice. Exceptional performance at low cost.

HF801D 8" 8W	£2.71	HF120D 12" 15W	£4.49
HF102D 10" 10W	£3.40	HF128 12" 15W	£5.25
HF120 12" 15W	£3.99	HF128D 12" 15W	£5.75

FANE 807 HIGH FIDELITY LOUDSPEAKER

A full range 8in. 10 watt unit for excellent sound quality, in suitable enclosure. Cast chassis Roll P.V.C. cone surround and long throw voice coil to achieve very low fundamental resonance of 30 c.p.s. Tweeter cone is fitted to extend high note response. Frequency range 25-15 KHz. Impedance 3 or 8-15 Ω . **£3.50** Gauss 10,000. Remarkable value.

HI-FI SPEAKER ENCLOSURES

Modern design. Teak veneer finish. Acoustically lined.

All sizes approx. Carr. 25p. per enclosure

JES Size 16 x 11 x 9in. Pressurised. Gives **£4.75**

pleasing results with any 8in. Hi-Fi speaker. **£5.75**

SE8 For optimum performance with any 8in. Hi-Fi speaker. Size 22 x 15 x 9in. Ported

SE10 For outstanding results SE12 For excelnt primnce with 12in. with 10in. Hi-Fi spkr

Size 24x15x10in. Ptd. **£5.99** Hi-Fi speaker and Tweeter. **£6.99**

Size 25 x 16 x 10in.

RECORD PLAYING UNITS

Money saving units. Mounted on Plinth. Supplied with transparent plastic cover. Ready to plug into Amp. or Tape recorder.

RPIC Garrard 3000 4-speed Auto-change Unit with Sonotone 9TA/HC Ceramic Stereo Cartridge. **£19.45** Carr. 50p.

RP23C Garrard SP25 Mk III fitted Goldring CS90 high compliance ceramic Stereo/Mono cartridge with diamond stylus. **£26.09** Carr. 50p

RPC6 Garrard 5200 Auto Unit fitted Stereo Cartridge Plinth & Cover as RP2C **£15** carr. 50p.

Other types available with Magnetic cartridges and with alternative design plinths.

R.S.C. PLINTHS

Superior Solid Natural Wood Construction

for Record Playing units, cut for Garrard

1025, 2025, 3000, AT60, SP25 etc.

£3.15

WITH TRANSP. PLASTIC COVER **£6.30**

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Introducing R.S.C. MkIII SUPER 30 HI-FI STEREO AMPLIFIER

A COMPLETELY NEW DESIGN FURTHER IMPROVED IN BOTH APPEARANCE and PERFORMANCE. REPRESENTING VALUE FAR HIGHER THAN THE £25 PRICES SUGGEST. Only

high grade components by leading manufacturers. Complete kit of parts.

Or FACTORY BUILT with 12 months guarantee **£33.75**

Or FACTORY BUILT in cabinet as illustrated **£36.75**

PRINTED CIRCUITRY, TWENTY SILICON TRANSISTORS.

FOUR DIODES, FOUR RECTIFIERS.

TECHNICAL DETAILS (Applying to each channel where appropriate)

CONTROLS: PUSH-BUTTON SELECTOR (1) Disc (2) Radio (3) Tape (4) Mono L (5) Mono R (6) SPEAKER DIS. (7) Mains on/off. Bass, Treble, and Balance. Plus Ceramic/Mag P.U. Switch.



- ★ SATIN SILVER METAL FACIA with black lettering. Black edged knobs with bright silver centres.
- ★ PUSH-BUTTON SELECTOR SWITCHING
- ★ NEON INDICATOR
- ★ JACK SOCKET FOR HEADPHONE CONNECTION
- ★ CABINETED MODEL VENEERED IN SATIN TEAK. SUITABLE FOR ANY MODERN PICK-UP CARTRIDGE or MAGNETIC, REGARDLESS OF PRICE. WE RECOMMEND USE WITH THE BEST ANCILLARY EQUIPMENT THAT CAN BE AFFORDED.

