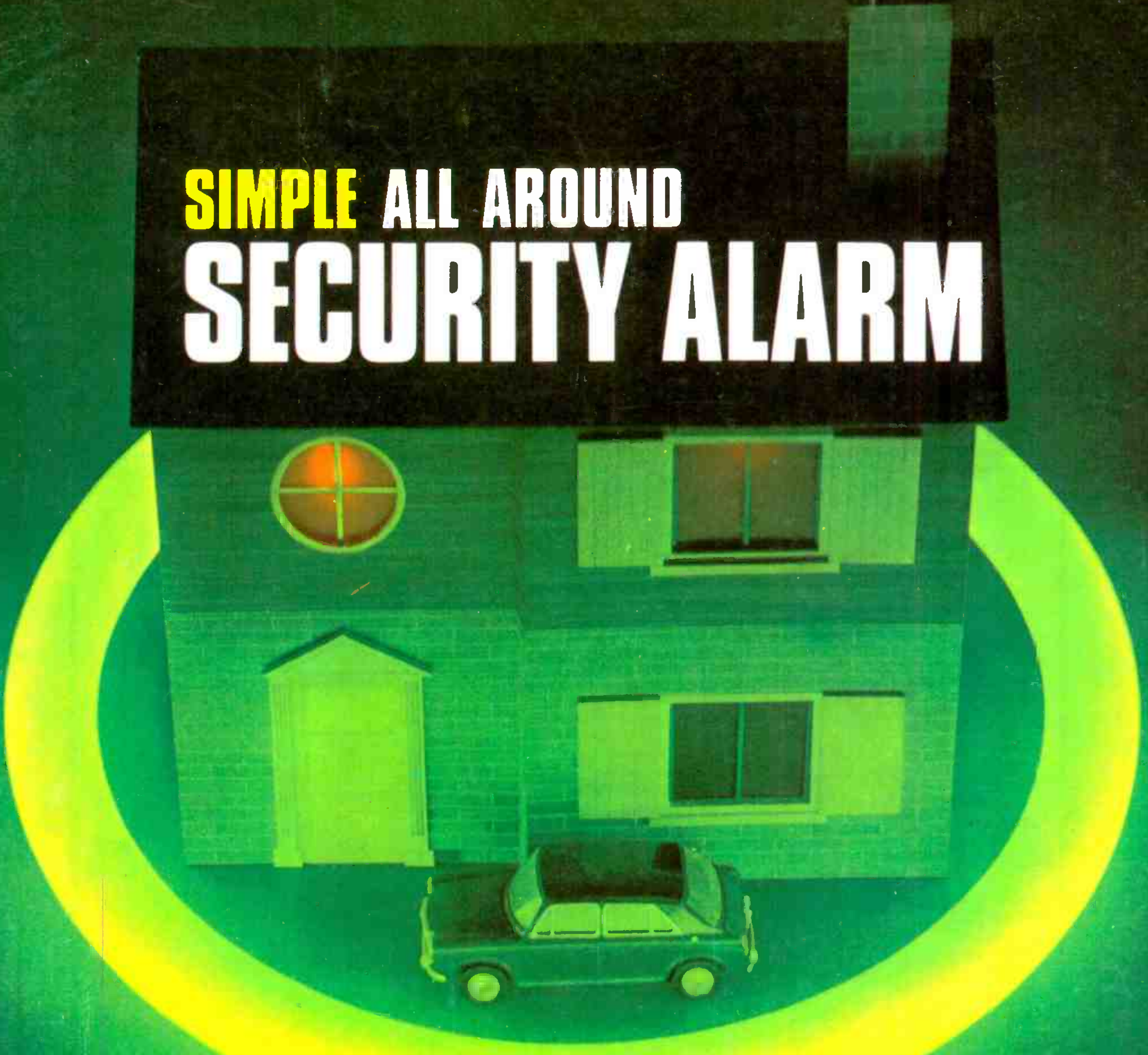
PRACTICAL
ELECTRONICS
APRIL 1973
20p

SIMPLE ALL AROUND SECURITY ALARM



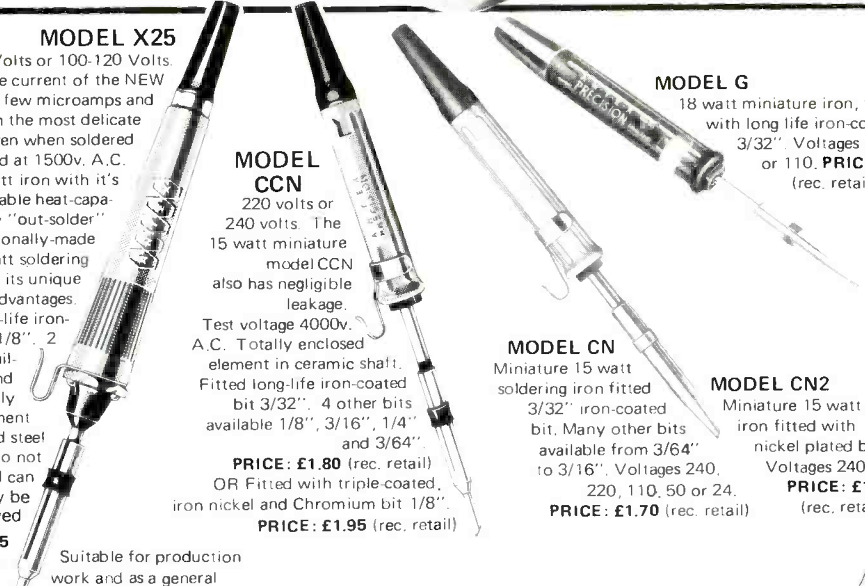
Also Inside: NOVEL BATTERY ELIMINATOR
P.E. Sound Synthesiser—VOLTAGE CONTROLLED OSCILLATOR and INVERTER

is this the price you pay?

Probably, if you're still using an ordinary soldering iron. Ordinary soldering irons can cause damage to transistors and integrated circuits – damage which wastes time and costs money. Now, with the unique ANTEX X25 and CCN low leakage soldering irons no harm can come to the most delicate equipment, even when soldered 'Live'.

(You could be making quite a saving).

All prices mentioned exclusive of VAT



MODEL X25

220-240 Volts or 100-120 Volts. The leakage current of the NEW X25 is only a few microamps and cannot harm the most delicate equipment even when soldered "live". Tested at 1500v. A.C. This 25 watt iron with it's truly remarkable heat-capacity will easily "out-solder" any conventionally-made 40 and 60 watt soldering irons, due to its unique construction advantages. Fitted long-life iron-coated bit 1/8". 2 other bits available 3/32" and 3/16". Totally enclosed element ceramic and steel shaft. Bits do not "freeze" and can easily be removed

PRICE: £1.75 (rec. retail)

Suitable for production work and as a general purpose iron.

MODEL CCN

220 volts or 240 volts. The 15 watt miniature model CCN also has negligible leakage. Test voltage 4000v. A.C. Totally enclosed element in ceramic shaft. Fitted long-life iron-coated bit 3/32". 4 other bits available 1/8", 3/16", 1/4" and 3/64".

PRICE: £1.80 (rec. retail)

OR Fitted with triple-coated, iron nickel and Chromium bit 1/8".

PRICE: £1.95 (rec. retail)

MODEL G

18 watt miniature iron, fitted with long life iron-coated bit 3/32". Voltages 240,220 or 110. **PRICE: £1.83** (rec. retail).

MODEL CN

Miniature 15 watt soldering iron fitted 3/32" iron-coated bit. Many other bits available from 3/64" to 3/16". Voltages 240, 220, 110, 50 or 24.

PRICE: £1.70 (rec. retail)

MODEL CN2

Miniature 15 watt soldeing iron fitted with nickel plated bit 3/32". Voltages 240 or 220.

PRICE: £1.70 (rec. retail)

MODEL MES.KIT

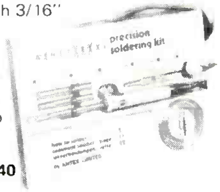
Battery-operated 12v. 25 watt iron fitted with 15' lead and 2 heavy clips for connection to car battery. Packed in strong plastic wallet with booklet "How to Solder"

PRICE: £1.95 (rec. retail)

MODEL SK.1 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32", heat sink, solder, stand and "How to Solder" booklet.

PRICE: £2.75 (rec. retail)



MODEL SK.2 KIT

Contains 15 watt miniature iron fitted with 3/16" bit, 2 spare bits 5/32" and 3/32" heat sink, solder, stand and "How to Solder" booklet.

PRICE: £2.40 (rec. retail)

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PRACTICAL
ELECTRONICS
VOLUME 9 No. 4 APRIL 1973

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

VALUE ADDED TAX

Prices quoted in this issue were correct at time of going to press. From 1st April 1973 there will be no purchase tax, but a large number of goods will carry Value Added Tax.

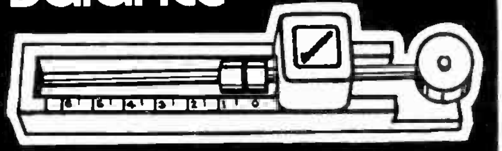
Our May issue will be published on Friday, April 13, 1973

Connoisseur

SAU2 Pick-up Arm

Recognised as one of today's most advanced pickup arms it features.
- Auto-bias Compensator
- Hydraulic Lowering Device
- Precision Balance
- New Adjustable Head Shell

Precision Stylus Balance



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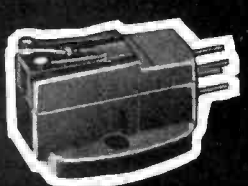

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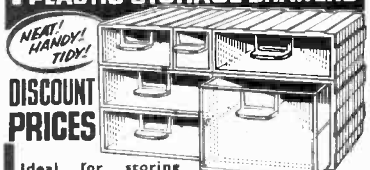

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12W, 3 to 8 or 15Ω, up or down, **£1·05**.

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15, 20 or 30V d.c., 2 C.O's **50p** each.

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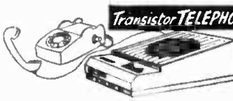
Transistor TELEPHONE AMPLIFIER



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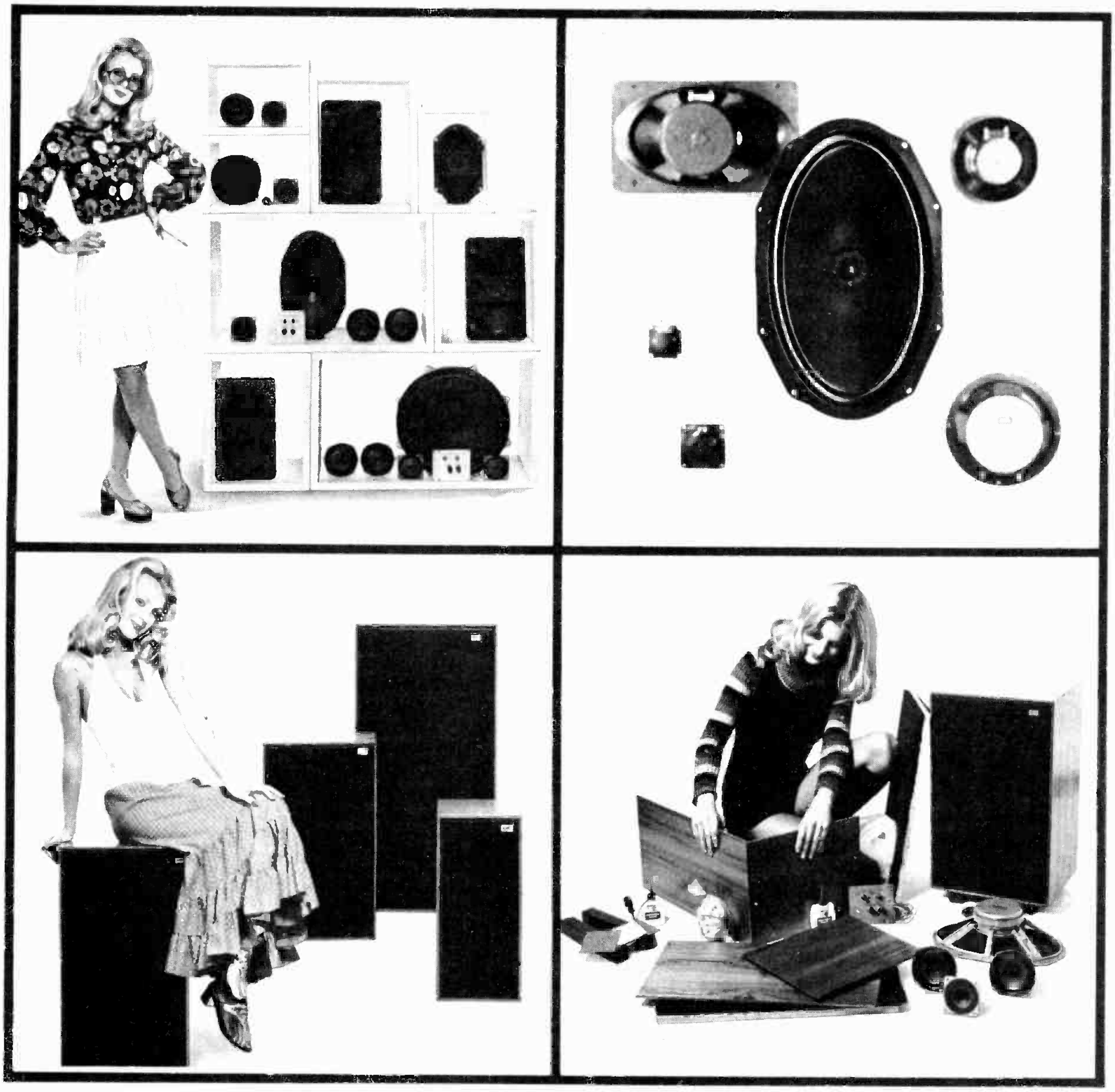

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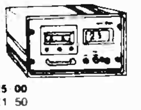

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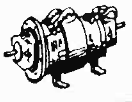

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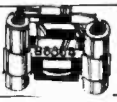

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NKT674	30p	NKT80113	98p	NKT126	35p	NKT238	18p
NKT677	18p	NKT80125	80p	NKT127	23p	NKT249	29p
NKT713	27p	BC107	8p	NKT128	18p	NKT261	19p
NKT734	24p	BC108	8p	NKT129	22p	NKT270	18p
NKT736	30p	BCY70	13p	NKT135	24p	NKT271	16p
NKT773	23p	BFY51	17p	NKT137	30p	NKT272	15p
NKT0216	20p	BSY95A	10p	NKT142	48p	NKT273	18p
NKT3055	23p	2N697	13p	NKT143	48p	NKT274	18p
NKT6917	27p	2N706	8p	NKT212	23p	NKT275	21p
NKT10339	23p	2N914	15p	NKT213	23p	NKT278	18p
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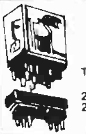

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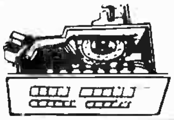
SL7622715	2 Pole C/O	220V a.c.	10A at 440V a.c	£0 87

TYPE	CONTACT FORM	COIL VOLTAGE	COIL RESISTANCE	PRICE EACH
SP13372	Single Pole C/O	6V d.c.	140 ohm	£0 40
SP13366	Single Pole C/O	12V d c	350 ohm	£0 40
11301D	Single Pole C/O	18V d.c	875 ohm	£0 40

UNISELECTOR SWITCHES



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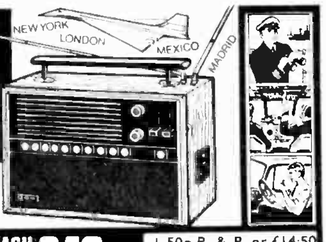

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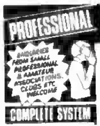

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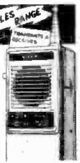

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AT **£26·12** INC. VAT

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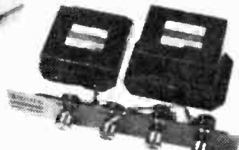

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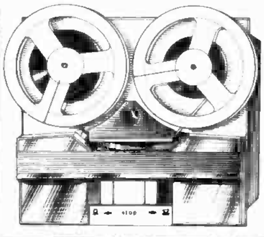

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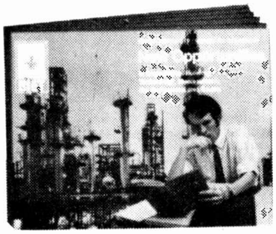

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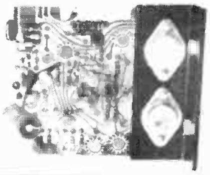

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PU45	Unstabilised supply for 2 SA25/35's, **£4·90.**
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MT45	Transformer for above, heavy duty, **£2·85**, carr. 20p
PS45	Stabilised module for 2 SA25's or two SA35's, **£3·50**, carr. free
MT70	Transformer for PS70, **£4·90**, carr. 40p
PS70	Stabilised supply module for one or two SA100's, **£4·90**, carr. free

ALL MODULES ARE BUILT ON GLASS FIBRE P.C. BOARD

OTHER SAXON PRODUCTS . . .

120 WATT HEAVY DUTY MODULE

£13·90+20p carr. or with supply **£18·95**+40p carr.

Featuring a rugged class A driver stage, this module will run from all our mixers etc., and most other makes of mixer. It delivers 120W into an eight ohm load and employs 4 TO3 can (115W) output transistors.

SPECIFICATION

Power output	120W into 8 ohms
Freq. response	20–20,000Hz ± 2dB
Input sensitivity	200mV into 10K
Construction	Fibreglass board
Size	8in × 4in × 4in (5in with supply)

Low distortion parallel push-pull output stage.

NEW: 160 Watt version & supply **£27·90**

SINGLE CHANNEL SOUND/LIGHT CONVERTER

This compact and reliable unit operates from amplifiers with outputs from 5–100W. Does not impose a heavy load on the amplifier, or, if connected in the wrong polarity, cause any damage, as with some units.

Operation is simplicity itself and the unit is fully fused. The unit is supplied to function from bass notes but may easily be converted to respond only to treble or mid-range notes by the addition of components costing less than 5p.

£8·90 carr. free

THREE CHANNEL SOUND TO LIGHT UNIT

Handling the total of 3,000W (3kW) this unit is unique for its price in that not only bass middle and treble but also master controls are provided. Two amplifier sockets eliminate the need for split leads, etc. Supplied in tough white steel case with a blue hooded cover. Fully guaranteed.

£19·75 carr. 30p

MONO VERSION **£6·50**, carr. 20p
(As illustrated below. S.A.E. details. 9V operation)
OUTPUTS UP TO 1V RMS

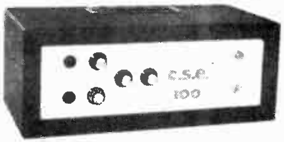
£15·80 carr. 30p

SAXON STEREO CONTROL UNIT

Two decks, and full headphone monitoring. The unit is mains operated and measures 17½in × 3in × 4in deep and is finished with a smart white on black facia. The controls are: Left/Right deck fader, volume, bass, treble, headphone selector and volume, microphone volume, bass, treble, mains on/off. **THIS IS A MUST FOR THE HOME BUILT HIGH QUALITY DISCOTHEQUE AND IS COMPARABLE TO UNITS AT OVER TWICE THE PRICE.**

COMPLETE AMPLIFIERS

THE CS 100. £34·90 carr. free



This versatile unit is now available in a black vynide case and so represents even better value than ever, delivering speech and music powers of up to 100W R.M.S. and continuous signal outputs of 70W.

Two individually controlled inputs with wide range bass and treble controls. Ideal for small groups, D.J's, etc

The SAXON 100. £48·50, carr. free.

With an R.M.S. output of 120W speech and music, 100W continuous power, four individually controlled F.E.T. input stages and wide range bass and treble controls, this amplifier has established itself as a unit offering quality and reliability at low cost.

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12in 25W 8/15 ohms **£5·95**, carr. 30p. 15in 50W 8/15 ohm, **£14·50**, carr. 50p.

12in 40W 15,000 gauss magnet system 8/15 ohm, **£11·50**, carr. 40p.

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D1000C 24 ct. gold plate r.r.p. £37, our price **£32** post free.

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TAPE NOISE LIMITER

PCB'S FROM PHONOSONICS

All PCB's Fibreglass, Drilled, Roller Tinned Circuit Diagram and Assembly. Notes Free with each PCB. Rotary Pots supplied as standard except where stated. PCB's designed by Phonosonics except where stated otherwise.

DESIGNS PUBLISHED IN P.E.

AURORA (Apr./Aug. 71) Multichannel Sound Controlled Light
S/c's (excl. SCRs), Rs. Cs, Cores, Pots., 8 ch., **£17·75**; 4 ch., **£10·15**. Power Supply (supplies 8 chans.), unstab., **£2·85**; stab., **£3·65**. PCB (4½in × 11in) for P/A and 4 chans. incl. pots, **£2·35**. PCB (4¾in × 5in) for PSU, Sync. Gen, 8 cores, 8 SCRs, **£1·35**.

A.F. SIGNAL GENERATOR (Nov. 72)
S/c's, Rs, Cs, Pots, Sw's, **£2·25**. PCB (2½in × 4in) also holds Sw's, **90p**.

AUDIO MIXER (Jan. 72)
Rs, Cs, Pots (i.c. excl.), PCB (1½in × 2in), **£1·55**.

BIOLOGICAL AMPLIFIER (Jan./Feb. 73)—Pre-amp Set
S/c's, Rs, Cs, Pots (i.c.'s excl.) **£2·05**. PCB (1½in × 3¾in), **85p**.

CALLERCORD (Jul./Aug. 72) Automatic Answering Machine
S/c's, Rs. Cs, Pots, Switches, Relays, Transformer, **£12·15**. PCB (4in × 7¾in) also holds relays, connectors, **£1·50**. Recorder, **£6·95**. Pips Gen with PCB, **£1·50**.

DOOR BELL YODELLER (Apr. 71)—S/c's, Rs, Cs, Pots, Transformer, Loudspeaker, PCB (3in × 3½in), **£7·70**.

ELECTRONIC PIANO (Sept. 72/Jan. 73) PRICES DOWN!
PA/Trem—Rs, Cs, Pots (excl. 2K), **£1·70**. PCB as publ., **£1·50**. Power Supply—Rs, Cs, **£1·10**. PCB as publ., **90p**. Pitch 1–12—Rs, Cs, **£1·90** each set. Pitch 13—Rs, Cs, **£1·30**. Pitch PCB as publ., **£1·80** each. Combined sets for PA/Trem, PSU, all 13 Pitch—Rs, Cs, Pots (excl. 2K), **£23·70**; PCBs, **£23·20**.

GEMINI STEREO AMP (Nov. 70/Mar. 71) Stereo Sets and PCBs
Pre-Amp—S/c's, Cs, Pots, Maka-Sw's—with ½W 2% M.O. Rs, **£13·45**—with ½W 5% C.F. Rs, **£11·20**.—with ¼W 5% C.F. Rs, **£10·75**. PCB (3½in × 10¾in) for kits with M.O. or ¼W C.F. Rs. Holds pots and Maka-Sw's, **£2·10**. Main Amp—Rs, Cs, Pots, **£5·40**. PCB (3½in × 5in), **£1·40**. PSU—Rs, Cs, Pot, **£3·70**. PCB (2in × 4in), **75p**.

GEMINI STEREO TUNER (Apr./Jun. 72)
Rs, Cs, Pot, **£3·80**. PCB as published, **£1·80**.

LOGICAL RADIO CONTROL (Dec. 71/Jan. 72)—Sets incl. Rs, Cs, S/c's and Pots (where requ.) but excl. I.C's. Coder 1 and Clock Pulse Gen., **£2·95**. Coder 2A, **£2·80**. Coder 2B, **£3**. Decoder, **55p**. PCBs as pub., **75p each**.

MODEL SERVO CONTROL (Feb./Mar. 72)—Sets incl. Rs, Cs, S/c's and Pots (where requ.) but excl. I.C's. Servo Amps: "A", **£1·40**; "B", **£2·55**; "C", **£1·30**. Fail-Safe, **65p**. PCBs as published: "A" and "B", **60p each**; "C" and Fail-Safe, **50p each**.

MICROPHONE MIXER (Apr. 69)—S/c's, Rs, Cs, Pots, **£2·90**. PCB (3¾in × 4½in)—also holds pots, **£1·20**.

PHOTOPRINT PROCESS CONTROL (Jan./Feb. 72)
Finds exposure, controls timing, stabilises mains voltage.
S/c's, SCR, LDR, Rs, Cs, Pots, Relay, Keyswitch, T/former, **£7·60**. PCB (3½in × 5½in) also holds pots, relay, keyswitch, **£1·20**.

SOUND SYNTHESISER—Details on request.

TAPE NOISE LIMITER (Feb. 72)—Mono Circuit
S/c's, Rs, Cs, Pot, PCB (1½in × 3in), **£2·20**. Regulated Power Supply (will feed 2 units) and PCB (1½in × 2½in), **£3·20**.

ULTRASONIC TRANSMITTER-RECEIVER (May 72)
Rs, Cs, Pot, S/c's, Transducers, Relay, **£9·90**. Dual PCB (2in × 5½in), **75p**.

VERSATILE LIGHT EFFECTS UNIT (Jun. 72)—Single Channel Sound Controlled Light—also has built-in variable strobe. S/c's (excl. SCR), Rs, Cs, Pots, T/formers, Keyswitch, **£8·85**. PCB (3¼in × 7¼in) also holds Pots, Sw, T/former (T/T7), **£1·50**.

SOME OTHER DESIGNS AVAILABLE

REVERBERATION UNIT (Practical Wireless Nov.–Dec. 72)
S/c's, Rs, Cs, Slider Pots, T/former, **£6·80** (with rotary pots **£5·70**). PCB (2in × 11¼in) also holds sliders (compatible with publ. panel) **£1·20**.

8 WATT AMPLIFIER (Practical Wireless Nov. 72)
Main Amplifier—S/c's, Rs, Cs, Pot (Mono Set), **£3·90**. PCB (2½in × 3in) (Mono), **60p**. Pre-amp—S/c's, Rs, Cs, Pots, Maka-Sw., Mono, **£2·50**; Stereo, **£5·20**. PCB (3½in × 7½in) (Stereo)—also holds all pots and Maka-Sw., **£1·50**.

AURORA AUXILIARY CONTROL UNIT (2 variable freq. strobe gens. and 4 variable amplitude freq. gens.), Rs, Cs, Pots, S/c's, **£3·25**. PCB (3¾in × 5¼in), also holds all pots, **£1·35**.

THYRISTORS (400V P.I.V.)
1A 50p. 3A 55p. 7A 70p. 16A 95p.

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Mono, **40p**; Dual, **60p**; Knobs, **13p**.

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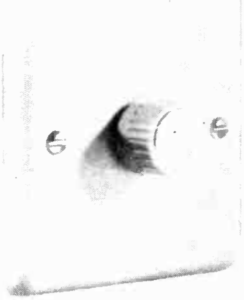

The DIMMASWITCH is an attractive and efficient dimmer unit which fits in place of the normal light switch and is connected up in exactly the same way. The white mounting plate of the DIMMASWITCH matches modern electric fittings. Two models are available, with the bright chrome knob controlling up to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

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All plus 10p post and packing

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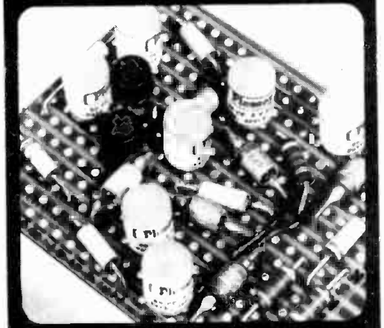

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AC115	0·23
AC117K	0·20
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AC126	0·17
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AC128	0·17
AC132	0·14
AC134	0·14
AC137	0·14
AC141	0·14
AC141K	0·17
AC142	0·14
AC142K	0·17
AC151	0·15
AC154	0·20
AC155	0·20
AC156	0·20
AC157	0·24
AC165	0·20
AC166	0·20
AC167	0·20
AC168	0·24
AC169	0·14
AC176	0·20
AC177	0·24
AC178	0·28
AC179	0·28
AC180	0·17
AC180K	0·20
AC181	0·17
AC181K	0·20
AC187	0·22
AC187K	0·20
AC188	0·22
AC188K	0·20
ACY17	0·25
ACY18	0·20
ACY19	0·20
ACY20	0·20
ACY21	0·20
ACY22	0·16
ACY27	0·18
ACY28	0·19
ACY29	0·35
ACY30	0·28
ACY31	0·28
ACY34	0·21
ACY35	0·21
ACY36	0·28
ACY40	0·17
ACY41	0·18
ACY44	0·35
AD130	0·38
AD140	0·48
AD142	0·48
AD143	0·38
AD149	0·50
AD161	0·33
AD162	0·33
AD161 & AD162 (MP)	0·55
ADT140	0·50
AF114	0·24
AF115	0·24
AF116	0·24
AF117	0·24
AF118	0·35
AF124	0·30
AF125	0·25
AF126	0·28
AF127	0·28
AF139	0·30
AF178	0·50
AF179	0·50
AF180	0·50
AF181	0·45
AF186	0·45
AF239	0·37
AL102	0·65
AL103	0·65
ASY26	0·25
ASY27	0·30
ASY28	0·25
ASY29	0·25
ASY50	0·25
ASY51	0·25
ASY52	0·25
ASY54	0·25
ASY55	0·25
ASY56	0·25
ASY57	0·25
ASY58	0·25
ASZ21	0·40
BC107	0·09
BC108	0·09
BC109	0·10
BC113	0·10
BC114	0·15
BC115	0·15
BC116	0·15
BC117	0·15
BC118	0·10
BC119	0·30
BC120	0·80
BC125	0·12
BC126	0·18
BC132	0·12
BC134	0·18
BC135	0·12
BC136	0·15
BC137	0·15
BC139	0·40
BC140	0·30
BC141	0·30
BC142	0·30
BC143	0·30
BC145	0·45
BC147	0·10
BC148	0·10
BC149	0·12
BC150	0·18
BC151	0·20
BC152	0·17
BC153	0·28
BC154	0·30
BC157	0·18
BC158	0·12
BC159	0·12
BC160	0·45
BC161	0·50
BC167	0·12
BC168	0·12
BC169	0·12
BC170	0·12
BC171	0·14
BC172	0·14
BC173	0·14
BC174	0·14
BC175	0·22
BC177	0·19
BC178	0·19
BC179	0·19
BC180	0·24
BC181	0·24
BC182	0·10
BC182L	0·10
BC183	0·10
BC183L	0·10
BC184	0·12
BC184L	0·12
BC186	0·28
BC187	0·28
BC207	0·11
BC208	0·11
BC209	0·12
BC212L	0·11
BC213L	0·11
BC214L	0·14
BC225	0·25
BC226	0·35
BCY30	0·24
BCY31	0·26
BCY32	0·30
BCY33	0·22
BCY34	0·25
BCY70	0·14
BCY71	0·18
BCY72	0·14
BCZ10	0·20
BCZ11	0·25
BCZ12	0·25
BD121	0·60
BD123	0·65
BD124	0·60
BD131	0·50
BD132	0·60
BD133	0·65
BD135	0·40
BD136	0·40
BD137	0·45
BD138	0·50
BD139	0·55
BD140	0·60
BD155	0·80
BD175	0·60
BD176	0·60
BD177	0·65
BD178	0·65
BD179	0·70
BD180	0·70
BD185	0·65
BD186	0·65
BD187	0·70
BD188	0·70
BD189	0·75
BD190	0·75
BD195	0·85
BD196	0·85
BD197	0·90
BD198	0·90
BD199	0·95
BD200	0·95
BD205	0·80
BD206	0·80
BD207	0·95
BD208	0·95
BDY20	1·00
BF115	0·24
BF117	0·45
BF118	0·70
BF119	0·70
BF121	0·45
BF123	0·50
BF125	0·45
BF127	0·50
BF152	0·55
BF153	0·45
BF154	0·45
BF155	0·70
BF156	0·48
BF157	0·55
BF158	0·55
BF159	0·60
BF160	0·40
BF162	0·40
BF163	0·40
BF164	0·40
BF165	0·40
BF167	0·22
BF173	0·22
BF176	0·35
BF177	0·35
BF178	0·30
BF179	0·30
BF180	0·30
BF181	0·30
BF182	0·40
BF183	0·40
BF184	0·25
BF185	0·30
BF188	0·40
BF194	0·12
BF195	0·12
BF196	0·14
BF197	0·14
BF200	0·45
BF222	0·95
BF257	0·45
BF258	0·60
BF259	0·65
BF262	0·55
BF263	0·55
BF270	0·35
BF271	0·30
BF272	0·80
BF273	0·35
BF274	0·35
BFW10	0·60
BFX29	0·27
BFX84	0·22
BFX85	0·30
BFX86	0·22
BFX87	0·24
BFX88	0·22
BFY50	0·20
BFY51	0·20
BFY52	0·20
BFY53	0·17
BPX25	0·85
BSX19	0·15
BSX20	0·15
BSY25	0·15
BSY26	0·15
BSY27	0·15
BSY28	0·15
BSY29	0·15
BSY38	0·18
BSY39	0·18
BSY40	0·28
BSY41	0·28
BSY95	0·12
BSY95A	0·12
Bu105	2·00
C111E	0·50
C400	0·30
C407	0·25
C424	0·20
C425	0·50
C426	0·35
C428	0·20
C441	0·30
C442	0·30
C444	0·35
C450	0·22
MAT100	0·19
MAT101	0·20
MAT120	0·19
MAT121	0·20
MPF102	0·42
MPF104	0·37
MPF105	0·37
OC19	0·35
OC20	0·63
OC22	0·38
OC23	0·42
OC24	0·56
OC25	0·38
OC26	0·25
OC28	0·50
OC29	0·50
OC35	0·42
OC36	0·50
OC41	0·20
OC42	0·24
OC44	0·15
OC45	0·12
OC70	0·10
OC71	0·10
OC72	0·14
OC74	0·14
OC75	0·15
OC76	0·15
OC77	0·25
OC81	0·15
OC81D	0·15
OC82	0·15
OC82D	0·15
OC83	0·20
OC84	0·20
OC139	0·20
OC140	0·20
OC169	0·25
OC170	0·25
OC171	0·25
OC200	0·25
OC201	0·28
OC202	0·28
OC203	0·25
OC204	0·25
OC205	0·35
OC309	0·40
P346A	0·20
P397	0·42
OCP71	0·43
ORP12	0·43
ORP60	0·40
ORP61	0·40
ST140	0·12
ST141	0·17
TIS43	0·30
UT46	0·27
2G301	0·09
2G302	0·19
2G303	0·19
2G304	0·24
2G306	0·40
2G308	0·35
2G309	0·35
2G339	0·20
2G339A	0·16
2G344	0·18
2G345	0·16
2G371	0·16
2G371B	0·12
2G373	0·17
2G374	0·17
2G377	0·30
2G378	0·16
2G381	0·16
2G382	0·16
2G401	0·30
2G414	0·30
2G417	0·25
2N388	0·35
2N388A	0·55
2N404	0·20
2N404A	0·28
2N524	0·42
2N527	0·49
2N598	0·42
2N599	0·45
2N696	0·12
2N697	0·13
2N698	0·24
2N699	0·35
2N706	0·08
2N706A	0·09
2N708	0·12
2N711	0·30
2N717	0·35
2N718	0·24
2N718A	0·50
2N726	0·28
2N727	0·28
2N743	0·20
2N744	0·20
2N914	0·14
2N918	0·30
2N929	0·21
2N930	0·21
2N1131	0·20
2N1132	0·22
2N1302	0·14
2N1303	0·14
2N1304	0·17
2N1305	0·17
2N1306	0·21
2N1307	0·21
2N1308	0·23
2N1309	0·23
2N1613	0·20
2N1711	0·20
2N1889	0·32
2N1890	0·45
2N1893	0·37
2N2147	0·72
2N2148	0·57
2N2160	0·60
2N2192	0·35
2N2193	0·35
2N2194	0·35
2N2217	0·22
2N2218	0·20
2N2219	0·20
2N2220	0·22
2N2221	0·20
2N2222	0·20
2N2368	0·17
2N2369	0·14
2N2369A	0·14
2N2411	0·24
2N2412	0·24
2N2646	0·47
2N2711	0·21
2N2712	0·21
2N2714	0·21
2N2904	0·17
2N2904A	0·21
2N2905	0·21
2N2905A	0·21
2N2906	0·15
2N2906A	0·18
2N2907	0·20
2N2907A	0·22
2N2923	0·14
2N2924	0·14
2N2925	0·14
2N2926 (G)	0·12
2N2926 (Y)	0·11
2N2926 (O)	0·10
2N2926 (R)	0·10
2N2926 (B)	0·10
2N3010	0·70
2N3011	0·14
2N3053	0·17
2N3054	0·46
2N3055	0·50
2N3391	0·14
2N3391A	0·16
2N3392	0·14
2N3393	0·14
2N3394	0·14
2N3395	0·17
2N3402	0·21
2N3403	0·21
2N3404	0·28
2N3405	0·42
2N3414	0·15
2N3415	0·15
2N3416	0·28
2N3417	0·28
2N3525	0·75
2N3646	0·09
2N3702	0·10
2N3703	0·10
2N3704	0·11
2N3705	0·10
2N3706	0·09
2N3707	0·11
2N3708	0·07
2N3709	0·09
2N3710	0·09
2N3711	0·09
2N3819	0·28
2N3820	0·50
2N3821	0·35
2N3823	0·28
2N3903	0·28
2N3904	0·30
2N3905	0·28
2N3906	0·27
2N4058	0·12
2N4059	0·10
2N4060	0·12
2N4061	0·12
2N4062	0·12
2N4284	0·17
2N4285	0·17
2N4286	0·17
2N4287	0·17
2N4288	0·17
2N4289	0·17
2N4290	0·17
2N4291	0·17
2N4292	0·17
2N4293	0·17
2N5172	0·12
2N5457	0·32
2N5458	0·32
2N5459	0·40
2S301	0·50
2S302A	0·42
2S302	0·42
2S303	0·55
2S304	0·70
2S305	0·84
2S306	0·84
2S307	0·84
2S321	0·56
2S322	0·42
2S322A	0·42
2S323	0·56
2S324	0·70
2S325	0·70
2S326	0·70
2S327	0·70
2S701	0·42
40361	0·40
40362	0·45

DIODES AND RECTIFIERS

AA119	0·08
AA120	0·08
AA129	0·08
AAY30	0·09
AAZ13	0·10
BA100	0·10
BA116	0·21
BA126	0·22
BA148	0·14
BA154	0·12
BA155	0·14
BA156	0·13
BY100	0·15
BY101	0·12
BY105	0·17
BY114	0·12
BY126	0·14
BY127	0·15
BY128	0·15
BY130	0·16
BY133	0·21
BY164	0·50
BYX38/30	0·42
BYZ10	0·35
BYZ11	0·30
BYZ12	0·30
BYZ13	0·25
BYZ16	0·40
BYZ17	0·35
BYZ18	0·35
BYZ19	0·28
CG62 (Eg) OA91	0·05
CG651 (Eq) OA70·	
OA79	0·06
OA5	0·35
OA58L	0·21
OA10	0·35
OA47	0·07
OA70	0·07
OA79	0·07
OA81	0·07
OA85	0·09
OA90	0·06
OA91	0·06
OA95	0·07
OA200	0·06
OA202	0·07
SD10	0·05
SD19	0·05
IN34	0·07
IN34A	0·07
IN914	0·06
IN916	0·06
IN414B	0·06
IS021	0·10
IS951	0·06

Cut these 3 pages out and keep for reference

NEW COMPONENT PAK BARGAINS

Pack No.	Qty.	Description	Price
C 1	250	Resistors mixed values approx. count by weight ..	0·50
C 2	200	Capacitors mixed values approx. count by weight ..	0·50
C 3	50	Precision Resistors 1%, ·01% mixed values	0·50
C 4	75	⅛th W Resistors mixed preferred values	0·50
C 5	5	Pieces assorted Ferrite Rods	0·50
C 6	2	Tuning Gangs, MW/LW VHF	0·50
C 7	1	Pack Wire 50 metres assorted colours	0·50
C 8	10	Reed Switches	0·50
C 9	3	Micro Switches	0·50
C10	15	Assorted Pots & Pre-Sets	0·50
C11	5	Jack Sockets 3 × 3·5m 2 × Standard Switch Types ..	0·50
C12	40	Paper Condensers preferred types mixed values ..	0·50
C13	20	Electrolytics Trans. types	0·50
C14	1	Pack assorted Hardware—Nuts/Bolts, Grommets etc. ..	0·50
C15	4	Mains Toggle Switches, 2 Amp D/P	0·50
C16	20	Assorted Tag Strips & Panels	0·50
C17	10	Assorted Control Knobs	0·50
C18	4	Rotary Wave Change Switches	0·50
C19	3	Relays 6—24V Operating	0·50
C20	4	Sheets Copper Laminate approx. 10″ × 7″	0·50

Please add 10p post and packing on all component packs, plus a further 10p on pack Nos. C1, C2, C19, C20.

PLUS-MUCH MORE - SEND NOW FOR THE BI-PAK "Component Catalogue"

5p to cover postage, etc.

Please note that as from April 1st 10% must be added to all the above prices.

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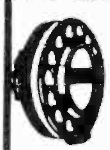
MIXED ELECTRONIC COMPONENTS

Exceptionally good value

Resistors, capacitors, pots, electrolytics and coils plus many other useful items. Approximately 3lbs in weight. Price incl. P. & P. £1·50 only.



BRAND NEW POST OFFICE TYPE TELEPHONE DIALS

ONLY 75p each

THE NEW S.G.S. EA 1000 AUDIO AMP MODULE **Guarantee*

3 Watts

R.M.S.

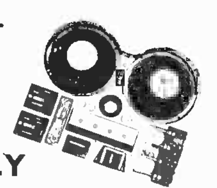
ONLY

£2·63 each

Modual Tested and Guaranteed.
Qty. 1—9 £2·63; 10—25 £2·28 Price each. Larger quantities quoted on request. Full hook-up diagrams and complete technical data supplied free with each modual or available separately at 10p each.

SYSTEM 12 STEREO

Each Kit contains two Amplifier Modules, 3 watts RMS, two loudspeakers, 15 ohms, the pre-amplifier, transformer, power supply module, front panel and other accessories, as well as an illustrated stage-by-stage instruction booklet designed for the beginner.
Further details available on request.



ONLY £16·95 FREE P. & P.

NOW-TURN OVER FOR MORE FANTASTIC OFFERS

The largest selection

NEW LOW PRICE TESTED S.C.R.'s

PIV	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
50	0·23	0·25	0·35	0·35	0·47	0·50	0·53	1·15
100	0·25	0·33	0·47	0·47	0·50	0·58	0·63	1·40
200	0·35	0·37	0·49	0·49	0 57	0·61	0·75	1·60
400	0·43	0·47	0·56	0·56	0·67	0·75	0·93	1·75
600	0·53	0·57	0·68	0·68	0·77	0·97	1·25	—
800	0·63	0·70	0·80	0·80	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA	750mA	1A	1·5A	3A	10A	30A
50	0·04	0·05	0·05	0·07	0·14	0·21	0·60
100	0·04	0·06	0·05	0·13	0·16	0·23	0·75
200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·25	0·34	0·45	1·86
800	0·10	0·17	0·11	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·14	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·38	0·57	0·75	—

TRIACS

VBOM	2A TO-1 £p	6A TO-66 £p	10A TO-88 £p
100	80	50	76
200	50	60	90
400	70	75	1–10

DIACS

FOR USE WITH TRIACS
BR100 (D32) 37p each

FREE

One 50p Pak of your own choice free with orders valued £4 or over.

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.			EQVT
T1	8	2G3713	OC71
T2	8	D1374	OC75
T3	8	D1216	OC81D
T4	8	2G381T	OC81
T5	8	2G382T	OC82
T6	8	2G344B	OC44
T7	8	2G345B	OC45
T8	8	2G378	OC78
T9	8	2G399A	2N1302
T10	8	2G417	AF117

All 50p each pak

2N2060 NPN SIL. DUAL TRANS. CODE D1699 TEXAS. Our price 25p each.

120 VCB MIXIE DRIVER TRANSISTOR. Sim. BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND 120. 1-24 17p each. TO.5 N.P.N. 25 up 15p each.

Sil. trans. suitable for P.E. Organ. Metal TO-18 Eqvt. ZTX300 5p each. Any Qty.

FULL RANGE OF ZENER DIODES VOLTAGE RANGE

2-33V. 400mV (DO-7 Case) 13p ea. 1½W (Top-Hat) 18p ea. 10W (SO-10 Stud) 25p ea. All fully tested 5% tol. and marked. State voltage required.

10 amp POTTED BRIDGE RECTIFIER on heat sink. 100PIV. 90p each

NEW LINE

Plastic Encapsulated 2 Amp. BRIDGE RECTS.

50 v RMS	32p each
100 v RMS	37p ,,
400 v RMS	46p ,,

Size 15 mm × 6 mm.

UNIJUNCTION

UT46. Eqvt. 2N2646, Eqvt. TI843. BEN3000 27p each, 25–99 25p 100 UP 20p.

CADMIUM CELLS

ORP12 43p
ORP60, ORP61 40p each

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8. BSY-27/28/95A.

All usable devices no open or short circuits. ALSO AVAILABLE in PNP Sim. to 2N2906, BCY70. When ordering please state preference NPN or PNP.

		£p
20	For	0·50
50	For	1·00
100	For	1·75
500	For	7·50
1000	For	13 00

SIL. G.P. DIODES £p

300mW	30	0·50
40PIV(Min.)	100	1·50
Sub-Min.	500	5·00
Full Tested	1,000	9·00

Ideal for Organ Builders.

KING OF THE PAKS Unequalled Value and Quality

SUPER PAKS NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		Description	Price
U 1	120	Glass Sub-Min. General Purpose Germanium Diodes	0·50
U 2	60	Mixed Germanium Transistors AF/RF	0·50
U 3	75	Germanium Gold Bonded Sub-Min. like OA5, OA47	0·50
U 4	40	Germanium Transistors like OC81, AC128	0·50
U 5	60	200mA Sub-Min. Silicon Diodes	0·50
U 6	30	Sil. Planar Trans. NPN like BSY95A. 2N706	0·50
U 7	16	Sil. Rectifiers TOP-HAT 750mA VLTG. RANGE up to 1000	0·50
U 8	50	Sil. Planar Diodes DO-7 Glass 250mA like OA200/202	0·50
U 9	20	Mixed Voltages, 1 Watt Zener Diodes	0·50
U10	20	BAY50 charge storage Diodes DO-7 Glass	0·50
U11	25	PNP Sil. Planar Trans. TO-5 like 2N1132, 2N2904	0·50
U12	12	Silicon Rectifiers Epoxy 500mA up to 800 PIV	0·50
U13	30	PNP-NPN Sil. Transistors OC200 & 2S 104	0·50
U14	150	Mixed Silicon and Germanium Diodes	0·50
U15	25	NPN Sil. Planar Trans. TO-5 like BFY51, 2N697	0·50
U16	10	3 Amp Silicon Rectifiers Stud Type up to 1000PIV	0·50
U17	30	Germanium PNP AF Transistors TO-5 like ACY 17-22	0·50
U18	8	6 Amp Silicon Rectifiers BYZ13 Type up to 600 PIV	0·50
U19	25	Silicon NPN Transistors like BC108	0·50
U20	12	1·5 Amp Silicon Rectifiers Top Hat up to 1000 PIV	0·50
U21	30	AF. Germanium Alloy Transistors 2G300 Series & OC71	0·50
U23	30	MADT's like MHz Series PNP Transistors	0·50
U24	20	Germanium 1 Amp Rectifiers GJM Series up to 300 PIV	0·50
U25	25	300 MHz NPN Silicon Transistors 2N708, BSY27	0·50
U26	30	Fast Switching Silicon Diodes like IN914 Micro-Min.	0·50
U27	12	NPN Germanium AF Transistors TO-1 like AC127	0·50
U29	10	1 Amp SCR's TO-5 can, up to 600 PIV CRS1/25-600	1·00
U30	15	Plastic Silicon Planar Trans. NPN 2N2926	0·50
U31	20	Silicon Planar Plastic NPN Trans. Low Noise Amp 2N3707	0·50
U32	25	Zener Diodes 400mW DO-7 case 3–18 volts mixed	0·50
U33	15	Plastic Case 1 Amp Silicon Rectifiers IN4000 Series	0·50
U34	30	Silicon PNP Alloy Trans, TO-5 BCY26 2S302/4	0·50
U35	25	Silicon Planar Transistors PNP TO-18 2N2906	0·50
U36	25	Silicon Planar NPN Transistors TO-5 BFY50/51/52	0·50
U37	30	Silicon Alloy Transistors SO-2 PNP OC200, 2S322	0·50
U38	20	Fast Switching Silicon Trans. NPN 400 MHz 2N3011	0·50
U39	30	RF. Germ. PNP Transistors 2N1303/5 TO-5	0·50
U40	10	Dual Transistors 6 lead TO-5 2N2060	0·50
U41	25	RF Germanium Transistors TO-5, OC45, NKT72	0·50
U42	10	VHF Germanium PNP Transistors TO-1 NKT667, AF117	0·50
U43	25	Sil. Trans. Plastic TO-18 A.F. BC113/114	0·50
U44	20	Sil. Trans. Plastic TO-5 BC115/NPN	0 50
U45	7	3A SCR. TO66 up to 600PIV	1·00

Code No's. mentioned above are given as a guide to the type of device in the pak. The devices themselves are normally unmarked.