OUTPUT: 15 watts R.M.S. (Continuous) into 8 ohms HUM and NOISE—75dB Min. Vol. 10 watts R.M.S. (Continuous) into 15 ohms—65dB Full Vol.
FREQUENCY RESPONSE: —3dB 7Hz to 70KHz HARMONIC DISTORTION
TREBLE CONTROL: +16dB to —12dB at 14KHz 0-1% at 1000 Hz 1D W
BASS CONTROL: +17dB to —16dB at 40Hz CROSS TALK —58dB
SENSITIVITIES: Disc Mag. 2.5mV. Ceramic 35mV. Radio 120mV. Tape 120mV.
REAR PANEL SOCKETS ARE FOR 3 PAIRS OF INPUTS (1) P.U. (2) Radio, (3) Tape Amp. Plus pair for tape recorder signal take off and 2 pairs for loudspeaker connections.

R.S.C. HIGH FIDELITY STEREO 'PACKAGE' OFFERS

- ★ Four fully wired units ready to 'plug in.' SUPER 30 AMPLIFIER (15 + 15 watt) in veneered housing
- ★ GARRARD SP25 MKIII Turntable on Plinth with cover
- ★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
- ★ PR. OF STANWAY II Speaker Units **£79.80**

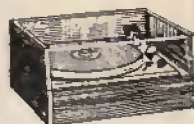
Special Total Price Carr. £1.50

- ★ Super 30 Amplifier (15 + 15 watt) in veneered housing
- ★ Goldring GL69 Transcription Turntable on Plinth as illustrated
- ★ Goldring Magnetic P.U. Cartridge.
- ★ Pair of Stanway II speaker units **£96.75**

Special Total Price Carr. £1.50

Matching as recommended for optimum performance. Send S.A.E. for coloured brochure showing other money-saving offers.

Package prices apply providing all individual units are purchased from any branch within 3 months. See leaflet.



ATTRACTIVE TEAK or AFORMOSIA VENEERED CABINETS and PLINTHS

- ★ TA12 AMPLIFIER 6.5+6.5 watt in veneered housing
- ★ GARRARD SP25 MK III Player unit on Plinth
- ★ GOLDRING CS90 Ceramic P.U. Cartridge with diamond stylus
- ★ PAIR OF DORCHESTER Loudspeaker Units

Special **£58** Carr. £1.25

Total Price

Or Deposit £7.15 and 9 monthly payments £6.35 (Total £64.30). Trans. Plastic Cover £3.15 extra. Package as above but with Garrard 8000 Auto-changer and Sonotone 9TA Ceramic Cartridge in lieu of SP25 £51.75 Carr. £1.25 Or Deposit £6 and 9 monthly payments £5.70 (Total £57.60) Trans. Plastic cover £3.15 extra.

TERMS AVAILABLE ON ALL PACKAGE OFFERS

AUDIOTRINE A55 HIGH QUALITY STEREO SYSTEM

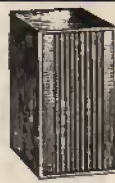
5 + 5 WATT OUTPUT

GARRARD 5200 Changer with low mass pick-up arm and Stereo Cartridge. CONTROLS: TREBLE, BASS, VOLUME, STEREO, BALANCE.

Operation on 200-250v.

A.C. mains.

Output rating. I.H.F.M



Luxurious Teak Veneer Finished Cabinets. Transparent plastic (tinted) cover included for main unit. Silver finished facia plate and matching control knobs.

A REALLY SURPRISING STANDARD OF QUALITY IS OBTAINABLE FROM THIS COMPACT LOW PRICED SYSTEM

PAIR OF LOUDSPEAKER UNITS

incorporating high flux 8 x 5 ins. speaker. Size approx. 13 x 7 1/4 x 8 1/2 ins.

Price complete **£42**

ONLY Carr. £1.25

Terms: Deposit £5.50 and 9 monthly payments £4.50 (Total £46.)

LOW DEPOSIT CREDIT TERMS

AVAILABLE ON PURCHASES OVER £8 (KITS OF PARTS EXCEPTED)

INTEREST CHARGES REFUNDED

ON CREDIT SALES SETTLED IN 3 MONTHS

RSC G66 6+6 WATT high quality STEREO AMPLIFIER

Individual Ganged controls: Bass, Treble, Volume and Balance. Printed circuit construction employing 10 Transistors plus Diodes. Output rating I.H.F.M. Suitable for Crystal Pick-ups, etc., and for loudspeaker output impedances of 3 to 15 ohms. For standard 200—250v A.C. mains operation. Attractive silver finished metal facia plate and matching control knobs.