QUALITY TESTED SEMICONDUCTORS

Pak No.			Price £p
Q1	20	Red spot transistors PNP	0·50
Q2	16	White spot R.F. transistors PNP	0·50
Q3	4	OC 77 type transistors	0·50
Q4	6	Matched transistors OC44/45/81/81D	0·50
Q5	4	OC 75 transistors	0·50
Q6	5	OC 72 transistors	0·50
Q7	4	AC 128 transistors PNP high gain	0·50
Q8	4	AC 126 transistors PNP	0·50
Q9	7	OC 81 type transistors	0·50
Q10	7	OC 71 type transistors	0·50
Q11	2	AC 127/128 Complementary pairs PNP/NPN	0·50
Q12	3	AF 116 type transistors	0·50
Q13	3	AF 117 type transistors	0·50
Q14	3	OC 171 H.F. type transistors	0·50
Q15	7	2N2926 Sil. Epoxy transistors mixed colours	0·50
Q16	2	GET880 low noise Germanium transistors	0·50
Q17	5	NPN 2 × ST.141 & 3 × ST.140	0·50
Q18	4	MADT'S 2 × MAT 100 & 2 × MAT 120	0·50
Q19	3	MADT'S 2 × MAT 101 & 1 × MAT 121	0·50
Q20	4	OC 44 Germanium transistors A.F.	0·50
Q21	4	AC 127 NPN Germanium transistors	0·50
Q22	20	NKT transistors A.F. R.F. coded	0·50
Q23	10	OA 202 Silicon diodes sub-min.	0·50
Q24	8	OA 81 diodes	0·50
Q25	15	IN914 Silicon diodes 75 PIV 75mA	0·50
Q26	8	OA95 Germanium diodes sub-min IN69	0·50
Q27	2	10A PIV Silicon rectifiers IS425R	0·50
Q28	2	Silicon power rectifiers BYZ 13	0·50
Q29	4	Silicon transistors 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7	Silicon switch transistors 2N706 NPN	0·50
Q31	6	Silicon switch transistors 2N708 NPN	0·50
Q32	3	PNP Silicon transistors 2 × 2N1131, 1 × 2N1132	0·50
Q33	3	Silicon NPN transistors 2N1711	0·50
Q34	7	Silicon NPN transistors 2N2369, 500MHz (code P397)	0·50
Q35	3	Silicon PNP TO-5. 2 × 2N2904 & 1 × 2N2905	0·50
Q36	7	2N3646 TO-18 plastic 300 MHz NPN	0·50
Q37	3	2N3053 NPN Silicon transistors	0·50
Q38	7	NPN transistors 4 × 2N3703, 3 × 2N3702	0·50

ELECTRONIC SLIDE-RULE

The MK Slide Rule, designed to simplify Electronic calculations features the following scales:—Conversion of Frequency and Wavelength. Calculation of L, C and fo of Tuned Circuits. Reactance and Self Inductance. Area of Circles. Volume of Cylinders. Resistance of Conductors. Weight of Conductors. Decibel Calculations. Angle Functions. Natural Logs and 'e' Functions. Multiplication and Division. Squaring, Cubing and Square Roots. Conversion of kW and Hp. A must for every electronic engineer and enthusiast. Size: 2 cm × 4cm. Complete with case and instructions. Price each: £3·35

SILICON PHOTO TRANSISTOR. TO-18 Lens end NPN Sim. to BP × 25 and P21. BRAND NEW. Full data available. Fully guaranteed.

Qty.	1·24	25·99	100 up
Price each	45p	40p	35p

F.E.T.'S

2N3819	35p	2N5458	50p
2N3820	50p	2N5459	40p
2N3821	35p	BFW10	40p
2N3823	30p	MPF105	40p

NEW EDITION 1971

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INTEGRATED CIRCUIT PAKS

Manufacturers "Fall Outs" which include Functional and Part-Functional Units. These are classed as 'out-of-spec' from the maker's very rigid specifications, but are ideal for learning about I.C's and experimental work.

Pak No.	Contents	Price	Pak No.	Contents	Price	Pak No.	Contents	Price
UIC00	= 12 × 7400	0·50	UIC46	= 5 × 7446	0·50	UIC86	= 5 × 7486	0·50
UIC01	= 12 × 7401	0·50	UIC47	= 5 × 7447	0·50	UIC90	= 5 × 7490	0·50
UIC02	= 12 × 7402	0·50	UIC48	= 5 × 7448	0·50	UIC91	= 5 × 7491	0·50
UIC03	= 12 × 7403	0·50	UIC50	= 12 × 7450	0·50	UIC92	= 5 × 7492	0·50
UIC04	= 12 × 7404	0·50	UIC51	= 12 × 7451	0·50	UIC93	= 5 × 7493	0·50
UIC05	= 12 × 7405	0·50	UIC53	= 12 × 7453	0·50	UIC94	= 5 × 7494	0·50
UIC06	= 8 × 7406	0·50	UIC54	= 12 × 7454	0·50	UIC95	= 5 × 7495	0·50
UIC07	= 8 × 7407	0·50	UIC60	= 12 × 7460	0·50	UIC96	= 5 × 7496	0·50
UIC10	= 12 × 7410	0·50	UIC70	= 8 × 7470	0·50	UIC100	= 5 × 74100	0·50
UIC13	= 8 × 7413	0·50	UIC72	= 8 × 7472	0·50	UIC121	= 5 × 74121	0·50
UIC20	= 12 × 7420	0·50	UIC73	= 8 × 7473	0·50	UIC141	= 5 × 74141	0·50
UIC30	= 12 × 7430	0·50	UIC74	= 8 × 7474	0·50	UIC151	= 5 × 74151	0·50
UIC40	= 12 × 7440	0·50	UIC75	= 8 × 7475	0·50	UIC154	= 5 × 74154	0·50
UIC41	= 5 × 7441	0·50	UIC76	= 8 × 7476	0·50	UIC193	= 5 × 74193	0·50
UIC42	= 5 × 7442	0·50	UIC80	= 5 × 7480	0·50	UIC199	= 5 × 74199	0·50
UIC43	= 5 × 7443	0·50	UIC81	= 5 × 7481	0·50			
UIC44	= 5 × 7444	0·50	UIC82	= 5 × 7482	0·50	UICXI	= 25 Assorted 74's	1·50
UIC45	= 5 × 7445	0·50	UIC83	= 5 × 7483	0·50			

Packs cannot be split, but 25 assorted pieces (our mix) is available as PAK UIC X1.

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Coded GP100. BRAND NEW TO-3 CASE. POSS. REPLACE.:—OC25-28-29-30-35-36. NKT 401-403-404-405-406-430-451-452-453. TI3027-3028, 2N250A, 2N456A-457A-458A, 2N511 A & B. 2G220-222, ETC. VCBO 80V VCEO 50V IC 10A PT. 30 WATTS Hfe 30-170.

PRICE	1-24	25-99	100 up
	43p each	40p each	36p each

SILICON High Voltage 250V NPN TO-3 case. G.P. Switching & Amplifier Applications. Brand new Coded R 2400 VCBO 250/VCEO 100/IC 6A/30 Watts. HFE type 20/fT 5MHZ.

OUR PRICE EACH :

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50p	45p	40p

2N3055

115 WATT SIL POWER NPN 50p EACH

AD161/162 *PNP*

M/P COMP GERM TRANS.
OUR LOWEST PRICE OF 55p *PER PAIR*

SILICON 50 WATTS MATCHED NPN/PNP
BIP 19 NPN TO-3 Plastic. BIP 20 PNP. Brand new. VCBO 100/VCEO 50/IC 10A. HFE type 100/ft 3mHZ.
OUR PRICE PER PAIR:

1–24 prs.	25–99 prs.	100 prs.
60p	55p	50p

BI-PAKS NEW COMPONENT SHOP NOW OPEN WITH A WIDE RANGE OF ELECTRONIC COMPONENTS AND ACCESSORIES AT COMPETITIVE PRICES—
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(STD 0920) 61593. MON.-SAT. 9.15a.m. to 6p.m., FRI. till 8p.m.

Please note that as from April 1st 10% must be added to all prices.

-the lowest prices!

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SN7401	0·15	0·14	0·12
SN7402	0·15	0·14	0·12
SN7403	0·15	0·14	0·12
SN7404	0·15	0·14	0·12
SN7405	0·15	0·14	0·12
SN7406	0·35	0·31	0·28
SN7407	0·35	0·31	0·28
SN7408	0·18	0·17	0·16
SN7409	0·18	0·17	0·16
SN7410	0·15	0·14	0·12
SN7411	0·25	0·24	0·23
SN7412	0·35	0·31	0·28
SN7413	0·29	0·26	0·24
SN7416	0·43	0·40	0·38
SN7417	0·43	0·40	0·38
SN7420	0·15	0·14	0·12
SN7422	0·50	0·48	0·45
SN7423	0·50	0·48	0·45
SN7425	0·50	0·48	0·45
SN7427	0·45	0·42	0·40
SN7428	0·70	0·65	0·60
SN7430	0·15	0·14	0·12
SN7432	0·45	0·42	0·40
SN7433	0·80	0·75	0·70
SN7437	0·64	0·62	0·60
SN7438	0·84	0·62	0·60
SN7440	0·15	0·14	0·12
SN7441	0·67	0·64	0·58
SN7442	0·67	0·64	0·58
SN7443	£1·30	£1·25	£1·20
SN7444	£1·30	£1·25	£1·20
SN7445	£1·80	£1·77	£1·75
SN7446	0·97	0·94	0·88
SN7447	£1·00	0·97	0·95
SN7448	£1·00	0·97	0·95
SN7450	0·15	0·14	0·12
SN7451	0·15	0·14	0·12
SN7453	0·15	0·14	0·12
SN7454	0·15	0·14	0·12
SN7460	0·15	0·14	0·12
SN7470	0·29	0·26	0·24
SN7472	0·29	0·26	0·24
SN7473	0·37	0·35	0·32
SN7474	0·37	0·35	0·32
SN7475	0·45	0·43	0·42
SN7476	0·40	0·39	0·38
SN7480	0·67	0·64	0·58
SN7481	£1·20	£1·15	£1·10
SN7482	0·87	0·86	0·85
SN7483	£1·10	£1·05	0·95
SN7484	£1·00	0·95	0·90
SN7485	£3·60	£3·50	£3·40
SN7486	0·32	0·31	0·30

	1	25	100 +
SN7489	£5·50	£5·25	£5·00
SN7490	0·67	0·64	0·58
SN7491	£1·00	0·95	0·90
SN7492	0·67	0·64	0·58
SN7493	0·67	0·64	0·58
SN7494	0·77	0·74	0·68
SN7495	0·77	0·74	0·68
SN7496	0·87	0·84	0·78
SN74100	£1·65	£1·60	£1·55
SN74104	0·97	0·94	0·88
SN74105	0·97	0·94	0·88
SN74107	0·40	0·38	0·36
SN74110	0·55	0·53	0·50
SN74111	£1·25	£1·15	£1·10
SN74118	£1·00	0·95	0·90
SN74119	£1·35	£1·25	£1·10
SN74121	0·40	0·37	0·34
SN74122	£1·40	£1·30	£1·10
SN74123	£2·80	£2·70	£2·60
SN74141	0·67	0·64	0·53
SN74145	£1·50	£1·40	£1·30
SN74150	£3·00	£2·70	£2·50
SN74151	£1·00	0·95	0·90
SN74153	£1·20	£1·10	0·95
SN74154	£1·80	£1·70	£1·60
SN74155	£1·40	£1·30	£1·20
SN74156	£1·40	£1·30	£1·20
SN74157	£1·90	£1·80	£1·70
SN74160	£1·80	£1·70	£1·60
SN74161	£1·80	£1·70	£1·60
SN74162	£4·00	£3·75	£3·50
SN74163	£4·00	£3·75	£3·50
SN74164	£2·20	£2·15	£2·10
SN74165	£2·25	£2·20	£2·15
SN74166	£3·50	£3·25	£3·00
SN74174	£2·30	£2·20	£2·10
SN74175	£1·60	£1·50	£1·40
SN74176	£2·50	£2·40	£2·30
SN74177	£2·50	£2·40	£2·30
SN74180	£2·00	£1·60	£1·40
SN74181	£5·50	£5·00	£4·75
SN74182	£2·00	£1·80	£1·60
SN74184	£3·50	£3·25	£3·00
SN74190	£1·95	£1·90	£1·85
SN74191	£1·90	£1·85	£1·80
SN74192	£1·95	£1·90	£1·85
SN74193	£2·00	£1·80	£1·75
SN74194	£2·70	£2·60	£2·50
SN74195	£2·00	£1·90	£1·80
SN74196	£1·80	£1·70	£1·60
SN74197	£1·80	£1·70	£1·60
SN74198	£5·50	£5·00	£4·50
SN74199	£5·50	£5·00	£4·50

LINEAR I.C.'s—FULL SPEC.

Type No.	Price 1–24	25–99	100 up
BP201C—SL201C	68p	58p	45p
BP701C—SL701C	68p	50p	45p
BP702C—SL702C	68p	50p	45p
BP702—72702	53p	45p	40p
BP709—72709	36p	34p	30p
LBP709P—μA709C	36p	34p	30p
BP710—72710	44p	42p	40p
BP711—μA711	45p	43p	40p
BP741—72741	75p	60p	50p
μA703C—μA703C	28p	26p	24p
TAA263—	70p	60p	55p
TAA293—	90p	75p	70p
TAA350	170p	158p	150p
S.G.S. EA 000 2·63			

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

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

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

NUMERICAL INDICATOR TUBES

MODEL	CD66	GR116	3015F Minitron
Anode voltage (Vdc)	170min	175min	5
Cathode Current (mA)	2·3	14	8
Numerical Height (mm)	16	13	9
Tube Height (mm)	47	32	22
Tube Diameter (mm)	19	13	12 wide
I.C. Driver Rec.	BP41 or 141	BP41 or 141	BP47
PRICE EACH	£1·70	£1·55	£1·90

All indicators 0·9 + Decimal point. All side viewing. Full data for all types available on request.

RTL MICROLOGIC CIRCUITS

Epoxy TO-5 case	Price each 1–24	25–99	100 up
uL900 Buffer	35p	33p	27p
uL914 Dual 2i/p gate	35p	33p	27p
uL923 J-K flip-flop	50p	47p	45p

Date and Circuits Booklet for IC's Price 7p.

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14 & 16 Lead Sockets for use with

DUAL-IN-LINE I.C's. TWO Ranges PROFESSIONAL & NEW LOW COST.

PROF. TYPE No.	1–24	25–99	100up.
TSO 14 pin type	30p	27p	25p
TSO 16 „ „	35p	32p	30p
LOW COST No.			
BPS 14	15p	13p	11p
BPS 16	16p	14p	12p

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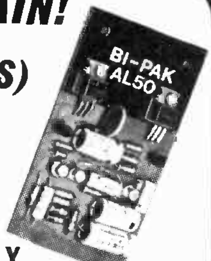

0·1% DISTORTION!
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THE AL50

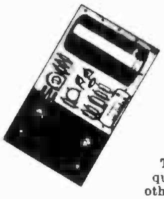
- ★ Frequency Response 15Hz to 100,000—1dB.
- ★ Load—3, 4, 8 or 16 ohms.
- ★ Distortion—better than ·1% at 1KHz.
- ★ Signal to noise ratio 80dB.

ONLY £3.25p each

- ★ Supply voltage 10–35 Volts.
- ★ Overall size 63mm × 105mm × 13mm.

Tailor made to the most stringent specifications using top quality components and incorporating the latest solid state circuitry and AL50 was conceived to fill the need for all your A.F. amplification needs.
FULLY BUILT — TESTED — GUARANTEED.

STABILISED POWER MODULE SPM80



AP80 is especially designed to power 2 of the AL50 Amplifiers, up to 15 watt (r.m.s.) per channel simultaneously. This module embodies the latest components and circuit techniques incorporating complete short circuit protection. With the addition of the Mains Transformer MT80, the unit will provide outputs of up to 1·5 amps at 35 volts. Size: 63mm × 105mm × 30mm.
These units enable you to build Audio Systems of the highest quality at a hitherto unobtainable price. Also ideal for many other applications including:—Disco Systems, Public Address, Intercom Units, etc. Handbook available, 10p **PRICE £2·95**

TRANSFORMER BMT80 £1·95 p. & p. 25p.

STEREO PRE-AMPLIFIER TYPE PA100

Built to a specification and NOT a price, and yet still the greatest value on the market, the PA100 stereo pre-amplifier has been conceived from the latest circuit tecnniques. Designed for use with the AL50 power amplifier system, this quality made unit incorporates no less than eight silicon planar transistors, two of these are specially selected low noise NPN devices for use in the input stages.
Three switched stereo inputs, and rumble and scratch filters are features of the PA100, which also has a STEREO/MONO switch, volume, balance and continuously variable bass and treble controls.

SPECIFICATION

Frequency Response	20Hz — 20KHz ± 1dB
Harmonic Distortion	better than 0·1%
Inputs : 1. Tape Head	1·25 mV into 50K Ω
2. Radio, Tuner	35 mV into 50K Ω
3. Magnetic P.U.	1·5 mV into 50K Ω

All input voltages are for an output of 250mV. Tape and P.U. inputs equalised to RIAA curve within ± 1dB. from 20Hz to 20KHz.

Bass Control	± 15dB at 20Hz
Treble Control	± 15dB at 20KHz
Filters : Rumble (High Pass)	100Hz
Scratch (Low Pass)	8KHz
Signal/Noise Ratio	better than — 65dB
Input overload	+ 26dB
Supply	+ 35 volts at 20mA
Dimensions	292mm × 82mm × 35mm

ONLY £11·95

SPECIAL COMPLETE KIT COMPRISING 2 AL50's, 1 SPM80, 1 BMT80 & 1 PA100 ONLY £23·00 FREE p. & p.

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Goldring G800 **£17·45**
Teak plinth and tinted cover
All leads supplied.
Please add £1·25 P. & P. & Ins.

TURNTABLES

Please add 75p P. & P. & Ins.

Connoisseur BD1 Chassis	£12·75
Garrard SP25 Mk. III	£9·90
Garrard AP76	£17·20
Garrard SL65B	£13·95
Garrard 401	£28·75
Garrard Zero 100 (Auto)	£36·90
Garrard Zero 100 (Single)	£35·90
BSR MP60	£9·40
Goldring GL72	£20·90
Goldring GL72 P	£27·45
Goldring GL75	£26·85
Goldring GL75 P	£34·95
Goldring 101 P.C.	£20·00
Wharfedale Linton + cart.	£25·90
Thorens TD125AB Mk. II	£27·95
Thorens TD150 Mk. II	£91·45
Thorens TD160 AB & C	£53·95

TUNERS

Please add 85p P. & P. & Ins.

Amstrad Multiplex 3000	£27·25
Armstrong 523	£39·50
Armstrong 524	£31·45
Rogers R/brook FET4 (Chassis)	£35·75
Rogers R/brook FET4 (Cased)	£38·95
Rogers R/bourne FET4 (Chassis)	£45·00
Rogers R/bourne FET4 (Cased)	£49·50
Sinclair PR060 (Module)	£16·95
Sinclair 2000/3000 Tuner	£29·90
Leak Delta FM (Cased)	£53·60
Leak Delta AM/FM (Cased)	£63·75
Alpha Highgate FT150	£37·95
Metrosound FMS 20	£38·65
Philips RH 690	£33·00

TUNER/AMPLIFIERS

Please add £1 P. & P. & Ins.

Alpha Highgate 150	£49·75
Armstrong 525 (Teak cased)	£69·45
Armstrong 526 AM/FM (Teak cased)	£77·25
Leak Delta 75	£119·00
Teleton 2100	£32·50
Goodmans One Ten	£98·90
Goodmans Mod 90	£85·50
Rotel 150	£49·50
Rotel 400	£75·50
Rogers Ravensbrook (Teak cased)	£77·00
Rogers R/brook (Chassis)	£72·00
Alpha FR 3000. New product	£72·00

All prices correct at time of press E. & O.E. and are subject to alterations.

AMPLIFIERS

Please add 85p P. & P. & Ins.

Amstrad 8000 Mk. II	£14·95
Amstrad IC2000	£27·50
Amstrad Integra 4000	£22·50
Armstrong 521 (Teak cased)	£43·90
Alpha Highgate 212	£24·85
Alpha Highgate FA300	£32·25
Alpha Highgate FA400	£35·65
Leak Delta 30	£44·85
Leak Delta 70	£54·90
Metrosound ST20E	£24·20
Metrosound ST60	£45·95
Pioneer SA600 & 610	£57·25
Pioneer SA5000A	£71·95
Pioneer SA1000	£96·95
Rogers R/brook (Chassis)	£37·95
Rogers R/brook (Cased)	£41·50
Rogers R/bourne (Chassis)	£49·95
Rogers R/bourne (Cased)	£52·75
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Sinclair PR060 2 × Z30 PZ6	£16·70
Sinclair PR060 2 × Z50 PZ8 Trans	£22·95
Sinclair AFU (Filter Unit)	£4·20
Sinclair 605	£17·95
Sinclair 2000 Mk. II	£21·50
Sinclair 3000 Mk. II	£28·00
Wharfedale Linton	£39·70
Teleton SAQ 307	£22·95
Rotel RA310	£34·95
Rotel RA610	£52·95

SPEAKERS

Please add £1·50 per pair P. & P. & Ins.

	Price per pair
Amstrad 138	£13·90
Wharfedale Denton 2	£28·40
Wharfedale Linton 2	£35·40
Wharfedale Melton 2	£45·90
Wharfedale Dovedale 3	£59·80
Celestion Ditton 120	£38·40
Celestion Ditton 15	£51·00
Celestion Ditton 25	£84·50
Celestion County (new prod)	£34·50
Goodmans Double Maxim	£47·40
Goodmans Mezzo 3	£45·95
Goodmans Magister	£82·95

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Goldring G800 Super E	£14·15
Shure M3D	£3·70
Shure M44E	£4·75
Shure M55E	£5·55
Ortofon SL15	£15·85
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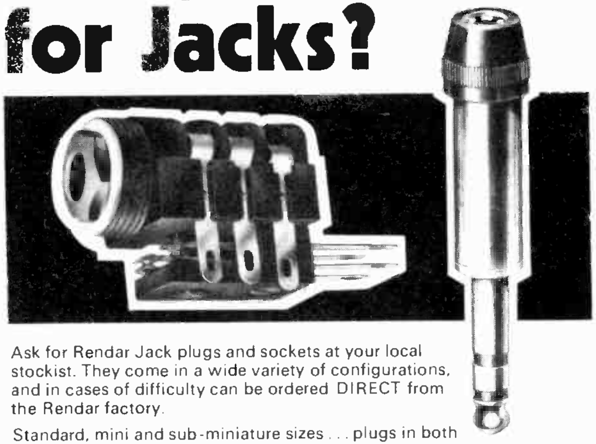

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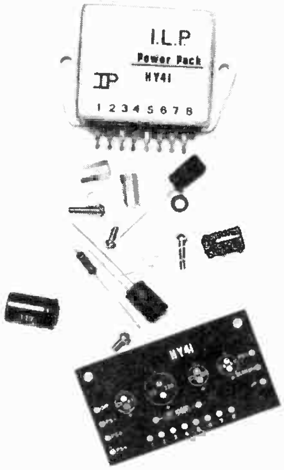


THE HY41

The HY41 supersedes the popular HY40 introduced by ILP last year. This highly improved module achieves true High Fidelity with a dramatic reduction in distortion (typically 0.05% at 1KHz into 8 ohms!) and is electronically and mechanically compatible with the HY40.

With this important improvement the HY41 retains all of the quality characteristics found in the earlier version and P.C. board, Resistor, Capacitors, Hardware Mountings and comprehensive manual are included in the basic kit. No further components are required to construct a complete power amplifier of extremely high performance sufficiently versatile to provide power not merely for Hi-Fi but also for public address systems and industry.

The free manual gives a full circuit diagram of the HY41 and its various applications including a complete stereo amplifier.

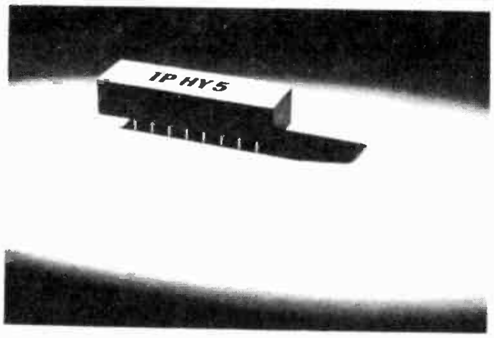
Like its predecessor the HY41 is based on conventional and proven circuit techniques developed over recent years.

OUTPUT POWER: British Rating 40 WATTS PEAK, 20 watts R.M.S. continuous.
LOAD IMPEDANCE: 4–16 ohms.
INPUT IMPEDANCE: 30K ohms at 1KHz.
VOLTAGE GAIN: 30db at 1KHz

TOTAL HARMONIC DISTORTION: less than 0.15% (typical 0.05%) at 1KHz.
FREQUENCY RESPONSE: 5Hz–50KHz ± 1db.
SUPPLY VOLTAGE: ± 22.5volts D.C.
SUPPLY CURRENT: 0.8 amps maximum.

PRICE: inc. comprehensive manual, P.C. board, five extra components and P. & P.:–
MONO: £4.90 **STEREO: £9.80**

UNIQUE HYBRID PRE-AMPLIFIER



The HY5 has rapidly established a position in the WORLD as the sole hybrid pre-amplifier to contain all feedback and equalization networks within an integrated pre-amplifier circuit.

Supplied with the HY5 are two stabilizing capacitors and by the addition of volume, treble and bass potentiometers it is ready for use.

Internally the HY5 provides equalization for almost every conceivable input, the desired function is achieved by use of a multi-way switch or by direct interconnection.

Two distinctive features of the HY5 are its inbuilt stabilization circuit, allowing it to be run off any unregulated power supply from **16–25** Volts and a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo pre-amplifier.

Specifically and critically designed to meet exacting Hi-Fi standards, the HY5 combines extremely low noise with a high overload capability. When used in conjunction with the HY41 and PSU45 forms a completely intergrated system.

INPUTS
Magnetic Pick-up (within ±1db RIAA curve) 2mV. 47K Ω
Tape Replay (external components to suit head). 4mV. 47K Ω
Microphone (flat) 10mV. 47K Ω
Ceramic Pick-up (equalized and compensatable) 20–2000mV. variable.
Tuner (flat) 250mV. 100K Ω
Auxiliary 1 250mV. 47K Ω
Auxiliary 2 2–20mV. 100K Ω

OUTPUTS
Main Pre-amp output 500mV.
Direct tape output 120mV.

ACTIVE TONE CONTROLS (Baxendall)
Treble ± 12db.
Bass ± 12db.

INTERNAL STABILIZATION
Enables the HY5 to share an unregulated supply with the Power Amplifier.

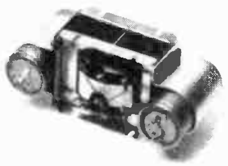
SUPPLY VOLTAGE
16–25 volts

SUPPLY CURRENT
6mA approx.

OVERLOAD CAPABILITY
better than 26db on most sensitive input infinite on tuner and auxl.

OUTPUT NOISE VOLTAGE: 0.5mV.

PRICE: **MONO: £3.60** **STEREO: £7.20**



POWER SUPPLY PSU45

The versatile P.S.U.45 is designed to supply your HY41's +HY5's in stereo or mono format.

Specification

Input: 200–240 Volts.
Output: ± 22.5 Volts at 2 amps.
Overall Dimensions: L. 7"; D. 3.8"; H. 3.1"

PRICE: **£4.50 inc. P. & P.**

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1N256	0·50
1N645	0·25
1N725A	0·20
1N914	0·07
1N4007	0·20
1S113	0·15
1S130	0·18
1S131	0·18
1S202	0·23
2G371	0·22
2G381	0·25
2G414	0·30
2G417	0·22
2N404	0·20
2N697	0·15
2N698	0·40
2N706	0·10
2N706A	0·12
2N708	0·15
2N709	0·63
2N1091	0·38
2N1131	0·25
2N1132	0·25
2N1302	0·18
2N1303	0·18
2N1304	0·22
2N1305	0·22
2N1306	0·25
2N1307	0·25
2N1308	0·25
2N2147	0·75
2N2148	0·60
2N2160	0·60
2N2218	0·20
2N2219	0·20
2N2369A	0·15
2N2444	1·99
2N2613	0·28
2N2646	0·45
2N2904	0·20
2N2904A	0·25
2N2906	0·20
2N2907	0·23
2N2924	0·23
2N2925	0·15
2N2926	0·10
2N3054	0·50
2N3055	0·75
2N3702	0·10
2N3705	0·10
2N3706	0·23
2N3707	0·12
2N3709	0·10
2N3710	0·10
2N3711	0·10
2N3819	0·35
2N5027	0·53
2N5088	0·33
2S301	0·50
2S304	0·75
2S501	0·37
2S703	0·62
AA129	0·20
AAZ12	0·30
AAZ13	0·12
AC107	0·37
AC126	0·20
AC127	0·25
AC128	0·20
AC187	0·25
AC188	0·25
ACY17	0·30
ACY18	0·25
ACY19	0·25
ACY20	0·20
ACY21	0·20
ACY22	0·10
ACY27	0·25
ACY28	0·17
ACY39	0·50
ACY40	0·15
ACY41	0·15
ACY44	0·25
AD140	0·50
AD149	0·50
AD161	0·37
AD162	0·37
AF106	0·30
AF114	0·25
AF115	0·25
AF116	0·25
AF117	0·25
AF118	0·62
AF119	0·20
AF124	0·25
AF125	0·20
AF126	0·17
AF127	0·17
AF139	0·30
AF178	0·55
AF179	0·65
AF180	0·52
AF181	0·42
AF186	0·40
AFY19	1·13
AFZ11	0·60
AFZ12	1·00
ASY26	0·25
ASY27	0·32
ASY28	0·25
ASY29	0·30
ASY36	0·25
ASY50	0·17
ASY51	0·40
ASY53	0·20
ASY55	0·20
ASY62	0·25
ASY86	0·38
ASZ21	0·42
ASZ23	0·75
AUY10	0·98
AU101	1·50
BC107	0·10
BC108	0·10
BC109	0·10
BC113	0·15
BC115	0·20
BC116	0·25
BC116A	0·30
BC118	0·25
BC121	0·20
BC122	0·20
BC125	0·68
BC126	0·65
BC140	0·55
BC147	0·15
BC148	0·13
BC149	0·15
BC157	0·15
BC158	0·12
BC160	0·68
BC169	0·13
BCY31	0·35
BCY32	0·55
BCY33	0·25
BCY34	0·30
BCY38	0·40
BCY39	1·00
BCY40	0·50
BCY42	0·25
BCY70	0·15
BCY71	0·20
BCZ10	0·35
BCZ11	0·50
BD121	0·65
BD123	0·80
BD124	0·75
BDY11	1·62
BF115	0·25
BF117	0·50
BF167	0·25
BF173	0·25
BF181	0·35
BF184	0·20
BF185	0·20
BF194	0·17
BF195	0·15
BF196	0·15
BF197	0·15
BF861	0·28
BF898	0·28
BFX12	0·20
BFX13	0·25
BFX29	0·25
BFX30	0·25
BFX35	0·98
BFX63	0·50
BFX84	0·25
BFX85	0·30
BFX86	0·25
BFX87	0·25
BFX88	0·20
BFY10	1·00
BFY11	1·25
BFY17	0·25
BYF18	0·25
BFY19	0·25
BFY24	0·45
BFY44	1·00
BFY50	0·22
BFY51	0·20
BFY52	0·22
BFY53	0·17
BFY64	0·42
BFY90	0·65
BSX27	0·50
BSX60	0·98
BSX76	0·15
BSY26	0·18
BSY27	0·17
BSY51	0·50
BSY95A	0·12
BSY95	0·12
BT102/500R	0·75
BTY42	0·92
BTY79/100R	0·75
BTY79/400R	1·25
BY100	0·15
BY126	0·15
BY127	0·17
BY182	0·85
BY213	0·25
BYZ10	0·85
BYZ11	0·32
BYZ12	0·30
BYZ13	0·25
BYZ15	1·00
BYZ16	0·62
BYZ88C3V3	0·15
C111	0·65
CRS1/05	0·25
CRS1/40	0·45
CS4B	2·50
CS10B	3·13
DD000	0·15
DD003	0·15
DD006	0·18
DD007	0·40
DD008	0·88
GD3	0·38
GD4	0·05
GD5	0·33
GD8	0·25
GD12	0·05
GET102	0·80
GET103	0·22
GET113	0·20
GET114	0·15
GET115	0·45
GET116	0·50
GET120	0·25
GET872	0·30
GET875	0·25
GET880	0·37
GET881	0·25
GET882	0·25
GET885	0·25
GEX44	0·08
GEX45/1	0·10
GEX941	0·15
GJ3M	0·25
GJ4M	0·38
GJ5M	0·25
GJ7M	0·37
HG1005	0·50
HS100A	0·20
MAT100	0·25
MAT101	0·30
MAT120	0·25
MAT121	0·30
MJE520	0·87
MJE2955	1·37
MJE3055	0·87
NKT128	0·35
NKT129	0·30
NKT211	0·25
NKT213	0·25
NKT214	0·15
NKT216	0·37
NKT217	0·35
NKT218	1·13
NKT219	0·33
NKT222	0·20
NKT224	0·22
NKT251	0·24
NKT271	0·25
NKT272	0·25
NKT273	0·15
NKT274	0·20
NKT275	0·25
NKT277	0·20
NKT278	0·25
NKT301	0·40
NKT304	0·75
NKT403	0·75
NKT404	0·55
NKT678	0·30
NKT713	0·25
NKT773	0·25
NKT777	0·38
O78B	0·38
OA5	0·20
OA6	0·12
OA47	0·10
OA70	0·10
OA71	0·10
OA73	0·10
OA74	0·10
OA79	0·10
OA81	0·08
OA85	0·12
OA86	0·15
OA90	0·08
OA91	0·07
OA95	0·07
OA200	0·07
OA202	0·10
OA210	0·25
OA211	0·30
OAZ200	0·55
OAZ201	0·50
OAZ202	0·42
OAZ203	0·42
OAZ204	0·30
OAZ205	0·42
OAZ206	0·42
OAZ207	0·47
OAZ208	0·32
OAZ209	0·32
OAZ210	0·32
OAZ211	0·32
OAZ222	0·45
OAZ223	0·45
OAZ224	0·45
OAZ241	0·22
OAZ242	0·23
OAZ244	0·22
OAZ246	0·23
OAZ290	0·38
OC16	0·50
OC16T	0·38
OC19	0·37
OC20	0·85
OC22	0·50
OC23	0·60
OC24	0·60
OC25	0·37
OC26	0·25
OC28	0·60
OC29	0·60
OC30	0·40
OC35	0·50
OC36	0·60
OC41	0·25
OC42	0·30
OC43	0·40
OC44	0·17
OC44M	0·17
OC45	0·12
OC45M	0·18
OC46	0·27
OC57	0·60
OC58	0·60
OC59	0·65
OC66	0·50
OC70	0·12
OC71	0·12
OC72	0·20
OC73	0·30
OC74	0·30
OC75	0·25
OC76	0·25
OC77	0·40
OC78	0·20
OC79	0·22
OC81	0·20
OC81D	0·20
OC81M	0·20
OC81DM	0·18
OC81Z	0·40
OC82	0·25
OC82D	0·20
OC83	0·25
OC84	0·25
OC114	0·38
OC122	0·60
OC123	0·65
OC139	0·25
OC140	0·35
OC141	0·60
OC169	0·20
OC170	0·25
OC171	0·30
OC200	0·40
OC201	0·70
OC202	0·80
OC203	0·40
OC204	0·40
OC205	0·75
OC206	0·90
OC207	0·90
OC460	0·20
OC470	0·30
OCP71	0·97
ORP12	0·50
ORP60	0·40
ORP61	0·42
S19T	0·30
SAC40	0·25
SFT308	0·38
ST722	0·38
ST7231	0·63
SX68	0·20
SX631	0·30
SX635	0·40
SX640	0·50
SX641	0·55
SX642	0·60
SX644	0·75
SX645	0·75
V15/30P	0·50
V30/201P	0·75
V60/201	0·50
V60/201P	0·75
XA101	0·10
XA102	0·18
XA151	0·15
XA152	0·15
XA161	0·25
XA162	0·25
XB101	0·43
XB102	0·10
XB103	0·25
XB113	0·12
XB121	0·48
ZR24	0·63
ZS170	0·10
ZS271	0·18
ZT21	0·25
ZT43	0·25
ZTX107	0·15
ZTX108	0·12
ZTX300	0·12
ZTX304	0·25
ZTX500	0·16
ZTX503	0·17
ZTX531	0·25
INTEGRATED CIRCUITS	
7400	0·20
7401	0·20
7402	0·20
7403	0·20
7404	0·20
7405	0·20
7406	0·30
7407	0·30
7408	0·20
7409	0·45
7410	0·20
7411	0·23
7412	0·42
7413	0·30
7416	0·30
7417	0·30
7420	0·20
7422	0·48
7423	0·48
7425	0·48
7427	0·42
7428	0·50
7430	0·20
7432	0·42
7433	0·70
7437	0·65
7438	0·65
7440	0·20
7441AN	0·75
7442	0·75
7450	0·20
7451	0·20
7453	0·20
7454	0·20
7460	0·20
7470	0·30
7472	0·30
7473	0·40
7474	0·40
7475	0·55
7476	0·45
7480	0·80
7482	0·87
7483	1·00
7484	0·90
7486	0·45
7490	0·75
7491AN	1·00
7492	0·75
7493	0·75
7494	0·80
7495	0·80
7496	1·00
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74111	1·45
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74119	1·90
74121	0·60
74122	1·35
74123	2·70
74141	1·00
74145	1·60
74150	3·35
74151	1·10
74154	2·00
74155	1·55
74156	1·55
74157	1·80
74170	4·10
74174	2·00
74175	1·35
74176	1·60
74190	1·95
74191	1·95
74192	2·00
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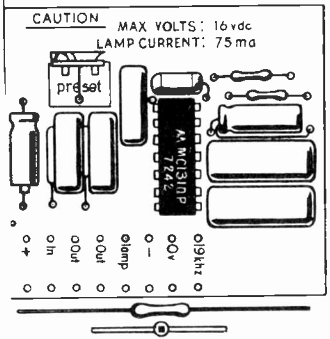
Stereo radio from your existing tuner.



A complete set of parts from Jermyn to build a stereo decoder module that will convert your existing mono tuner for stereo reception whilst maintaining a high standard of reproduction.

The distortion is very low (typically 0.3% at 560 mV RMS composite input signal) with 40dB channel separation.

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Fitting. The module requires a 10-16 volt power supply which can normally be tapped off the existing tuner. The signal input is taken off before the de-emphasis circuit which in practice means disconnecting one, or at the most, two capacitors. Any radio engineer will be able to spot these capacitors, but if you're really stuck send the circuit with a SAE to us and one of our engineers will indicate the output point. (This is the full extent of our involvement, no hardware please).

Of course, if you have a modern mono tuner with a multiplex output our module simply plugs in.

The outputs go via a screened twin cable to the tuner inputs of your stereo amplifier.

And the cost? £4.90 for the Kit with 100% tested integrated circuit.

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Please rush me ☐ Kit(s), ☐ made up Stereo decoders.
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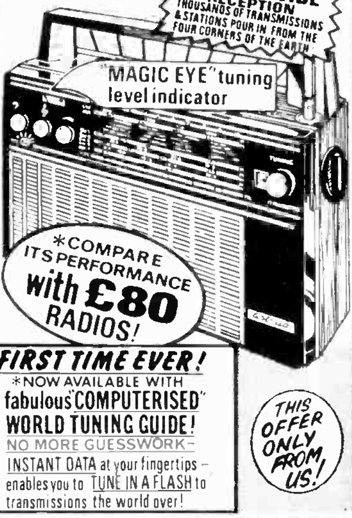

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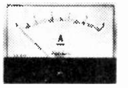

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10mA	£2·50
50mA	£2·50
100mA	£2·50
500mA	£2·50
1 amp.......	£2·50
5 amp.......	£2·50
10 amp......	£2·50
5V d.c.	£2·50
10V d.c.	£2·50
20V d.c.	£2·50
50V d.c.	£2·50
300V d.c. ...	£2·50
15V a.c.	£2·75
300V a.c. ...	£2·75
VU Meter ...	£3·00

Type SD.640 63·5mm × 85mm Fronts

50μA........	£2·60
50-0-50μA...	£2·55
100μA.......	£2·55
100-0-100μA.	£2·55
200μA.......	£2·55
500μA.......	£2·35
1mA	£2·35
5mA	£2·35
10mA	£2·35
50mA	£2·35
100mA	£2·35
500mA	£2·35
1 amp.......	£2·35
5 amp.......	£2·35
10 amp......	£2·35
5Vd.c.	£2·35
20V d.c.	£2·35
50V d.c.	£2·35
300V d.c. ...	£2·35
15V a.c.	£2·40
300V a.c. ...	£2·40
VU Meter ...	£2·70

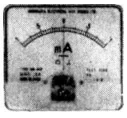
Type SD.460 46mm × 59·5mm Fronts

50μA........	£2·40
50-0-50μA...	£2·35
100μA.......	£2·35
100-0-100μA.	£2·35
200μA.......	£2·35
500μA..... ..	£2·20
1mA	£2·15
5mA	£2·15
10mA	£2·15
50mA	£2·15
100mA	£2·15
500mA	£2·15
1 amp.......	£2·15
5 amp.......	£2·15
10 amp......	£2·15
5V d.c.	£2·15
10V d.c.	£2·15
20V d.c.	£2·15
50V d.c.	£2·15
300V d.c. ...	£2·15
15V a.c.	£2·30
300V a.c. ...	£2·30
VU Meter ...	£2·55

*MOVING IRON—
ALL OTHERS MOVING COIL

Please add postage

Type MR.85P. 4¼in. × 4¾in. Fronts



50μA........	£3·95
50-0-50μA...	£3·40
100μA.......	£3·40
100-0-100μA.	£3·30
200μA.......	£3·30
500μA.......	£3·20
500-0-500μA.	£3·10
1mA	£3·10
1-0-1mA· ..	£3·10
5mA	£3·10
10mA	£3·10
50mA	£3·10
100mA	£3·10
500mA	£3·10
1 amp.......	£3·10
5 amp.......	£3·10
15 amp......	£3·10
30 amp......	£3·20
20V d.c.	£3·10
50V d.c.	£3·10
150V d.c. ...	£3·10
300V d.c. .	£3·10
15V a.c.	£3·10
300V a.c. ...	£3·10
8 Meter 1mA.	£3·15
VU Meter ...	£3·95
1 amp. a.c. ..	*£3·10
5 amp. a.c. ..	*£3·10
10 amp. a.c. .	*£3·10
20 amp. a.c. .	*£3·10
30 amp. a.c. .	*£3·10

Type MR.52P. 2⅜in. square Fronts.

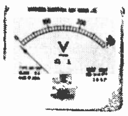
50μA........	£3·40
50-0-50μA...	£2·85
100μA.......	£2·85
100-0-100μA.	£2·75
500μA.......	£2·55
1mA	£2·20
5mA	£2·20
10mA	£2·20
50mA	£2·20
100mA	£2·20
500mA	£2·20
1 amp.......	£2·20
5 amp.......	£2·20
10V d.c.	£2·20
20V d.c.	£2·20
50V d.c.	£2·20
300V d.c. ...	£2·20
15V a.c.	£2·30
300V a.c. ...	£2·30
8 Meter 1mA.	£2·30
VU Meter ...	£3·50
1 amp. a.c. ..	*£2·20
5 amp. a.c. ..	*£2·20
10 amp. a.c. .	*£2·20
20 amp. a.c. .	*£2·20
30 amp. a.c. .	*£2·20

Type MR.65P. 3⅜in. × 3⅛in. Fronts

50μA........	£3·70
50-0-50μA...	£3·00
100μA.......	£3·00
100-0-100μA.	£2·90
200μA.......	£2·90
500μA.......	£2·65
500-0-500μA.	£2·40
1mA	£2·40
5mA	£2·40
10mA	£2·40
50mA	£2·40
100mA	£2·40
500mA	£2·40
1 amp	£2·40
5 amp	£2·40
10 amp......	£2·40
15 amp......	£2·40
20 amp......	£2·40
30 amp......	£2·55
50 amp......	£2·75
5V d.c.	£2·40
10V d.c.	£2·40
20V d.c.	£2·40
50V d.c.	£2·40
150V d.c. ...	£2·40
300V d.c. ...	£2·40
15V a.c.	£2·55
50V a.c.	£2·55
150V a.c. ...	£2·55
300V a.c. ...	£2·55
500V a.c. ...	£2·55
8 Meter 1mA.	£2·60
VU Meter ...	£3·70
50mA a.c. ...	*£2·40
100mA a.c. ..	*£2·40
200mA a.c. ..	*£2·40
500mA a.c. ..	*£2·40
1 amp. a.c. ..	*£2·40
5 amp. a.c. ..	*£2·40
10 amp. a.c. .	*£2·40
20 amp. a.c. .	*£2·40
30 amp. a.c. .	*£2·40

Send for illustrated brochure on SEW Panel Meters—discounts for quantities.

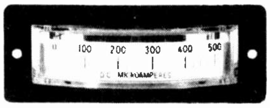
Type MR.38P. 1 21/32in. square Fronts.



50μA........	£2·30
50-0-50μA...	£2·10
100μA.......	£2·10
100-0-100μA.	£1·95
200μA.......	£1·95
500μA.......	£1·80
500-0-500μA.	£1·75
1mA	£1·75
1-0-1mA ...	£1·75
2mA	£1·75
5mA	£1·75
10mA	£1·75
20mA	£1·75
50mA	£1·75
100mA	£1·75
150mA	£1·75
200mA	£1·75
300mA	£1·75
500mA	£1·75
750mA	£1·75
1 amp.......	£1·75
2 amp.......	£1·75
5 amp.......	£1·75
10 amp......	£1·75
3V d.c.	£1·75
10V d.c.	£1·75
15V d.c.	£1·75
20V d.c.	£1·75
50V d.c.	£1·75
100V d.c. ...	£1·75
150V d.c. ...	£1·75
300V d.c. ...	£1·75
500V d.c. ...	£1·75
750V d.c. ...	£1·75
15V a.c.	£1·85
50V a.c.	£1·85
150V a.c. ...	£1·85
300V a.c. ...	£1·85
500V a.c. ...	£1·85
8 Meter 1mA.	£1·85
VU Meter ...	£2·30

Type MR.45P. 2in. square Fronts.

50μA........	£2·50
50-0-50μA...	£2·30
100μA.......	£2·30
100-0-100μA.	£2·05
200μA.......	£2·05
500μA.......	£1·95
500-0-500μA.	£1·85
1mA	£1·85
5mA	£1·85
10mA	£1·85
50mA	£1·85
100mA	£1·85
500mA . ..	£1·85
1 amp.......	£1·85
5 amp.......	£1·85
10V d.c.	£1·85
20V d.c.	£1·85
50V d.c.	£1·85
300V d.c. ...	£1·85
15V a.c.	£2·00
300V a.c. ...	£2·00
8 Meter 1mA.	£2·05
VU Meter ...	£2·50
1 amp. a.c.	*£1·85
5 amp. a.c. ..	*£1·85
10 amp. a.c. .	*£1·85
20 amp. a.c. .	*£1·85
30 amp. a.c. .	*£1·85



"SEW" EDGEWISE METERS

Type PE.70. 3 17/32in. × 1 15/32in. × 2¾in. deep.

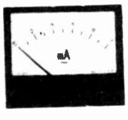
50μA........	£3·40
50-0-50μA...	£3·30
100μA.......	£3·30
100-0-100μA.	£3·20
200μA.......	£3·20
500μA.......	£3·05
1mA	£2·70
300V a.c. ...	£2·70
VU Meter ...	£3·75

"SEW" BAKELITE PANEL METERS

Type MR.65. 3½in. square Fronts.