Complete KIT OF PARTS INCLUDING FULLY WIRED PRINTED CIRCUIT and comprehensive wiring diagram and instructions **£9.99**



Or FACTORY BUILT IN TEAK VENEERED CABINET as illus. **£12.50** carr 40p, or dep £2 and 9 mthly pymnts. £1.45 (Total £15.05).

'YORK' HIGH-FIDELITY 3 SPEAKER SYSTEM

- ★ Moderate size only 25 x 14 x 10in.
- ★ Response 30-20,000 c.p.s. Impedance 15 ohms
- ★ Performance comparable with units costing considerably more. Consists of (1) 12in. 15 watt Bass unit with cast chassis, Roll rubber cone surround for ultra low resonance, and ceramic magnet. (2) 3-way quarter section series cross-over system. (3) 8 x 5in. high flux middle range speaker. (4) High efficiency tweeter. (5) Appropriate quantity acoustic damping material (6) Handsome Teak veneered cabinet. (7) Circuit and full instructions. Terms: Dep. £4.50 and 9 mthly. pymnts. £2.25 (Total £24.75)

DEMONSTRATIONS AT ALL BRANCHES

HIGH FIDELITY LOUDSPEAKER UNITS Cabinets latest

style Satin Teak or Afrormosia veneer. Acoustically lined or filled acoustic damping. Ported where appropriate. Credit terms available.

DORCHESTER Size 16 x 11 x 9in. appr. Range 45-15,000 c.p.s.

Rating 8-10 watts. Fitted High flux 13 x 5in. **£9.45** Carr. 40p.

Dual Cone speaker. Imp. 3 or 15 ohms.

STANWAY II Size 20 x 10 1/2 x 9 1/2in. approx. Rating 10 watts. Inc.

13 x 8in. speaker with highly flexible cone surround, long throw voice coil and 11,000 line magnet. High flux tweeter. Handsome Scandinavian design cabinet. Range 35-20,000 c.p.s. Imp. 15 ohms. Gives **£17.85**

smooth realistic sound output. See above for illustration

R.S.C. TA12 MKIII 6.5 + 6.5 WATT STEREO AMPLIFIER

FULLY TRANSISTORISED, SOLID STATE CONSTRUCTION

HIGH FIDELITY OUTPUT OF 6.5 WATTS PER CHANNEL

Designed for optimum performance with any crystal or ceramic Gram. P.U. cartridge, Radio tuner, Tape recorder etc. ★ 3 separate switched input sockets on each channel ★ Separate Bass and Treble controls ★ Slide Switch for mono use ★ Speaker Output 3-15 ohms ★ For 200-250v. A.C. mains ★ Frequency Response 20-20,000 c.p.s. —2dB ★ Harmonic Distortion 0.3% at 1,000 c.p.s. Hum and Noise —70dB ★ Sensitivities (1) 50mV (2) 400mV (3) 100mV. Output rating I.H.F.M. ★ Handsome finish Facia plate & knobs.

COMPLETE KIT OF PARTS WITH FULL WIRING DIAGRAMS & INSTRUCTIONS.

Factory built with 12 months guarantee **£19.50** or Deposit £3 and **£15.50** Carr. 40p.

9 mthly pymnts £2.05 (Total £21.45). Or in Teak veneer housing

£23 Dep. £3 & 9 mthly payments £2.55 (Total £25.95). Send S.A.E. for leaflet



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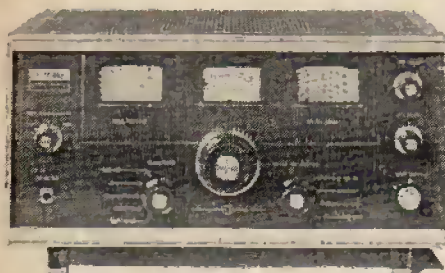
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MARCH ISSUE