25μA........	£3·85
50μA........	£3·00
50-0-50μA...	£2·60
100μA.......	£2·60
100-0-100μA.	£2·50
500μA.......	£2·45
500-0-500μA.	£2·15
1mA	£2·15
1-0- 1mA ...	£2·15
5mA	£2·15
10mA	£2·15
50mA	£2·15
100mA	£2·15
500mA	£2·15
1 amp.......	£2·15
5 amp.......	£2·15
15 amp......	£2·15
30 amp......	£2·15
50 amp......	£2·15
5V d.c.	£2·15
10V d.c.	£2·15
20V d.c.	£2·15
50V d.c.	£2·15
150V d.c. ...	£2·15
300V d.c. ...	£2·15
50mV d.c. ...	£2·40
100mV d.c. ..	£2·40
30V a.c.* ...	£2·20
50V a.c.* ...	£2·20
150V a.c.* ..	£2·20
300V a.c.* ..	£2·20
500mA a.c.* .	£2·15
1 amp. a.c.* .	£2·15
5 amp. a.c.* .	£2·15
10 amp. a.c.*	£2·15
20 amp. a.c.*	£2·15
30 amp. a.c.*	£2·15
50 amp. a.c.*	£2·15
VU Meter ...	£3·40

Type S-80 80mm square Fronts



50μA........	£3·50
50-0-50μA...	£3·40
100μA.......	£3·40
100-0-100μA.	£3·30
500μA.......	£3·05
1mA	£2·85
20V d.c.	£2·85
50V d.c.	£2·85
300V d.c. ...	£2·85
1 amp. d.c. ..	£2·85
5 amp. d.c. ..	£2·85
300V a.c. ...	£2·85
VU Meter ...	£3·70

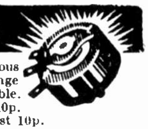
"SEW" EDUCATIONAL METERS

Type ED.107. Size overall 100mm × 90mm × 108mm.

A new range of high quality moving coil instruments ideal for school experiments and other bench applications. 3in. mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50μA........	£5·50
100μA.......	£5·10
1mA	£4·85
50-0-50μA...	£5·10
1-0-1mA ...	£4·85
1A d.c.	£4·85
5A d.c.	£4·85
10V d.c.	£4·85
20V d.c.	£4·85
50V d.c.	£4·85
300V d.c. ...	£4·85
Dual range	
500mA/5A d.c.	£5·10
5V/50V d.c. .	£5·10

POWER RHEOSTATS



High quality ceramic construction. Windings embedded in vitreous enamel. Heavy duty brush wiper. Continuous rating. Wide range ex-stock. Single hole fixing, ¼in. dia. shafts. Bulk quantities available.

25 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, **90p.** Post 10p.

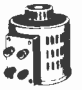
50 WATT. 10/25/50/100/250/500/1000/2500 or 5000 ohms, **£1·15.** Post 10p.

100 WATT. 1/5/10/25/50/100/250/500/1000 or 2500 ohms, **£1·65.** Post 15p.

"YAMABISHI" VARIABLE VOLTAGE TRANSFORMERS

Excellent quality. Low price. Immediate delivery

S-260 General Purpose Bench Mounting



1 amp.	£7·00
2·5 amp.	£8·05
5 amp.	£11·75
8 amp.	£15·90
10 amp.	£22·50
12 amp.	£23·60
20 amp.	£49·00
25 amp. . .	£58·00
40 amp.	£82·50

S-260 Panel Monnting

1 amp	£7·00
2·5 amp	£8·05

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ALL MODELS
INPUT 230V 50/60 CYCLES
OUTPUT VARIABLE 0–260 VOLTS.

Special discounts for quantity

AUTO TRANSFORMERS

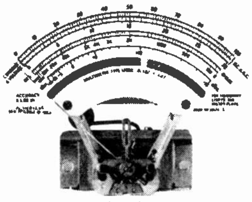
0/115/230V. Step up or step down. Fully shrouded.

80W	£2·10	P. & P. 18p
150W	£2·70	P. & P. 18p
300W	£3·60	P. & P. 23p
500W	£5·25	P. & P. 33p
1000W	£7·50	P. & P. 38p
1500W	£10·20	P. & P. 43p
2250W	£17·25	P. & P. 50p
5000W	£35·00	P. & P. £1

230 VOLT A.C. 50 CYCLES RELAYS

Brand new. 3 sets of changeover contacts at 5 amp. rating. **50p** each. Post 10p (100 lots **£40**) Quantities available.

AVOMETER MOVEMENTS



Spare movements for Model 8 or 9. (Fitted with Model 9 scale) or basis for any multimeter. Brand New and Boxed.

£3·50 Post 25p.

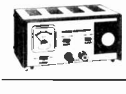
240° Wide Angle 1mA Meters

MW1-6 60mm square	£3·97
MW1-8 80mm square	£4·97

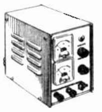
Post extra

RP214 REGULATED POWER SUPPLY

Solid state. Variable output 0–24V d.c. up to 1 amp. Dual scale meter to monitor voltage and current. Input 220/240V a.c. Size 185 × 85 × 105mm. **£8·97** Post 25p.



PS.200 REGULATED P.S.U.



Solid state. Variable output 5–20V d.c. up to 2 amp. Independent meters to monitor voltage and current. Output 220/240V. a.c. Size 7¼in. × 5¾in. × 3⅞in. **£14·97.** Post 25p.

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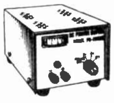

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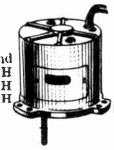

LB4 TRANSISTOR TESTER

Tests PNP or NPN transistors. Audio indication. Operates on two 1·5V batteries. Complete with all instructions, etc.

£4·50. Post 20p.

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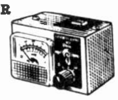
Tests ICO and B. *Pnp/npn*. Operates from 9V battery. Complete with all instructions, etc. **£3·95.** Post 20p.



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Input 88–125V a.c. or 176–250V a.c. Output 120V a.c. or 240V a.c. 200VA rating. **£11·97.** Post 50p.

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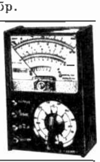
High-precision at low-cost. Ranges: D.c. 15V, 150V, 1,000V (10,000 O.P.V.). A.c. 15V, 150V, 100V (1,000 O.P.V.).
D.c. Current 150mA. Resistance 100k ohms.
£1·85. Post 15p.

MODEL 1092 Testmeter.



5,000 O.P.V.
0/3/15/150/300/1,200V d.c.
0/6/30/300/600V a.c.
0/300μA/300MA
0/10K/1 meg Ω
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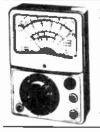
£2·75 each. Post 15p.



HIOKI MODEL 720X

20,000 O.P.V.
Overload protection
5/25/100/500/1,000V d.c.
10/50/250/1,000V a.c.
50μA/250mA. 20K/2 meg. ohm. −5 to +62dB.
£4·97. Post 15p.

HIOKI MODEL 730X

30,000 O.P.V. Overload protection. 6/30/60/300/600/1,200V d.c. 12/60/120/600/1,200V a.c. 60μA/30mA/300 mA. 2K/200K/2 megohm. −10 to +63 dB. **£6·50.** Post 15p.

MODEL TE-12

20,000 O.P.V. 0/0·6/6/30/120/600/1,200/3,000/6,000V d.c. 0/6/30/120/600/1,200V a.c. 0/60μA/6/60/600mA. 0/6K/600K/6Meg./60 Meg. Ω 50pF. 0·2mFd. **£5·97.** Post 17p.

MODEL TE-200 20,000 O.P.V. Mirror scale, overload protection. 0/5/25/125/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50μA/250mA. 0/60K/6 meg Ω. −20 to +62dB. **£3·95.** Post 15p.

MODEL 500 30,000 O.P.V. with overload protection mirror scale 0/0·5/2·5/10/25/100/250/500/1,000V d.c. 0/2·5/10/25/100/250/500/1,000V a.c. 0/50μA/5/50/500mA. 12 amp. d.c. 0/60/K/6 Meg./60 MegΩ. **£8·87.** Post paid.

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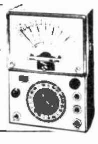


50,000 O.P.V.
43 ranges 0-0·3 to 1,200V d.c.
0-3 to 1,200V a.c.
0-30μA/300mA.
0-3K/30 meg ohms. −10 to +17dB.
£8·97. Post 20p.

HT100B4 MULTI-METER

Features a.c. current ranges. 100,000 O.P.V. Mirror Scale, Overload protection.
0/0·5/2·5/10/50/250/500/1,000V d.c.
0/2·5/10/50/250/500/1,000V a.c.
0/10/250μA/2·5/25/250MA/10 amp. d.c.
10 amp. a.c. 0/20K/200K/2MEG/20 MEG. −20 +62dB. **£12·50.** Post 25p.

370 WTR MULTIMETER

Features a.c. current ranges. 20,000 O.P.V.
0/0·5/2·5/10/50/250/500/1,000V d.c.
0/2·5/10/50/250/500/1,000V a.c.
0/50μA/1/10/100mA/1/10 amp. d.c.
0/100mA/1/10 amp. a.c.
0/5K/50K/500K/5MEG/50MEG. −20 +62dB. **£15.** Post 25p.

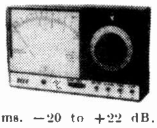
RUSSIAN 22 RANGE MULTIMETER

Model U437 10,000 O.P.V. A first class versatile ininstrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5/10/50/250/500/1,000V d.c. 2·5/10/50/250/500/1,000V a.c. D.c. current 100wA/1/10/100mA/1A. Resistance 300 ohms/3/30/300K/3mΩ. Complete with batteries, test leads, instructions and sturdy steel carrying case. OUR PRICE **£5·97.** Post 25p.

ROUND SCALE TYPE PENCIL TESTER MODEL TS.68

Completely portable, simple to use pocket sized tester. Ranges 0/3/30/300V a.c. and d.c. at 2,000 O.P.V. Resistance 0·20K ohms. ONLY **£1·97.** Post 13p.

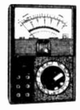
LT 601 MULTIMETER



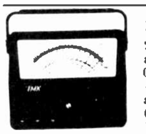
New style 20,000 O.P.V. pocket multimeter. 5/25/50/250/500/2,500V d.c. 10/50/100/500/1,000V a.c. 50μA/250A. 6K/6 meg ohms. −20 to +22 dB. **£3·75.** Post 20p.

MODEL TH-12

20,000 O.P.V. Overload protection. Slide switch selector. 0/0·25/2·5/10/50/250/1,000V d.c. 0/10/50/250/1,000V a.c. 0/50μA/25/250mA d.c. 0/3K/30K/300K/3 meg. −20 to +50dB.
£4·97. Post 15p.



MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30μA/6mA/60mA/300mA/600mA. 0/8K/80K/800K/8 meg. ohm −20 to −63dB. **£5·97.** Post 15p.

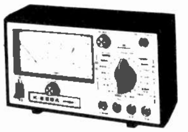


MODEL PL436

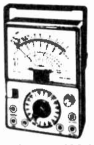
20kΩ/V d.c. 8kΩ/V a.c. Mirror scale. 0·6/3/12/30/120/600V d.c. 3/30/120/600V a.c. 50/600μA/60/600mA. 10/100K/1 Meg/10 MegΩ. −20 to +46dB. **£6·97,** Post 12p.

TMK MODEL TW-50K 46 ranges, mirror scale, 50K/V d.c. 5K/V a.c. D.c.: Volts 0·125, 0·25, 1·25, 2·5, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. Current: 25, 50μA, 2·5, 5, 25, 50, 250, 500mA, 5, 10 amp. Resistance: 10K, 100K, 1 MEG, 10 MEG Ω. Decibels: −20 to +81·5 dB. **£8·50.** Post 17p.

MODEL K228A



Taut band suspension. Overload protection. Polarity reversing switch. 30,000 O.P.V. 0/0·5/2·5/15/50/250/500/1,000/2,500V d.c. 0/15/50/150/500/1,000V a.c. 0/50μA/5/50/150/500mA/5A d.c. 0/3K/300K/3meg. **£8·95.** Post 20p.



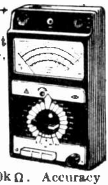
HIOKI MODEL 700X

100,000 O.P.V. Overload protection. Mirror scale. 0·3/0·6/1·2/1·5/3/6/12/30/60/120/300/600/1,200V d.c. 1·5/3/6/12/30/60/150/300/600/1,200V a.c. 15/30μA/3/6/30/60/150/300mA 6/12 amp. d.c. 2K/200K/2 Meg/20 Meg ohm −20 to +63dB. **£13·50.** Post 20p.

MODEL C-7080 EN

Giant 6in mirror scale.
20,000 O.P.V.
0/0·25/1/2·5/10/50/250/1,000/5,000V d.c. 0/2·5/10/50/250/1,000/5,000V a.c. 0/50μA/1/10/100/500mA/10 amp. d.c. 0/2K/200K/20 meg.
−20 to +50dB.
£13·95. Post 35p.

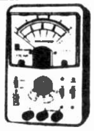
U4312 MULTIMETER



Extremely sturdy instrument for general electrical use. 667 O.P.V.
0/0·3/1·5/7·5/30/60/150/300/600/900V d.c. and 75mV.
0/0·3/1·5/7·5/30/60/150/300/600/900V a.c.
0/300μA/1·5/6/15/60/150 600MA/1·5/6 amp. d.c.
0/1·5/6/15/60/150/600MA/1·5/6 amp. a.c. 0/200Ω/3k/30kΩ. Accuracy Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **£9·50.** Post 25p.

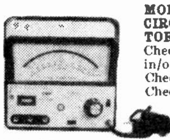
Selected TEST EQUIPMENT

FTC-401 TRANSISTOR TESTER



Full capabilities for measuring A, B and ICO. *npn* or *pnp*. Equally adaptable for checking diodes. Supplied complete with instructions, battery and leads. **£7·50.** Post 20p.

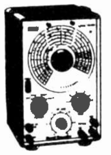
Model S-100TR MULTIMETER/TRANSISTOR TESTER. 100,000 O.P.V. mirror scale/overload protection. 0/0·12/0·6/3/12/30/120/600V d.c. 0/6/30/120/600V a.c. 0/12/600μA/12/300mA/12 amp. d.c. 0/10 K/1 MEG/100 MEG. −20 to +50dB. 0·01–2 MFD. Transistor tester measures Alpha, beta and Ico. Complete with batteries, instructions and leads.
£13·50. Post 25p.



MODEL 449A IN CIRCUIT TRANSISTOR TESTER

Checks true a.c. beta in/out. Checks Icbo. Checks diodes in/out. Checks SCR, etc.
Beta HI 10—500
LO 2—50
Icbo 0-5000μA.
220/240V a.c. operation. **£17·50.** Post 25p.

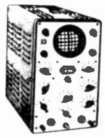
TE-20D RF SIGNAL GENERATOR



Accurate wide range signal generator covering 120 kHz-500 MHz on 6 bands. Directly calibrated Variable R.F. attenuator, audio output, Xtal socket for calibration. 220/240V a.c. Brand new with instructions. **£15.** Carr. 37p. Size 140mm × 215mm × 170mm.

MODEL L-55 FET V.O.M.

Input impedance 10 meg ohms. 0/0·3/1·2/6/30/120/600V d.c. 0/3/12/60/120/600V a.c. 0/120μA/120mA d.c. 0/1K/100K/10 meg/100 meg ohms.
£15·97. Post 25p.



CI-5 PULSE OSCILLOSCOPE

For display of pulsed and periodic waveforms in electronic circuits. VERT. AMP. Bandwidth 10MHz. Sensitivity at 100kHz V RMS/mm. 0·1-25; HOR. AMP. Bandwidth 500kHz. Sensitivity at 100kHz, V RMS/mm. 0·3-25; Pre-set triggered sweep 1-3,000μsec.; free running 20-200,000Hz in nine ranges. Calibrator pips. 220mm × 360mm × 430mm. 115-230V a.c. operation.
£39. Carr paid.

TO-3 PORTABLE OSCILLOSCOPE

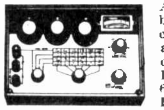
3in tube, Y amp. Sensitivity 0·1V p-p/CM. Bandwidth 1·5cps-1·5MHz. Input imp. 2 meg Ω 25pF X amp. sensitivity 0·9V. p-p/CM. Bandwidth 1·5cps-800kHz. Input imp. 2 meg Ω 20pF. Time base. 5 ranges 10cps-300kHz. Synchronisation. Internal/external. Illuminated scale 140mm × 215mm × 330mm. Weight 15½lb. 220/240V a.c. Supplied brand new with handbook. **£40·00.** Carr. 50p.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPE

5MHz Pass Band. Separate Y1 and Y2 amplifiers. Rectangular 5in × 4in C.R.T. Calibrated triggered sweep from 0·2μ/sec to 100 milli-sec per cm. Free running time base 50 Hz-1MHz. Built-in time base calibrator and amplitude calibrator. Supplied complete with all accessories and instruction manual. **£87.** Carr. paid.

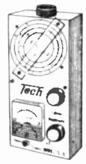
TE-16A Transistorised Signal Generator. 5 ranges 400kHz—30MHz. An inexpensive instrument for the handyman. Operates on 9V battery. Wide easy to read scale. 800kHz modulation. 5¾in × 5¾in × 3⅜in. Complete with instructions and leads. **£7·97.** Post 25p.

TRANSISTORISED L.C.R. A.C. MEASURING BRIDGE



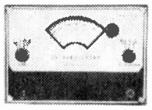
A new portable bridge offering excellent range and accuracy at low cost. Ranges: R. 1Ω–11·1 megΩ 6 Ranges ±1%. L.1 μH — 111 HENRYS 6 Ranges −2%. C. 10pF ±1110 mFd. 6 Ranges ·2%. TURNS RATIO 1:1/1000-1:11100. 6 Ranges +1%. Bridge voltage at 1,000cps. Operated from 9V 100μA. Meter indication. Attractive 2 tone metal case. Size 7¾in × 5in × 2in. **£20.** Post 25p.

MODEL TE15 GRID DIP METER

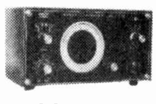


Transistorised. Operates as Grid Dip. Oscillator. Absorption Wave Meter and Oscillating Detector. Frequency range 440kHz–280MHz in 6 coils. 500μA meter. 9V battery operation. Size 180mm × 80mm × 40mm.
£12·50. Post 20p.

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

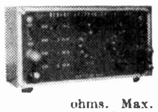


Sine 18-200,000 Hz; Square 18-50,000 Hz. Output max. +10dB (10 K ohms) Operation internal batteries. Attractive 2-tone case 7½in × 5in × 2in. Price **£17·50.** Carr. 17p.



MODEL MG-100 SINE SQUARE WAVE AUDIO GENERATOR

Range 19-220,000 Hz. Sine Wave 19 — 100,000Hz. Square Wave. Output Sine or Square wave 10V. P. to P. Size 180mm × 90mm × 90mm. Operation 220/240V a.c.
£17·50. Post 37p.



MODEL AT201 DECADE ATTENUATOR

Frequency range 0-200kHz. Attenuator 0-111dB, 0·1dB step. Impedance 600 ohms. Max. input power 30dBm. Size 180mm × 90mm × 55mm.
£12·50. Post 37p.

TE-65 VALVE VOLTMETER

28 ranges. D.c. volts 1·5–1,500V a.c. volts 1·5–1,500V. Resistance up to 1,000 megohms. 200/240V a.c. operation. Complete with probe and instructions. **£17·50.** Post 30p. Additional probes available: R.F. **£2·12**; H.V. **£2·50.**

MODEL U4311 SUB-STANDARD MULTI-RANGE VOLT AMMETER

Sensitivity 330 ohms/Volt a.c. and d.c. Accuracy 0·5% d.c. 1% a.c. Scale length 165mm.
0/300/750μA/1·5/3/7·5/15/30/75/150/300/750mA/1·5/3/7·5 amp. d.c. 0/3/7·5/15/30/75/150/300/750mA/1·5/3/7·5 amp. a.c. 0/75/150/300/750mV/1·5/3/7·5/15/30/75/150/300/750V d.c. 0/750mV/1·5/3/7·5/15/30/75/150/300/750V a.c.
Automatic cut out. Supplied complete with test leads, manual and test certificates. **£49.** Post 50p.

G. W. SMITH
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Also see opposite page and next two pages

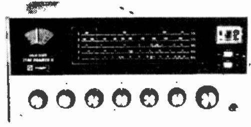
UNR-30 RECEIVER

4 Bands covering 550kHz–30MHz. BFO. Built-in Speaker 220/240V a.c. Brand new with instructions. **£15·75**. Carr. 37p.

UR-1A SOLID STATE COMMUNICATION RECEIVER

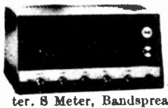
4 Bands covering 550kHz–30MHz. FET. S Meter. Variable BFO for SSB, Built-in Speaker, Bandspread, Sensitivity Control. 220/240V a.c. or 12V d.c. 12¾in × 4¾in × 7in. Brand new with instructions. **£25**. Carr. 37p.

SKYWOOD CX203 COMMUNICATION RECEIVER

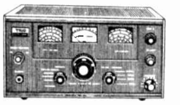


Solid state. Coverage on 5 bands 200–420 kHz and 0·55 to 30MHz. Illuminated slide rule dial. Bandspread. Aerial tuning. BFO, AVC, ANL, "S" meter. AM/CW/SSB. Integrated speaker and phone socket. Operation 220/240V a.c. or 12V d.c. Size 325 × 266 × 150 mm. Complete with instructions and circuit. **£32·50**. Carr. 50p.

LAFAYETTE HA-600 SOLID STATE RECEIVER

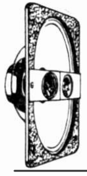


General coverage 150–400kHz. 550 kHz–30MHz. FET front end. 2 mech. filters, product detector, variable BFO, noise limiter. S Meter, Bandspread. RF Gain. 15in × 9¾in × 8¼in. 18lbs. 220/240V a.c. or 12V d.c. Brand new with instructions. **£50**. Carr. 50p.



TRIO 9R59DS COMMUNICATION RECEIVER

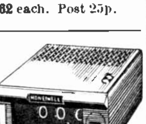
4 band covering 550kHz–30MHz continuous and electrical bandspread on 10, 15, 20, 40 and 80 metres. 8 valve plus 7 diode circuit. 4/8 ohm output and phone jack. SSB-CW. ANL. Variable BFO. S meter. Sep. bandspread dial. IF frequency 455kHz. Audio output 1·5W. Variable RF and AF gain controls 115/250V a.c. Size 7in × 13in × 10in with instruction manual. **£49·50**. Carr. paid.



EMI LOUDSPEAKERS

Model 350. 13in × 8in with single tweeter/crossover, 20–20,000Hz. 15W RMS. Available 8 or 15 ohms. **£7·25** each. Post 37p.
Model 450. 13in × 8in with twin tweeter/crossover. 55–13,000Hz. 8W RMS. Available 8 or 15 ohms. **£3·62** each. Post 25p.

HONEYWELL DIGITAL VOLTMETER VT.100



Can be panel or bench mounted. Basic meter measures 1V d.c. but can be used to measure a wide range of a.c. and d.c. volt, current and ohms with optional plug in cards. Specification: Accuracy: ±0·2, ±1 digit. Resolution: 1mV. Number of digits: 3 plus fourth overrange digit. Overrange: 100% (up to 1·999). Input impedance: 1000 Meg ohm. Measuring cycle: 1 per second. Adjustment: Automatic zeroing, full scale adjustment against an internal reference voltage. Overload: to 100V d.c. Input: Fully floating (3 poles). Input power: 110–230V a.c. 50/60 cycles. Overall size: 5⅝in × 2 11/16 in × 8 1/16 in. AVAILABLE BRAND NEW AND FULLY GUARANTEED. **£35·50**. Carr. 50p.

SINCLAIR IC-12

List Price £2·98

OUR PRICE £1·80

P. & P. 10p.

SINCLAIR EQUIPMENT

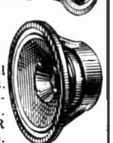
Project 60 Package offers.

2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply. **£15·95**. Carr. 37p. Or with PZ6 power supply. **£18·00**. Carr. 37p.
2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply. **£20·25**. Carr. 37p.
Transformer for PZ8. **£2·97** extra.
Add to any of the above **£4·45** for active filter unit and **£13·00** for pair of Q16 speakers.
All other Sinclair products in stock.
2000 amp. **£21·95**. Carr. 37p.; 3000 amp. **£28·50**. Carr. 37p.: Neoteric Amp. **£43·95**. Carr. 37p. IC12. **£1·80**. P. & P. 10p.
NEW PROJECT 605—**£20·97**. Carr. 37p.

WHARFEDALE MID-RANGE HI-FI UNITS

As used in world famous system. 5in dia. Impedance 4/8 ohms. High flux ceramic magnet. 20W RMS. Brand new **£1·50**. Carr. 37p.

SPECIAL OFFER! GOODMANS AXIOM 301



Hi-Fi 12in 20W twin cone full range speaker. 30–16,000Hz. 16,500 gauss. 8 ohm impedance. Brand new and boxed. (List price £21·72). OUR PRICE **£12·50** each. Carr. 50p.

HA-10 STEREO HEADPHONE AMPLIFIER

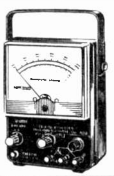
All silicon transistor amplifier operates from magnetic, ceramic or tuner inputs with twin stereo headphone outputs and separate volume controls for each channel. Operates from 9V battery. Inputs 5MU/100MU. Output 50MW. **£5·97**. Post 15p.

SPECIAL PURCHASE !

NEAT G30J STATIC BALANCE PICK-UP ARMS

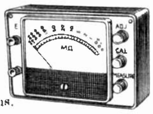
Identical specification to NEAT G30 arm but with two-tone chrome and black finish. Complete with head shell, pick-up rest and plug in phono leads. BRAND NEW—FULLY GUARANTEED.
ONLY **£8·95**. Post 25p.

KAMODEN HM-350 TRANSISTOR TESTER

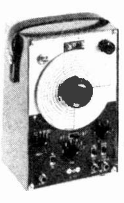


High quality instrument to test Reverse Leak current and D.C. current. Amplification factor of NPN, PNP, transistors, diodes, SCR's, etc. 4″ × 4¾″ clear scale meter. Operates from internal batteries. Complete with instructions, leads and carrying handle. **£12·50**. Post 30p.

KAMODEN HMG-500 INSULATION RESISTANCE TESTER



Range 0–1,000 Megohms, 500 Volt. Battery operated. Wide range clear meter 4¾″ × 4″. Complete with deluxe carrying case, batteries, instructions. **£19·95**. Post 30p.



ARF-300 AF/RF SIGNAL GENERATOR

All transistorised, compact, fully portable. AF sine wave 18 Hz to 220 KHz. AF square wave 18 Hz to 100 KHz. Output sine/square 10v. P-P. RF 100 KHz to 200 MHz. Output 1v. maximum. Operation 220/240v. AC. Complete with instructions and leads. **£29·95**. Post 50p.

AKAI BARGAINS

SUPER MONEY SAVING OFFERS—BUY NOW WHILE STOCKS LAST! ALL BRAND NEW AND FULLY GUARANTEED

1721 Tape Rec.	£73·95
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X2000SD Tape/Cas/8 Rec.	£223·30
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CR81D 8 track Rec.	£65·95
CR81T 8 track/Receiver	£118·90
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GXC46D Cassette Deck	£103·50
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GXC60D Cassette Deck	£111·25
GXC65D Cassette Deck	£110·25
CS35D Cassette Deck	£59·50
AA6300 Receiver	£79·95
AA8030 Receiver	£106·95
AA8080 Receiver	£144·95
AA8500 Receiver	£175·00
ADM11 Microphones (Pair)	£7·50

Carriage 50p extra (recorders and decks 75p).

GENUINE BARGAIN!

KOSS SP.3XC STEREO HEADPHONES

Response 10–15,000Hz.
Impedance 4–6 ohms.
Brand new.
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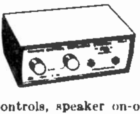

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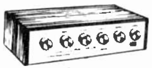

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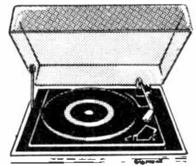

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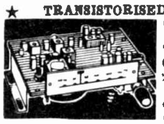

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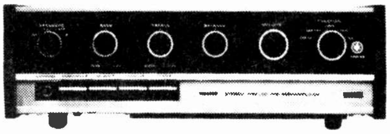

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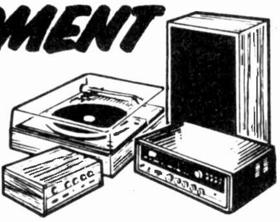

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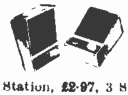

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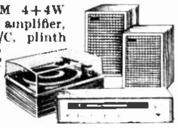

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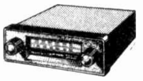

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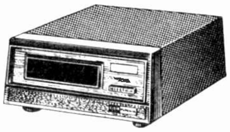

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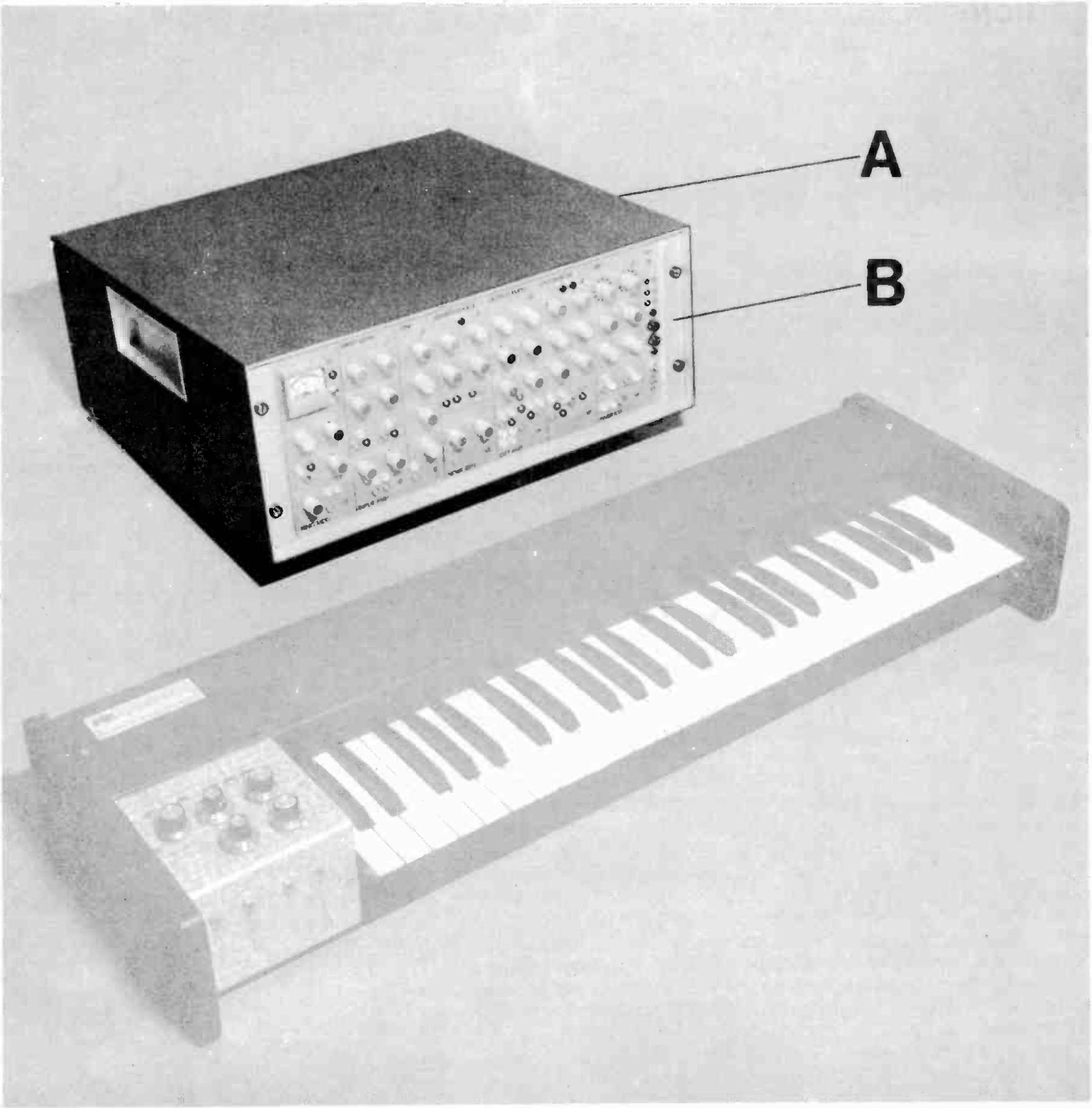

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FASHIONS IN BUILDING

As a constructors' magazine Practical Electronics is naturally very much concerned with building methods and materials. In its fairly short history, electronics has evolved through three distinct periods represented by different fashions in constructional techniques. First was the wood or original "breadboard" era; then the metal era dominated by the box-like chassis; now the plastics era is here with s.r.b.p. board (in some form or another) providing the main platform for the assembly of circuit components.

In many modern designs metalwork is no longer an essential part of the structure carrying the circuit components. Frequently, metalwork is used in a subservient role, merely to enclose or protect an electronic assembly which exists as a more or less self-contained entity built upon a piece of laminated plastics board.

The "plastics era" dawned soon after the arrival of the transistor. Right at the outset of this momentous technological event, industry was able to accommodate this newcomer by adopting printed circuit techniques. These techniques were already well established and in use with miniature valves. While the printed circuit was an ideal technique for mass production of electronic assemblies, it was not so ideal for the private constructor and his "one-off's". So when transistors became available to the individual, improvisation was called for, and a period of great inventiveness ensued. Many varied (and some quite unexpected) building techniques were tried out.

As a start, existing standard items such as component group boards and tag strips were commonly pressed into service as a platform for a transistorised circuit. Assemblies of varying degrees of elegance were built on odd scraps of s.r.b.p. laminate board, hardboard, and even cardboard. The arrival of perforated s.r.b.p. board helped towards a tidier form of construction and eliminated the drudgery of drilling countless holes. However, there was no universally adopted method for home construction until, some 12 years after the first transistor, there appeared in this country the first purpose-designed proprietary printed wiring board. Like many brilliant and successful ideas, this product was, in essence, beautifully simple and—after the event—so obvious. In due course this printed wiring board, though of course initially conceived with the professional user in mind, was to prove the answer to most private constructors' needs, and in time it rationalised the construction of electronic circuits.

Practical Electronics played not an insignificant part in bringing this constructional method to the attention of the amateur. This particular board was introduced to constructors in the very first issue of this magazine, and subsequently has been used in the majority of our projects.

Though very popular, the printed wiring board has no monopoly however, and the constructor has a fair choice of alternative methods, including home-made printed circuits. But practically all methods used today are based on the plastics board, the indispensable material which provides the foundations for modern electronic assemblies.—F.E.B.

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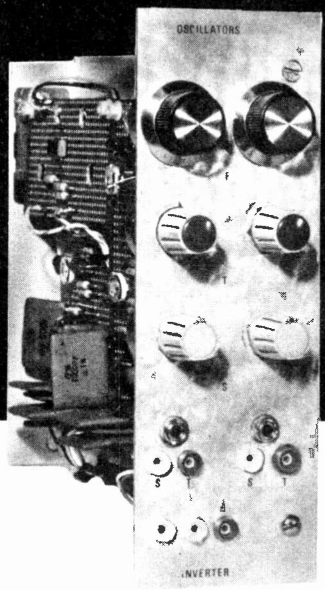
PE Sound Synthesiser 3
VOLTAGE CONTROLLED OSCILLATORS and INVERTER

By G.D.SHAW



THIS month the voltage controlled oscillator and voltage inverter will be described as well as details for assembling them.

THE VOLTAGE CONTROLLED OSCILLATOR

Perhaps the most important reason for the employment of a voltage controlled oscillator lies in the resultant ability of the oscillator to produce tone patterns by application of varying voltages to its control input. If these voltages are derived from what is essentially another oscillator, or series of oscillators, running at ultra low frequency, then the performance of the tone generating oscillator becomes quite automatic and dependent only on the continued operation of the programming devices.

The oscillators in the Synthesiser are based on the operational linear integrator and the circuit is shown in Fig. 3.1. In this arrangement IC1 acts as the integrator while IC2 is connected as a comparator and serves to switch the direction of integration.

The integrator programming signal is applied across the diode bridge D1–D4 and it is important that the polarities are maintained as shown.

CIRCUIT ACTION

To describe the circuit action assume that the comparator is sitting at its positive saturation level then diodes D1 and D3 in the integrator input bridge are reverse biased. There is a current flow into the integrator summing junction through R1, D2 and similarly a current flow away from the bridge through D4, R2, shown by solid arrows, so that the integrator begins to ramp negatively. The negative excursion of the integrator output voltage will continue until the current driven through R5 is equal to or greater than the current driven through R4 as a result of the output voltage of the comparator. At this time the voltage at point *P* will go negative and the comparator will switch rapidly to its negative saturation level.

Under these conditions diodes D2 and D4 in the integrator input bridge are reverse biased and current flows are established as shown by the dotted arrows. In the case of the current flow away from the integrator summing junction, this causes the integrator to ramp positively.

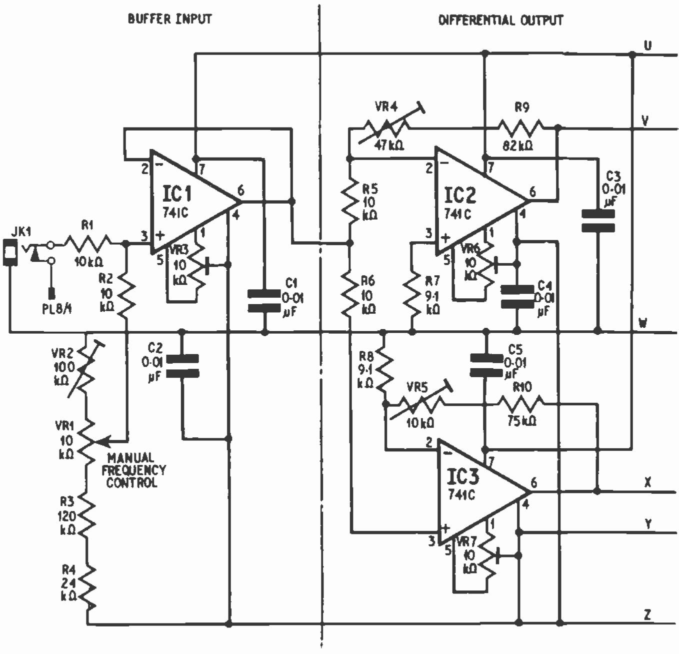
WAVESHAPES DEVELOPED

Providing that R2 is the same value as R1 and both polarities across the input bridge are at the same potential then the rate of change of integrator output voltage is the same as before and the result is a symmetrical triangular waveform appearing at point *Q*. The oscillogram of Fig. 3.1 shows the phase relationship between the triangular waveform generated by the integrator and the switching waveform generated by the comparator at point *R* in the circuit.

When the integrator output voltage is again equal to or greater than the level of positive feedback set by R4 the comparator switches back to its positive saturation level and the cycle repeats.

FREQUENCY CONTROL

Consideration of the foregoing reveals that R4 actually plays a part in the determination of fre-



quency by setting the point at which the integrator output causes the comparator to switch.

Lowering the value of this component has the effect of increasing the level of positive feedback to the comparator thereby requiring a higher integrator output voltage to switch the comparator and thus lowering the frequency of operation of the integrator..

Conversely, if the value of R4 is increased the overall frequency of operation is also increased.

PRACTICAL V.C.O.

The circuit shown in Fig. 3.2 is the three stage prototype v.c.o. arrangement. Starting from the output end, the third stage is a practical form of the oscillator shown schematically in Fig. 3.1. The second stage consists of two operational amplifiers arranged to provide a differential output across the oscillator input bridge. This particular stage is necessary since, in order to attain the full frequency range, the oscillator requires a drive potential greater than the individual power supply rails can provide.

The first stage of the circuit is a buffer/follower which serves to reduce the current drive required from the control source and which also provides a test-bed on which to try out various forms of circuit response without the necessity of disturbing the settings of the oscillator and differential driver. The type of input stage used in the v.c.o. is of some importance since it has a bearing, not only on the performance of the oscillator as a whole, but also on the design and operation of other circuits in the synthesiser. The response of the input stage may therefore be either linear or logarithmic and there are advantages and disadvantages attached to both methods.

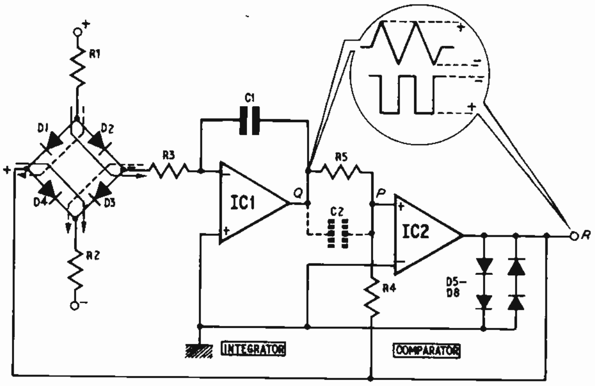


Fig. 3.1. Basic voltage controlled oscillator. Oscillogram shows phase relation between integrator and comparator outputs. The inclusion of the capacitor shown dotted linearises the input voltage/frequency relationship.

LOGARITHMIC OSCILLATORS

Most commercially available synthesisers use logarithmic v.c.o.s in which the slope of the response is adjusted so that equal increments of input voltage raise the frequency of oscillation by one semitone.

A typical response curve is shown in Fig. 3.3. This has the distinct advantage that if, say, three oscillators are programmed simultaneously by the same control voltage, two of the oscillators may be manually offset by fixed multiples of the semitonal voltage increment so that the effect of the mixed oscillator output is that of producing a chord by the depression of only one key.

The arrangement of having equal voltage increments per semitone also allows for a simplification in the construction of the keyboard divider network and some commercial instruments use a series chain of equal value resistors with a form of "tuning" control which varies the voltage across the chain.

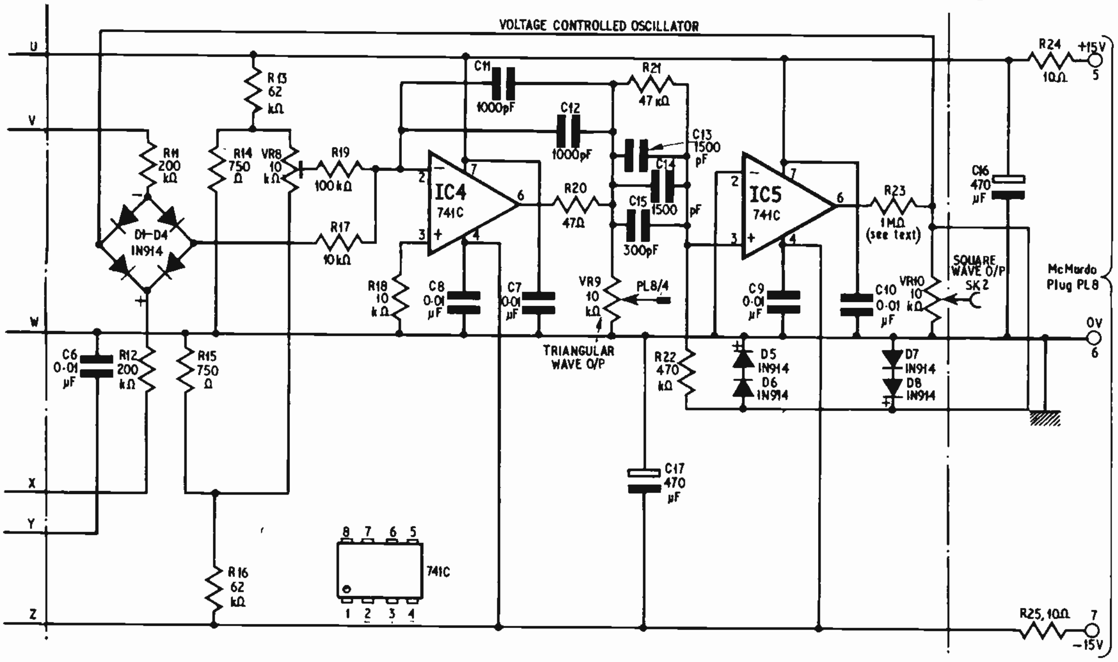


Fig. 3.2. Circuit diagram of the three stage voltage controlled oscillator

LINEAR V.C.O.'s COMPARED

The oscillators in this Synthesiser are arranged with an input stage having a linear performance such that the overall response is as shown in Fig. 3.4.

The resulting loss of the ability to play "chords" was not considered a disadvantage when weighed against the advantages of simplification in building and setting up. Furthermore, the use of linear characteristics in the oscillators provides greater justification for the use of a parallel divider network in the keyboard which, although rather more complex than the series arrangement, means that the accuracy of each semitone is dependent only on the accuracy and stability of its own resistors and not upon the remainder of the chain.

The overall performance of the oscillator, however, is solely dependent upon the response characteristic of the buffer/follower stage and it will be noted that space has been left on circuit board B (Fig. 3.6) for the benefit of constructors who may wish to try out their own ideas of logarithmic response.

The SN76502 manufactured by Texas Instruments is a logarithmic amplifier in integrated circuit form.

MAJOR COMPONENTS

The estimated total cost of this project is around £200. Obviously this figure can be reduced if bulk purchase of components which will appear in quantity is made. To make this possible, components in excess of 12 are listed below.

Resistors	**Quantity**
10kΩ	52
33kΩ	12
All 5% ½ watt carbon	
5·1kΩ	13
7·5kΩ	36
10kΩ	15
All 2% ½ watt metal oxide	

Potentiometers	**Quantity**
10kΩ carbon linear	19
All 25mm dia. midget moulded carbon types	
10kΩ carbon linear horizontal presets	12
100Ω linear horizontal Cermet presets	53
10kΩ linear horizontal Cermet presets	21

Integrated Circuits	**Quantity**
741C 8 pin D.I.L.	56

Diodes	**Quantity**
1N914	39
1SJ50	14

Capacitors	**Quantity**
470μF elect. 25V	12
0·01μF polyester	46

Sockets	**Quantity**
3·5mm miniature jack sockets	15
2mm miniature sockets	48

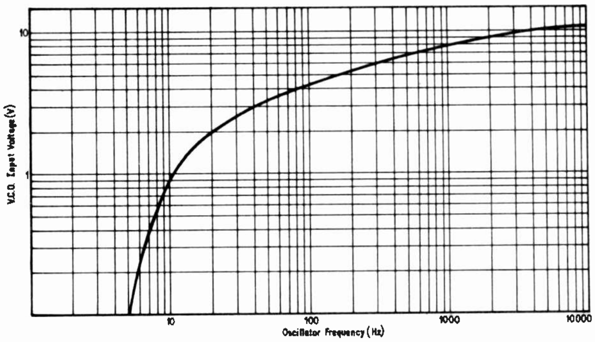


Fig. 3.3. Logarithmic response curve showing the positive exponential relationship obtained when control voltage required is IV/octave

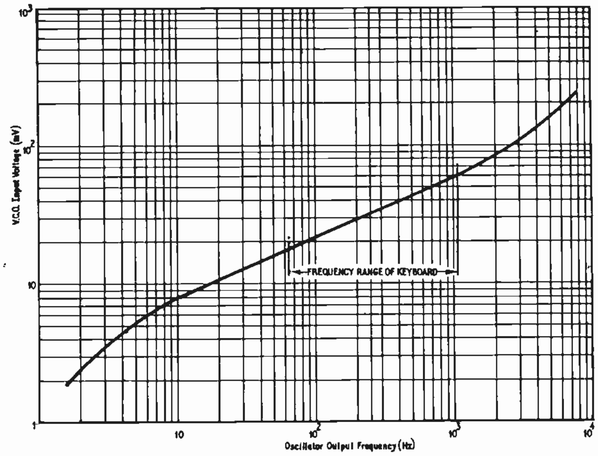


Fig. 3.4. Linear response curve of v.c.o. showing frequency range of keyboard

The advantage of this device is that its response slope may be varied by adjustment of one external component so that performance matching becomes a relatively simple matter.

BUILDING THE OSCILLATOR

Due to the restricted space in the finished module construction should start by assembly and wiring of all the components on to the front panel before the panel is mounted to the circuit board support plate. Figs. 3.5 and 3.6 give the front panel drilling details and component layout. The leads from the controls should be formed into a harness which passes down the centre of the panel between the potentiometers as shown, those for routing to the circuit boards being about ten inches long.

Next mount the McMurdo plug to the rear of the circuit board support plate complete with its wire leads already soldered into position. Fit the eight stand-off supports to the plate—transipillars are recommended but six B.A. screws with metallic spacers may be used providing that these are isolated from the conducting strips on the circuit boards.