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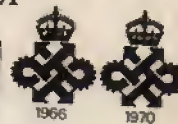
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10 1/2"	7 1/2"	1 14 6	2 2 6	2 6 0
12 1/2"	3 1/2"	1 5 0	1 11 9	1 17 6
12 1/2"	5 1/2"	1 14 0	2 2 0	2 5 6
12 1/2"	8 1/2"	2 3 0	2 11 6	2 15 6
14 1/2"	3 1/2"	1 10 0	1 17 6	2 2 0
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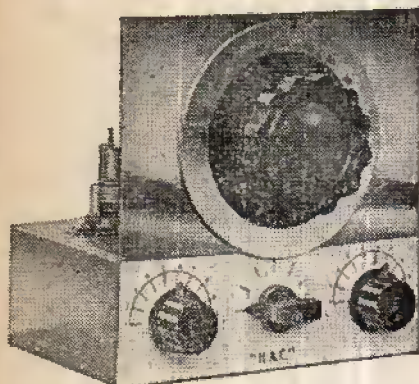
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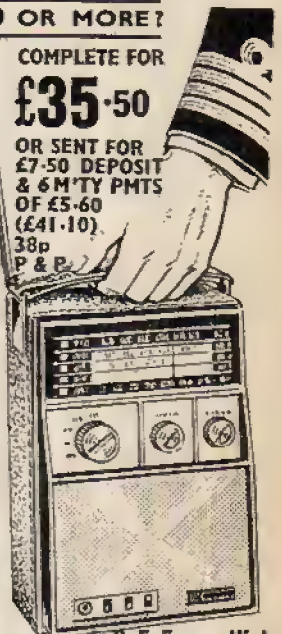
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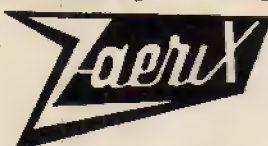
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EF89	0.28	EZ41	0.45	PCL801	0.70	U201	0.35
EF91	0.23	EZ80	0.25	PD500	1.50	U281	0.40
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EL33	1.25	KT66	1.70	PL302	0.80	UBC41	0.50
EL34	0.50	KT88	1.75	PL504	0.80	UBC81	0.40
EL36	0.50	N78	1.15	PL508	0.90	UBF80	0.40
EL37	1.25	PABCS00.40		PL509	1.30	UBF89	0.35
EL41	0.55	PC86	0.60	PL509	1.30	UBL1	0.50
EL42	0.58	PC89	0.80	PL801	0.80	UBL21	0.50
EL81	0.55	PC97	0.50	PM84	0.50	UC92	0.35
EL83	0.42	PC900	0.43	PY31	0.30	UCC85	0.40
EL84	0.25	PC84	0.40	PY33	0.63	UCF80	0.55
EL85	0.43	PC85	0.40	PY80	0.35	UCH21	0.60
EL86	0.40	PC88	0.55	PY81	0.30	UCH42	0.70
EL90	0.35	PC89	0.50	PY82	0.30	UCH43	0.75
EL95	0.35	PC189	0.55	PY83	0.38	UCH81	0.35
EL360	1.15	PC805	0.85	PY88	0.40	UCL1	0.60
EL803	1.00	PC806	0.80	PY500	1.00	UCL2	0.35
EL821	0.55	PCF80	0.30	PY800	0.50	UCL3	0.60
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EM71	0.75	PCF87	0.85	QQV3-10	1.25	UF80	0.35
EM80	0.40	PCF801	0.50	QQV3-20A	5.25	UF85	0.40
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EN91	0.35	PCF2000.70		U26	0.75	UY1N	0.50
EX61	0.40	PCL81	0.50	U27	0.75	UY11	0.65
EX80	0.45	PCL82	0.35	U28	0.75	UY41	0.45
EX81	0.40	PCL83	0.65	U31	0.45	UY82	0.60
EX83	0.55	PCL84	0.45	U37	1.50	UY85	0.60
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EX87	0.43	PCL86	0.45	U76	0.30	Z803U	0.90