The front panel should now be fixed to the circuit board support plate using a 4B.A. countersunk screw and nut in the upper hole, and the locking rod and bush in the lower one. If the assembly seems to be

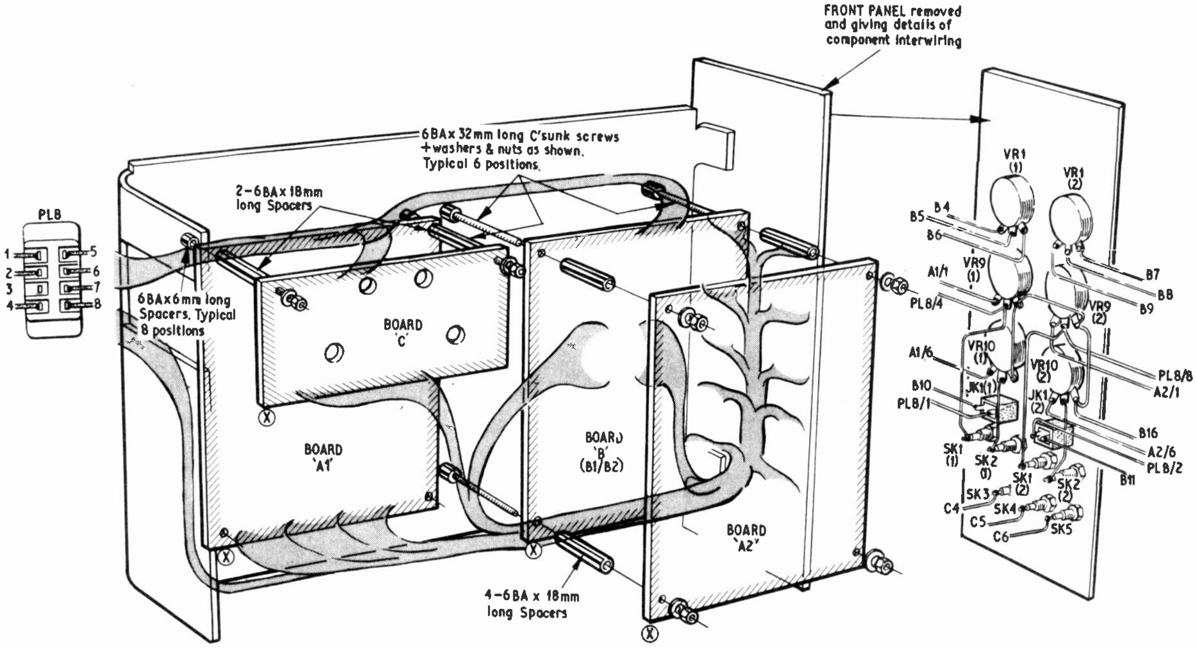


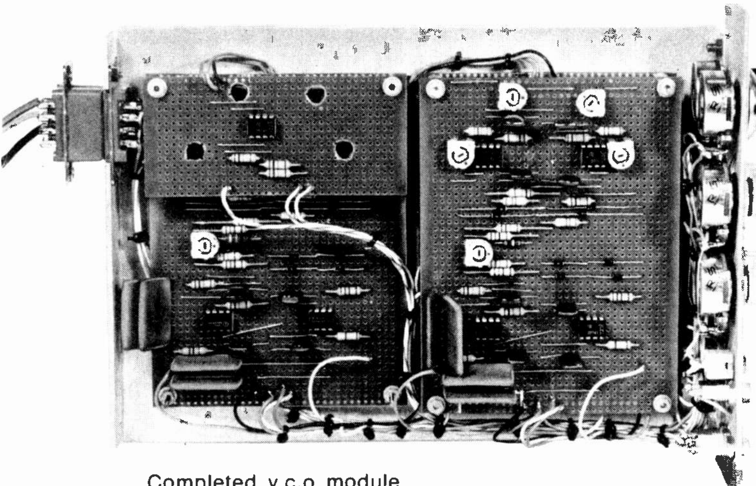
Fig. 3.5. Front panel component assembly and wiring with details of mounting and disposition of boards on the module support plate. The small ringed X at the board edges indicates orientation. (See board details)

on the slack side this may be corrected by fitting a thin steel washer between the bush and lug on the circuit board support plate.

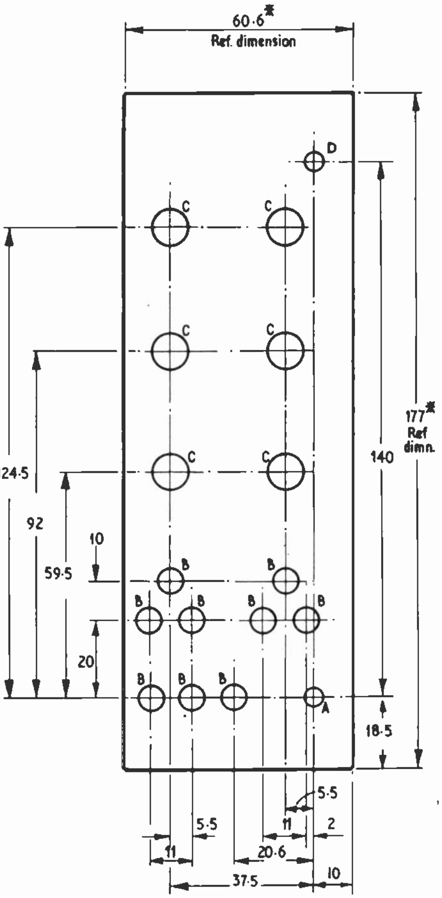
It is useful, at this stage, to make up a jumper lead carrying power supplies from the main busbars so that modules may be tested and set up outside the main frame assembly. The lead should be about 24in (61 cms) in length terminated at one end by a McMurdo plug and at the other by a McMurdo socket wired to match the power supply outputs.

Figs. 3.7 and 3.8 show the circuit board layouts for the oscillator. Board A carries the differential output stage together with the oscillator itself and two of these boards are required.

Board B carries the buffer input stages and power supply decoupling stages for both the other boards.



Completed v.c.o module



1 Hole 'A' 2BA clear
9 Holes 'B' 6 dia
6 Holes 'C' 9 dia
1 Hole 'D' 4BA c/s

*Ref dimensions (see Note Fig 2·2 March 1973)
All dimensions in mm
Material: 14S.W.G. Aluminium

Fig. 3.6. Drilling details for v.c.o. module front panel

BOARD B

The next stage of construction covers assembly of the buffer input stage and power supply decoupling Board B. Fig. 3.7 shows the recommended layout. Wiring of the completed board into the support frame is simplified if single ended Veropins are inserted into the boards at the indicated positions of the lead out wires.

Mount Board B to the support plate adjacent to the front panel and couple up the leads to the power supply, VR1 (manual frequency control) and external input sockets. The leads to Boards A may be omitted at this stage.

COMPONENTS . . .

VOLTAGE CONTROLLED OSCILLATOR (2 REQUIRED)

Resistors

R1	10kΩ	R13	62kΩ
R2	10kΩ	R14	750Ω
R3	120kΩ	R15	750Ω
R4	24kΩ	R16	62kΩ
R5	10kΩ	R17	10kΩ
R6	10kΩ	R18	10kΩ
R7	9·1kΩ	R19	100kΩ
R8	9·1kΩ	R20	47Ω
R9	82kΩ	R21	47kΩ
R10	75kΩ	R22	470kΩ
R11	200kΩ	R23	1MΩ (see text)
R12	200kΩ	R24–R25	10Ω (2 off)

All 2% ½ watt metal oxide

Capacitors

C1–C10	0·01µF Polyester (10 off)
C11–C12	1,000pF Silver Mica (2 off)
C13–C14	1,500pF Silver Mica (2 off)
C15	300pF Silver Mica
C16–C17	470µF elect. 25V (2 off)

Diodes

D1–D8 1N914 (8 off)

Potentiometers

VR1	10kΩ carbon log	
VR2	100Ω horizontal preset	miniature cermet types
VR3	10kΩ horizontal preset	
VR4	47kΩ horizontal preset	
VR5	10kΩ horizontal preset	
VR6	10kΩ horizontal preset	
VR7	10kΩ horizontal preset	
VR8	10kΩ horizontal preset	
VR9	10kΩ midget moulded carbon linear	
VR10	10kΩ midget moulded carbon linear	

Integrated Circuits

IC1–IC5 741C 8 pin dual-in-line (5 off)

Miscellaneous

SK1—3·5mm jack socket, SK2–SK3 2mm miniature socket (2 off) 0·1in matrix Veroboards as required.

CHECK-OUT

Set VR3 to mid position and VR2 to the minimum position and attach the jumper lead. With the power supply switched on and VR1 at minimum position measure the voltage at VR1 wiper. Adjust VR2 on both drivers so that voltages are exactly the same.

The value is not critical at this stage but is preferably in the range −5mV to −10mV. Measure the output voltage of both drivers and adjust VR3 until it is equal to whatever voltage has been set on the wipers of VR1.

Connect a temporary link between the external input and ground on both drivers. The purpose of these links is to simulate a zero-voltage prewired programming connection and they will be removed on completion of the setting up of the oscillators. Finally, set VR1 to its maximum position and measure the voltage at the sliders. This should be about −750mV, depending on the actual potential of the power supply rails, any discrepancy between the two readings being corrected by adjustment of the values of R3 and/or R4.

BOARD A: ASSEMBLY AND CHECK-OUT

Assembly of Board A should commence with the differential output stage which should be constructed up to and including R11 and R12. This stage should now be set up before proceeding with the construction of the oscillator.

Make temporary power supply connections from Board B, attach an input lead to the differential output stage and connect this directly to ground. With VR4 and VR5 at their maximum settings and VR6 and VR7 at their mid positions switch on.

Monitor the output voltages of both halves of the stage and adjust VR6 so that the output of IC2 reads +5mV and VR7 so that the output of IC3 reads −5mV. Now reconnect the input of the differential stage to the output of the driver from which the power supply is being taken and set the output voltage of the driver to −25mV by means of VR1.

Monitor the outputs of IC2 and IC3 and adjust VR4 and VR5 until these read +255mV and −255mV respectively. Repeat the measurements at various settings of VR1 to ensure that the gain of each half of the stage is linear at × 10 throughout the working range. Remember that the actual readings should be, in the case of IC2, + [5mV + (10 × driver output voltage)] and in the case of IC3, − [5mV + (10 × driver output voltage)].

Having set the gain and offset of the differential output stage the assembly of the oscillator section may now be completed (Fig. 3.8).

CHOICE OF CAPACITOR

The type of capacitor used in the integrator is of some importance as far as frequency stability is concerned and it is best to use a type having low leakage and as low a value of inductance as possible. Silver mica is thus the best choice and the value shown may be made up of two or more parallel wired capacitors.

R23 serves to limit the current output of the comparator. With this omitted the comparator has only the forward resistance of D5–8 between its output and ground and, although IC5 is capable of handling the current involved, this means that a substantial ripple will be present on the oscillator power supply rails and could possibly be transmitted through to

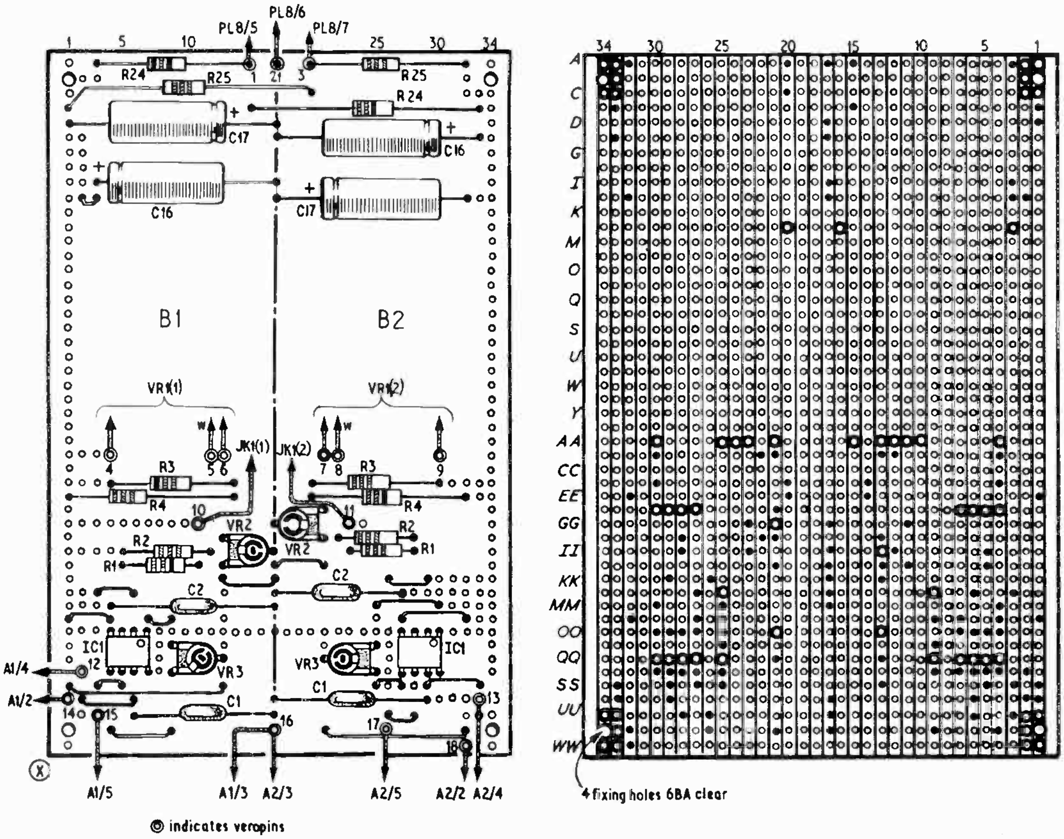


Fig. 3.7. Component layout and wiring for Board B. Since two v.c.o.'s are required, components for each are arranged in board areas B1 and B2

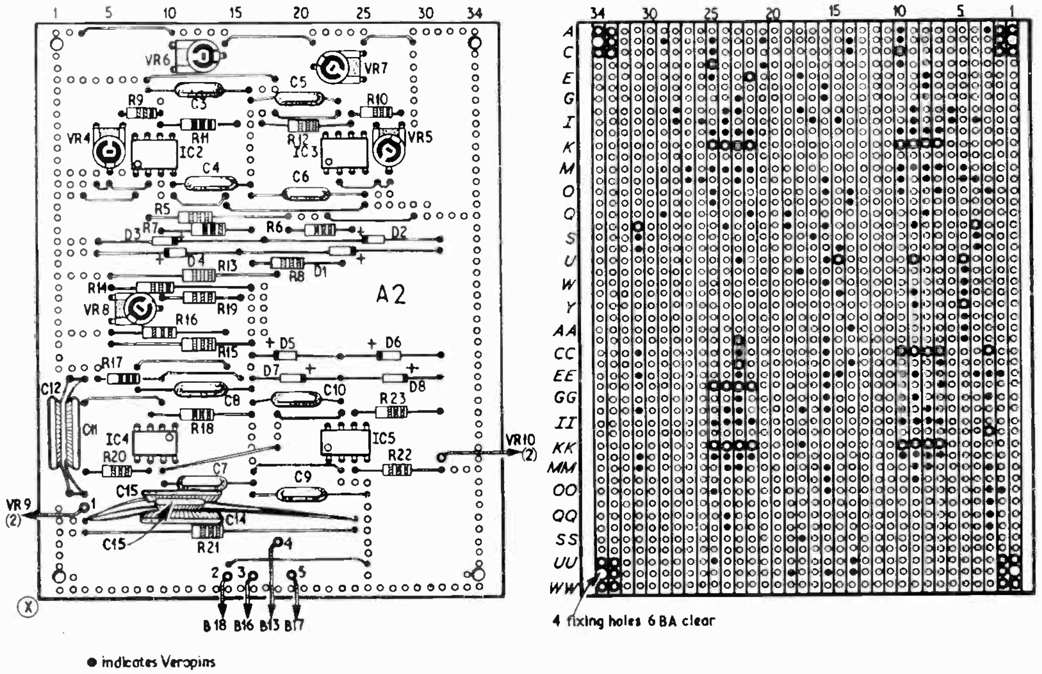


Fig. 3.8. Component layout and wiring for Board A. Two of these are required as shown in Fig. 3.5

the main bus-bars. Thus, where it is intended to use the comparator square wave output as a signal source the value of R23 should be 2·2 kilohms, that is, sufficient to reduce the ripple to an acceptable level. When the square wave output is not to be used, such as in the keyboard oscillators, the value may be increased to 1 Megohm to reduce ripple to negligible proportions. The inclusion of this resistor will however reduce the triangular wave voltage swing to 200mV p-p and limit the maximum frequency of the oscillator to about 8·3kHz.

R13 to R16 and VR8 form a divider network which provides a value of bias current to the summing junction of the integrator.

MOUNTING THE A AND B BOARDS

The completed A boards should be mounted on the support plate such that one is immediately adjacent to the McMurdo plug and the other directly above Board B. It is best to mount and set-up the oscillator boards one at a time. When a board has been fully connected, set VR8 and VR1 to their mid positions and switch on the power supply. Observe the triangular waveform on the oscilloscope —the frequency of oscillation should be about 7kHz.

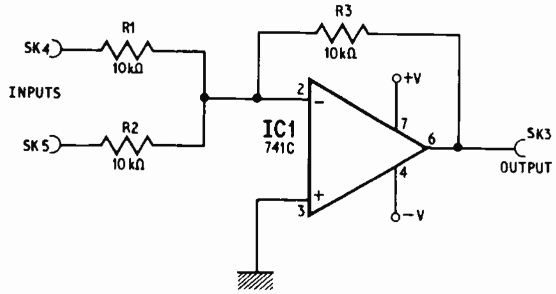


Fig. 3.9. Circuit diagram of voltage inverter

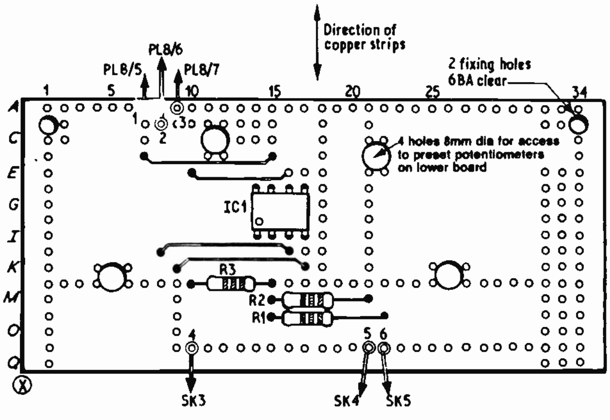
COMPONENTS . . .

INVERTER

Resistors
R1–R3 10kΩ (3 off)

Integrated Circuit
IC1—741C 8 pin D.I.L.

Miscellaneous
SK1-SK3 2mm miniature sockets (3 off) 0·1in matrix Veroboard as required



Copper strips broken at holes G14,15,16,17

Fig. 3.10. Inverter component Board C layout and wiring

Gradually reduce the setting of VR1 until the waveform begins to exhibit marked signs of assymmetry. At this point adjust the setting of VR8 *with great care* to restore the symmetry, this latter operation also being seen to cause an increase in the frequency.

Continue reducing the setting of VR1, adjusting VR8 as necessary, until VR1 is at its minimum setting and the output waveform is symmetrical.

At very low frequencies the setting of VR8 is extremely critical, too large a shift in either direction causing IC4 to saturate. If this happens, VR1 should be set to its mid position again and the various steps repeated.

With VR1 in its minimum position final setting of the very low frequency end of the range is accomplished by adjustment of VR2 in conjunction with VR8 as before. If IC4 saturates at or before minimum setting of VR1 the setting of VR2 will have to be increased.

Very low frequency instability can be a problem with this type of oscillator and although it can be made to operate at less than 1Hz with the component values given it is best to set the minimum operating frequency to about 5Hz.

MATCHING THE OSCILLATORS

If the component values and tolerances specified have been adhered to, comparison of performance between both oscillators will show that the input voltage/frequency relationship is substantially similar, any differences in performance characteristic being due to tolerance variations in the components.

Extreme accuracy in the matching of oscillators is not necessary since linear response is involved.

INVERTER

Little need be said concerning the assembly of the voltage inverter which is essentially an inverting unity gain amplifier of the simplest kind. The circuit is shown in Fig. 3.9 while the recommended circuit board layout is shown in Fig. 3.10.

The completed board should be mounted directly over the A board furthest from the front panel.

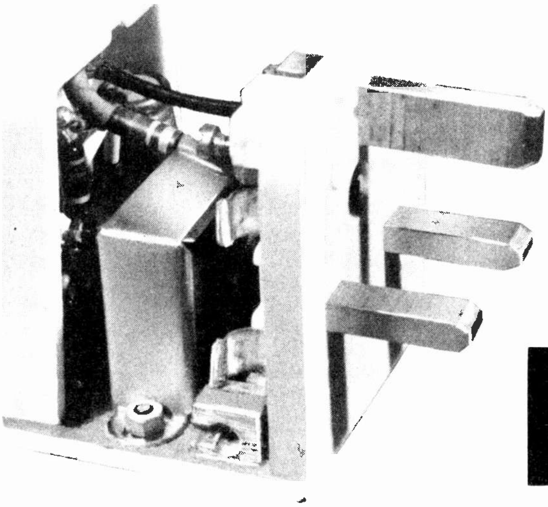
USING THE MODULE

On completion of the whole module use the voltage inverter to investigate the effects of mixing triangular and square waves at varying frequencies.

The output may be fed to the high level input of most power amplifiers, but bear in mind that the output will be equal to the sum of the voltage swings at the inputs.

Additionally it is possible to carry out some simple experiments in frequency modulation by setting one of the oscillators to modulate the other. A low amplitude modulation at about 7Hz produces a true vibrato to the tone of the modulated oscillator whilst varying the amplitude and frequency of modulation can produce some strange, even bizarre effects.

Next month: the ramp generators and input amplifiers are described.



A Novel BATTERY ELIMINATOR

By J. S. GODDARD

THIS article describes a d.c. power supply unit with the unusual feature of being contained in a 13A flat pin mains plug. It will supply 60mA at 9V suitable for radio, cassette or record players.

UNIT ADVANTAGES

One of the disadvantages of conventional battery eliminators is that you are left with a box which must either be strung between plug and unit or replace the batteries in the battery compartment.

This design overcomes both problems. The lead from the mains plug goes directly to the unit and plugs in with a simple jack plug. The batteries of the unit are left in place but simply disconnected when the jack plug is attached. The batteries are reconnected when the plug is removed. The project becomes even easier if the unit has a socket for a battery eleminator.

CIRCUIT

The circuit diagram of the battery eliminator is given in Fig. 1 together with suitable battery cut-out circuit in cases where a socket is not available on the unit to be supplied.

The transformer has a 6-0-6V secondary with the centre tap unconnected. This feeds a four diode bridge rectifier, the output being smoothed by the reservoir capacitor C1 and R2. The Zener diode D5 provides a final 9V regulated output.

MODIFYING THE PLUG

The plug used for housing the circuit components is an Ever-Ready type which has to be modified. This is accomplished by cutting a $\frac{5}{16}$in step at the bottom rear of the plug as in Fig. 2. A piece of $1\frac{7}{8}$in × $1\frac{3}{4}$in × $\frac{1}{8}$in hardboard is cut to form a new base for the plug. This is Araldited into place ensuring that the ends of the plug are upright and parallel.

A $\frac{3}{16}$in hole is drilled and countersunk in the upper half of the plug directly above the brass screw insert for the neon LP1.

For the d.c. leadout pair a $\frac{1}{8}$in hole is drilled $\frac{3}{4}$in up from the base at the centre rear of the plug.

ASSEMBLING THE COMPONENTS

The components may now be mounted in the expanded plug. First, the transformer is loosely held in position by two 6 B.A. screws.

The mains neon is now positioned and connected to the plug terminals together with the transformer primary windings.

With the capacitor and diodes in place the transformer is tightened down. The output lead is connected across the Zener diode after R2 has been added in series, in the positive line, as shown in the circuit diagram.

With all the components mounted in place care should be taken to see that none are touching the mains pins or their screws. If necessary more room can be made by discarding the screws on the back of the mains pins and soldering instead of clamping. Once all appears to be correct inside a cover has to be constructed for the plug.

COMPONENTS . . .

Resistors

R1	220kΩ $\frac{1}{2}$W carbon
R2	82 Ω $\frac{1}{2}$ watt 10% carbon

Capacitor

C1	400μF 10V elect.

Diodes

D1–D4	IN4003 (4 off)
D5	9·1V 400mW Zener

Transformer

T1	Eagle miniature mains transformer 240V primary 6-0-6V secondary at 100mA.

Miscellaneous

13A fused mains plug (Ever Ready Type 7032), LP1 mains neon, $1\frac{7}{8}$in × $1\frac{3}{4}$in × $\frac{1}{8}$in hardboard, $\frac{1}{4}$in 6 B.A. countersunk screws (2 off), $\frac{3}{8}$in self tapping (2 off), FS1 fuse to suit equipment. PL1 3·5mm jack plug.