TRANSISTORS

2N404	0.17	2N3034	1.00	BC152	0.15
2N444A	0.25	2N102	0.40	BC175	0.25
2N696	0.20	2N104	0.50	BCY30	0.35
2N697	0.23	2N701	0.50	BCY33	0.25
2N698	0.40	2N702	0.50	BCY34	0.30
2N706	0.70	2N746	0.30	BCY72	0.20
2N706	0.16	AC113	0.15	BCZ11	0.40
2N708	0.20	AC125	0.30	BD121	0.80
2N753	0.25	AC126	0.25	BD123	0.95
2N929	0.30	AC127	0.20	BF116	0.20
2N930	0.35	AC132	0.35	BF167	0.25
2N947	0.35	AC153	0.25	BF173	0.30
2N1131	0.40	AC154	0.15	BF181	0.25
2N1132	0.45	AC156	0.23	BF184	0.25
2N1184	1.25	AC157	0.20	BF185	0.20
2N1301	0.40	AC169	0.10	BF194	0.20
2N1302	0.25	AC176	0.25	BF195	0.15
2N1304	0.25	AC187	0.30	BF196	0.20
2N1305	0.25	AC188	0.30	BF197	0.20
2N1306	0.25	ACY17	0.30	BFW87	0.30
2N1307	0.30	ACY18	0.20	BFW88	0.25
2N1308	0.40	ACY19	0.25	BFW89	0.23
2N1309	0.35	ACY20	0.20	BFW91	0.20
2N1613	0.25	ACY21	0.20	BFX88	0.25
2N1711	0.30	ACY22	0.15	BFY17	0.40
2N1756	0.75	AD140	0.80	BFY19	0.60
2N2147	0.75	AD149	0.50	BFY50	0.25
2N2160	1.25	AD161	0.35	BFY61	0.20
2N2217	0.30	AD162	0.35	BFY62	0.25
2N2218	0.40	AF114	0.25	BSY26	0.25
2N2219	0.45	AF115	0.30	BSY27	0.30
2N2369A	0.25	AF116	0.25	BSY28	0.30
2N2477	0.65	AF117	0.20	BSY65	0.20
2N2646	0.60	AF118	0.45	BSY95A	0.20
2N2906	0.50	AF125	0.25	OC16	0.75
2N2923	0.15	AF127	0.25	OC22	0.65
2N2924	0.15	AF178	0.40	OC23	0.60
2N2926	0.15	AF180	0.35	OC24	0.60
2N3053	0.30	AF181	0.35	OC25	0.40
2N3055	0.75	AF186	0.50	OC26	0.30
2N3133	0.35	AF239	0.40	OC28	0.60
2N3134	0.50	AFZ11	0.45	OC29	0.65
2N3391	0.20	ASY26	0.25	OC30	0.75
2N3392	0.15	ASY27	0.30	OC35	0.50
2N3393	0.15	ASY28	0.30	OC36	0.60
2N3394	0.15	ASY29	0.30	OC42	0.30
2N3395	0.20	ASY54	0.25	OC44	0.20
2N3402	0.15	ASY74	0.50	OC45	0.20
2N3403	0.15	ASY77	0.35	OC70	0.20
2N3404	0.35	ASY82	0.20	OC71	0.15
2N3414	0.20	ASY86	0.20	OC72	0.25
2N3415	0.15	ASZ16	0.70	OC73	0.40
2N3416	0.25	ASZ17	0.75	OC75	0.25
2N3417	0.25	ASZ18	0.75	OC76	0.25
2N3702	0.15	ASZ21	0.50	OC78	0.25
2N3703	0.15	BC107	0.15	OC78D	0.20
2N3704	0.20	BC108	0.15	OC81	0.25
2N3707	0.20	BC109	0.20	OC81D	0.15
2N3709	0.15	BC113	0.40	OC83	0.20
2N3710	0.15	BC118	0.30	OC139	0.35
2N3819	0.35	BC134	0.30	OC140	0.40
2N3906	0.30	BC147	0.20	OC141	0.40
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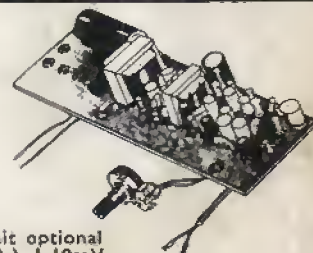
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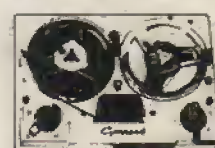


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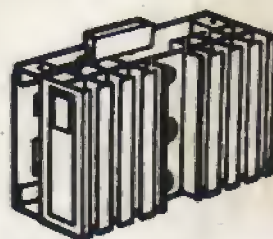
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