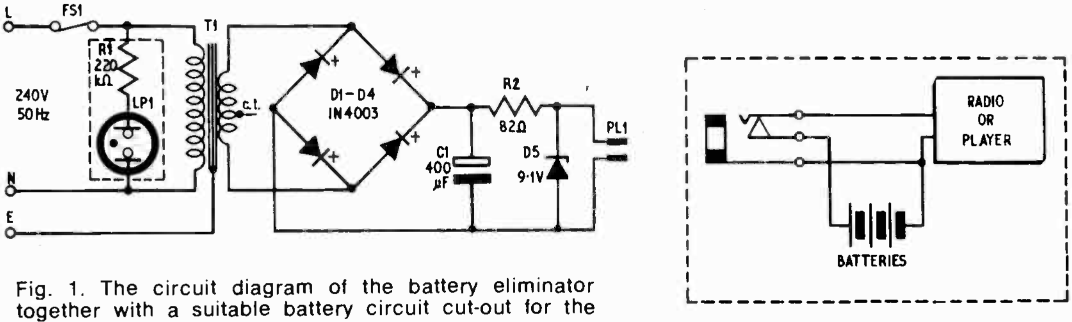
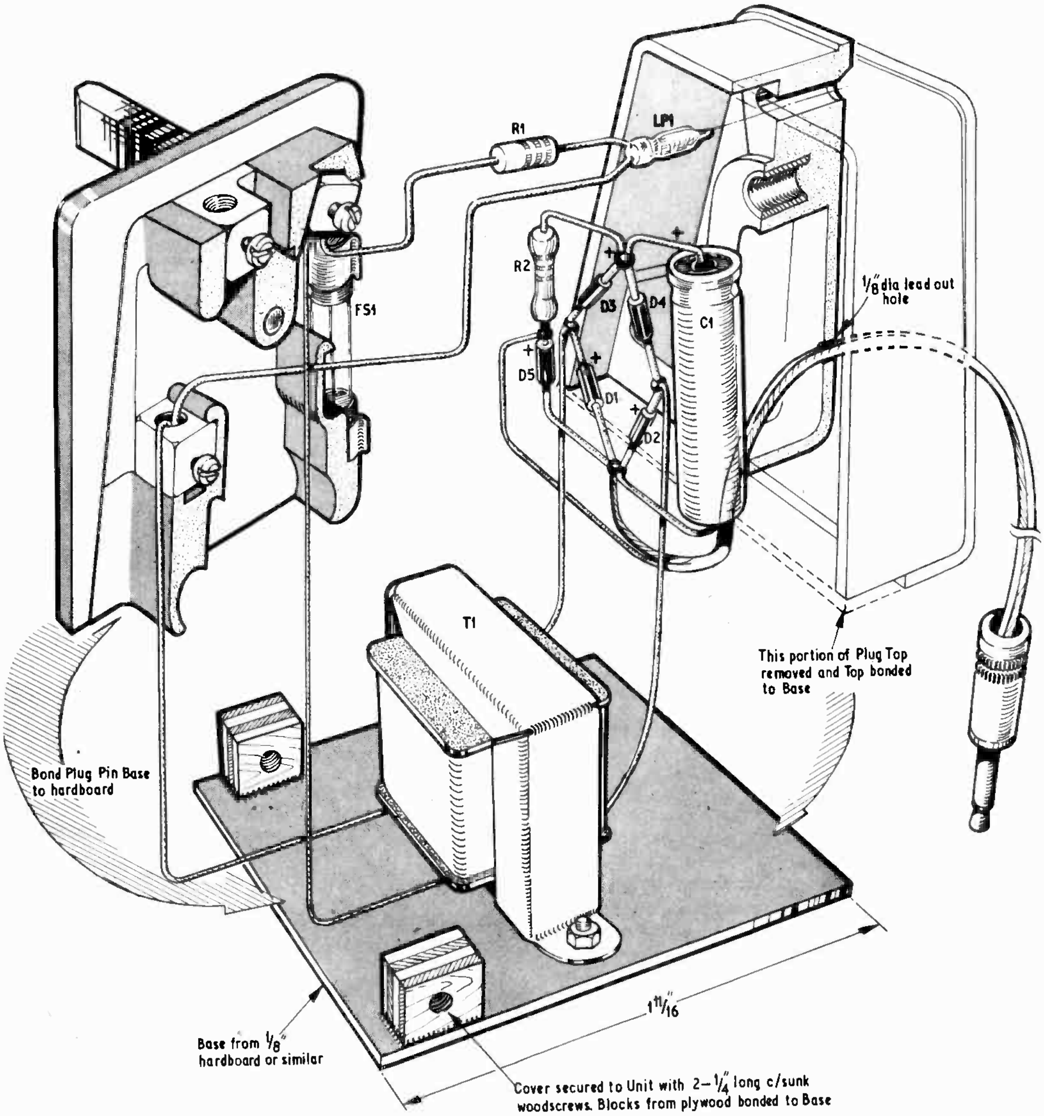


Fig. 1. The circuit diagram of the battery eliminator together with a suitable battery circuit cut-out for the equipment to be supplied



1/8" dia lead out hole

This portion of Plug Top removed and Top bonded to Base

Bond Plug Pin Base to hardboard

Base from 1/8" hardboard or similar

Cover secured to Unit with 2–1/4" long c/sunk woodscrews. Blocks from plywood bonded to Base

Fig. 2. Assembly and wiring details for the battery eliminator

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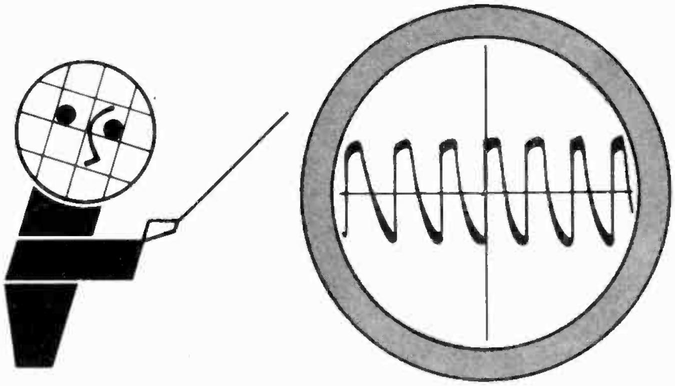

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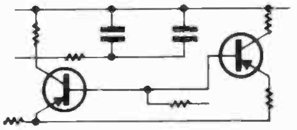

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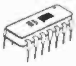

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7401	15p	14p	7451	15p	14p	7493	67p	64p
7402	15p	14p	7453	15p	14p	7494	77p	74p
7403	15p	14p	7454	15p	14p	7495	77p	74p
7404	15p	14p	7460	15p	14p	7496	77p	74p
7405	15p	14p	7470	29p	25p	74100	£1·75	£1·65
7408	18p	17p	7472	29p	25p	74104	97p	94p
7410	15p	14p	7473	37p	35p	74105	97p	94p
7411	15p	14p	7474	37p	35p	74107	40p	33p
7413	29p	26p	7475	47p	45p	74110	£1·25	£1·25
7420	15p	14p	7476	43p	40p	74111-	£1·00	95p
7430	15p	14p	7480	67p	64p	74118	£1·00	95p
7440	15p	14p	7481	97p	94p	74119	£1·35	£1·25
7441	67p	64p	7482	97p	94p	74121	67p	64p
7442	67p	64p	7483	£1·10	£1·05	74141	67p	64p
7446	97p	94p	7486	32p	30p	74145	£1·50	£1·40
7447	97p	94p	7490	67p	64p	74150	£1·80	£1·70
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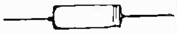
301a	DIL	45p	723c	DIL	90p
701c		63p	741c	TO99	38p
702c		63p	741c	DIL	36p
709c	TO99	28p	741c 3 pin	DIL	34p
709c	DIL	31p	747c	DIL	42p
710c		53p	743c	TO99	33p
711c		58p	1437		£1·10
			1458		£1·10

Electrolytic Capacitors



4 volt		**16 volt**		**40 volt**	
47μF	6p	15μF	6p	47μF	6p
100μF	6p	33μF	6p	100μF	8p
220μF	6p	68μF	6p	150μF	9p
330μF	6p	150μF	7p	220μF	10p
1,000μF	12p	220μF	8p	470μF	17p
4,700μF	26p	680μF	15p	680μF	23p
		1,000μF	15p	1,000μF	23p
		1,500μF	23p	2,200μF	40p
6·3 volt		2,000μF	39p		
33μF	6p				
68μF	6p				
150μF	6p	**25 volt**			
470μF	10p	10μF	6p	**63 volt**	
680μF	12p	22μF	6p	1μF	6p
1,500μF	16p	47μF	6p	2·2μF	6p
2,200μF	16p	100μF	7p	4·7μF	6p
3,300μF	24p	150μF	7p	6·8μF	6p
		220μF	9p	10μF	6p
		470μF	12p	22μF	6p
10 volt		680μF	18p	68μF	9p
22μF	6p	1,000μF	20p	100μF	10p
47μF	6p	2,200μF	36p	150μF	12p
100μF	6p	5,000μF	62p	220μF	17p
220μF	7p			330μF	20p
330μF	9p			470μF	24p
470μF	9p	**40 volt**			
1,000μF	12p	6·8μF	6p	1,000μF	40p
1,500μF	23p	15μF	6p	1,600μF	74p
2,000μF	39p	33μF	6p	2,500μF	93p

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Pack of 25
1N4148
50p

Pack of 10
BC108 **50p**
BC107 **50p**
(Plastic can)

Pack of 10
Plastic BC109
50p

Pack of 10
BC169 **50p**
(unmarked)
but tested

2N2646
(unmarked)
30p each

Pack of 10
2N2926G **50p**
Unmarked but fully tested

2N3055
1–9 **30p**
10 plus **25p**

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M/P
1–9 **54p**
10 plus **48p**

BC107-BC108
BC109
1–9 **8p**
10–99 **7p**
100 plus **6p**

BC 182L-3-4-212-4
1–9 **8p**
10 plus **7p**

AC127 or AC128
1–9 **12p**
10 plus **11p**
100 plus **9½p**

Transistors

	p		p		p		p		p
AC107	15	BC142	30	BF330	16	OC81	13	2N2905	42
AC126	14	BC143	30	BF390	34	OC83	20	2N2924	16
AC127	12	BC144	26	BFX84	25	OC84	25	2N2926	9
AC128	12	BC145	24	BFX85	32	TIP29A	48	2N3053	24
AC142K	20	BC147	8	BFX86	22	TIP30A	58	2N3054	50
AC141K	18	BC148	8	BFX87	25	TIP31A	58	2N3055	48
AC176	14	BC149	8	BFX88	24	TIP32A	66	2N3405	40
AC187	12	BC153	15	BFY50	19	TIP33A	95	2N3663	52
AC187K	18	BC154	16	BFY51	15	TIP34A		2N3702	8
AC188	12	BC157	12	BFY52	15		£1·40	2N3703	8
AC188K	18	BC158	11	BFY64	35	TIP35A		2N3704	8
ACY17	21	BC159	12	BFY90	65		£2·30	2N3705	8
ACY18	19	BC167	11	BSX20	17	TIP36A		2N3706	8
ACY19	23	BC168	10	C407	20		£2·90	2N3708	8
ACY20	20	BC169	10	C426	30	TIP41A	72	2N3707	8
ACY21	21	BC177	14	C428	28	TIP42A	83	2N3709	8
ACY22	16	BC179	14	C450	15	2N706	12	2N3710	8
ACY39	62	BC182L	8	MP8111	32	2N930	21	2N3711	8
AD140	36	BC183L	8	MP8112	42	2N1131	20		
AD142	40	BC184L	8	MP8113	32	2N1132	25	2N3794	15
AD143	35	BC186	30	MP8121	30	2N1613	20	2N3819	25
AD149	34	BC212L	10	MP8122	40	2N1711	24	40361	45
AD150	55	BC213L	10	MP8123	45	2N2904	36	40362	45
AD161	27	BC214L	10	NKT211	25	2N2904A	40	40636	55
AD162	27	BC258	8	NKT212	25				
„ M/P	50	BC259	8	NKT214	23				
AF114	14	BC267	12	NKT217	50				
AE115	14	BC268	13	NKT261	21				
AF116	14	BC300	36	NKT271	18				
AF117	14	BC301	29	NKT274	18				
AF118	82	BC302	26	NKT275	23				
AF124	24	BC303	45	NKT403	65				
AF139	36	BC304	35	NKT405	79				
AF239	37	BCY70	15	NKY603F					
AL100	68	BCY71	33		60				
AL102	60	BCY72	15	NKT613F	30				
AL103	49	BD123	60	NKT674	24				
ASY26	27	BD130	45	NKT677F	22				
ASY27	36	BD131	62	NKT713	29				
AU103	90	BD132	81	NKT773	25				
AU110	97	BD135	38	OC19	50				
AU111	67	BD136	44	OC20	50				
BC107	8	BD141	£1·70	OC23	30				
BC108	8	BD142	45	OC25	25				
BC109	8	BF159	30	OC28	30				
BC113	14	BF173	26	OC29	30				
BC116	15	BF177	25	OC35	25				
BC125	15	BF178	26	OC36	35				
BC126	22	BF179	32	OC41	13				
BC132	14	BF194	14						
BC134	14			OC44	13				
BC135	14	BF195	15	OC45	13				
		BF244	25	OC70	21				
BC137	14	BF260	26	OC71	13				
BC138	24	BF329	16	OC72	13				

DIODES & RECTIFIERS

	p		p
1N914	7	BA145	20
1N916	7	BA154	12¼
1N4148	7	BAX13	12½
1N4007	20	BAX16	12½
1S44	9	BAY18	17½
1S113	15	BAY31	7½
1S120	15	BY100	17½
1S121	14	BY126	15
1S130	8	BY127	17½
1S131	10	BYX10	22½
1S132	12	OA5	17½
1S920	7	OA9	10
1S922	8		
1S923	12	OA10	22½
1S940	5	OA47	8
AA119	10	OA70	7
AA129	10	OA73	10
AAZ13	10	OA79	7
AAZ15	12½	OA81	8
AAZ17	12½	OA85	10
BA100	15	OA90	7
BA102	22½	OA91	7
BA115	7½	OA95	7
BA144	12½	OA200	10

MULLARD POLYESTERS

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·22μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **2½p.** 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3p.** 0·047μF, 0·068μF, 0·1μF, **4p.** 0·15μF, **6p.** 0·22μF, **7½p.** 0·33μF, **11p.** 0·47μF, **13p.**

160V: 0·01μF, 0·015μF, 0·22μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF, **3½p.** 0·15μF, **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

VOLUME CONTROLS

Potentiometers
Carbon track 500 Ω to 22 M Ω
Log or Linear
Single **12p.** Dual gang (stereo) **40p**
Single type with D.P. switch **12p** extra.

SLIDE POTENTIOMETERS

58mm, TRACK
SINGLE GANGED, LOG or LIN
1k to 1M. **40p each.**
TWIN GANGED, LOG or LIN
1k to 500k. **60p each.**

CARBON SKELETON PRESETS

Small high quality type (linear only).
All values 100–5megohms.

- ● 1 watt **5p each.**
- ● 2·5 watt **6p each.**

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½in × 3¾in	17p	23p
2½in × 5in	25p	25p
3¾in × 3¾in	25p	25p
3¾in × 6in	30p	29p
5in × 17in (plain)	83p	—

Vero Pins (bag of 36), **20p.**
Vero cutter, **45p**; Pin insertion Tools (0·1 and 0·15 matrix) at **55p.**

SLIDE SWITCH
SPST **10p** each. D.P.D.T. **12p** each.
MINIATURE NEON LAMPS
240V or 110V 1–4 **5p,** 5 plus **4½p** each.

MINITRON DIGITAL INDICATOR TYPE 3015F. Reads 0–9 and decimals (Data Sheet on request). Only **£1·50.** 16 DIL Socket, **30p.** Driven by 7447, **95p.**

RECTIFIERS

P.I.V.	1 amp		1·5 amp	
50	1N4001	4p	PL4001	7p
100	1N4002	4p	PL4002	8p
200	1N4003	5p	PL4003	9p
400	1N4004	6p	PL4004	9p
600	1N4005	7p	PL4005	12p
800	1N4006	3p	PL4006	14p
1,000	1N4007	9p	PL4007	18p

BRIDGE RECTIFIERS

P.I.V.	1 amp	2 amp	5 amp	10 amp
50	30p	48p	£1·60	£2·00
100	32p	52p	—	—
200	34p	55p	£1·80	£2·10
400	36p	58p	£1·95	£2·20
600	40p	62p	£2·20	£2·50
800	45p	—	—	—

THYRISTORS

PIV	50	100	200	300	400
1 Amp	25	23	37	40	47
3 Amps	40	45	55	—	60
7 Amps	—	87	92	—	1·12

RESISTORS

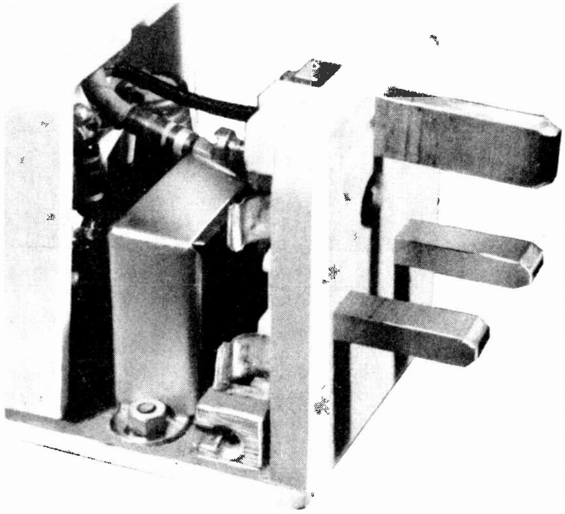
¼ watt 5% carbon	1p each
½ watt 10% carbon	1p each
1 watt 10% carbon range 10 ohms to 4·7 meg.	2½p each
½ watt m/o 2% range 10–1 meg ohms.	3p each

ZENER DIODES

400 M/W 5%
Miniature
BZY 88 Range
All voltages
3·3–33 Volt
8p each

1 Watt 5%
All voltages
6·8–200 volts
12p each

10 Watt 5%
All voltages
7·5–100 volts
45p each



Good results can be obtained by using good quality card about $\frac{1}{16}$in thick. The card is bent to fit around the top and two sides of the plug snugly. The inside of the card may be scored with a knife to make it bend more easily. With the card bent around the plug mark off, with a pencil, the exact dimensions. When cut to shape check to ensure a good fit, if necessary a former may be made to hold the card in the required shape.

The cover is held onto the plug by two self tapping screws. These screws tighten into $\frac{5}{16}$in blocks of plywood about $\frac{3}{8}$in square. The blocks must be drilled to accept the screws and glued in the bottom front of the plug as shown.

Now is the time to fill any gaps between plug and base. A plastic filler is used, which can be sandpapered smooth when dry. The cover and base may be painted to match the plug, sprayed paint gives good results on a suitable primer.

CONNECTING THE UNIT

Consideration now has to be given to the method of connecting the battery eliminator to the unit which it will power. A number of radio and cassette players on the market have facilities for battery eliminators, and in this case it is only necessary to obtain the correct plug. If your unit does not have facilities such as this, or you are unable to obtain the plug, the following will serve as an alternative.

A 3·5mm jack plug is connected to the eliminator's outlet lead with the matching socket in the unit. The jack plug is connected to the outlet lead wire with the positive line going to the tip. The socket may now be fitted to the unit, a suitable position must be found to ensure it will not interfere with any internal workings.

With the hole drilled and socket fitted the supply wiring must be adapted to cater for the new facility. The positive lead to the battery compartment must be broken and the jack socket connected in the break. The negative lead goes to the third contact on the socket as well as the battery compartment.

With the jack plugged into the socket the positive line from battery to unit is broken and connected instead to the outlet of the power supply.

The 400μF electrolytic capacitor may be difficult to obtain, but good results can still be obtained with a smaller one. ★

BOOK REVIEWS

ELECTRONICS IN MUSIC

By F. C. Judd
Published by Neville Spearman
169 pages, 9in × 6in. Price £3·15

Mr Judd has condensed into this book the fruit of many years' experience in electronics. The six main chapter headings cover virtually every aspect of the subject ranging from the application of electronics in the production of music through a survey of electronic musical instruments, the production of synthetic sound and electronic music, the uses of the tape recorder in the field and, finally, a rundown on the parameters involved in the high fidelity reproduction of music.

The text throughout seems designed to guide the reader into this fascinating and ultra-technical subject without once getting bogged down in an excess of detail. Despite this tendency there is sufficient data presented to enable the home constructor to build and experiment with several interesting circuits. The book is well illustrated with sixteen pages of half tone plates and plenty of clear line diagrams and circuits. The author could have perhaps usefully expanded his treatment of the subjects of synthetic sound and electronic music in view of the current high level of interest although the shortfall in this respect does little to mar the overall presentation of the book which is excellent.

"Electronics in Music" is likely to be welcomed enthusiastically by technical and non-technical readers whose interest in the subject matter may be frustrated by the lack of definitive texts.

G.D.S.

TELEVISION INTERFERENCE MANUAL

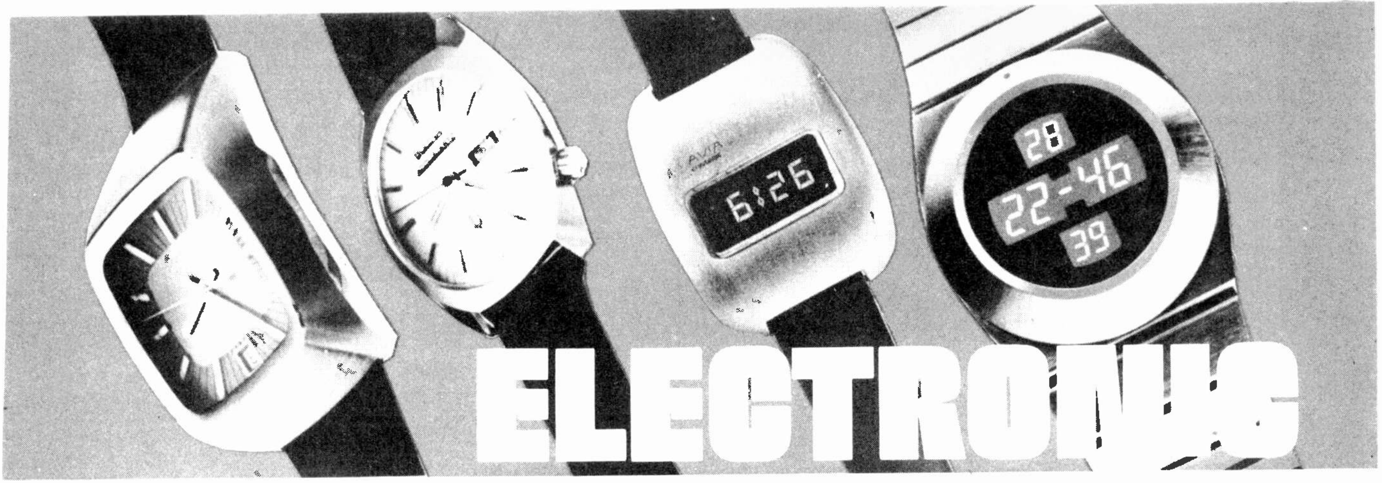
By B. Priestley, B.Sc., G3JGO
Published by Radio Society of Great Britain
92 pages, 148mm × 210mm. Price 80p

Television interference from s.w. transmitters is something which many amateur radio enthusiasts find very difficult to eliminate. The Radio Society of Great Britain must therefore be congratulated for attempting to bring this problem to the notice of radio hams and for providing many hints on suppression which, if followed, could greatly reduce the annoyance of TV viewers near to a transmitter.

Television interference can arise from many sources and one of the main problems is tracking down the exact cause. Of course, a well-designed transmitter should include effective circuits for suppressing this unwanted output and transmitter design is included in the book. However, even the best transmitter can have a component failure and the book points out that a careful check on meter readings should be kept and any change in performance noted. R. F. injection into the mains and its suppression is also discussed.

This book has a spiral binding so that the pages lie flat on the bench. The manual may be obtained from RSGB Publications, 35 Doughty Street, London, WC1N 2AE, price 90p including postage.

S.R.L.



ELECTRONIC TIMEPIECES

By J. B. DANCE, M.Sc.

In this final part, quartz crystal controlled watches and clocks are examined together with various time displays.

QUARTZ TIMEPIECES

Quartz crystal piezo-electric oscillators are now well known for their great frequency stability. Although the piezo-electric effect was discovered by J. and P. Currie in 1880, it was not used for frequency control until 1921 by Cady. Natural quartz can be used, but synthetic quartz often gives a better performance.

CLOCKS

Various clocks using quartz crystal oscillators are available. For example, the General Time Company produce "Quartzmatic" clocks using 262,144Hz crystal oscillators with an integrated circuit to reduce the frequency to 64Hz. The Simplex Company produce quartz controlled master time centres for driving a number of clocks in an establishment with an accuracy of two seconds per month.

The Golay Company produce marine chronometers using a 12kHz oscillator which has a stability of 0·005 second per day at constant temperature or 0·1 second per day over the range 4 to 36°C: this clock employs about 29 transistors.

A quartz clock with a digital display is available from Girard-Perregaux; it is mains driven with stand-by battery power and provides an accuracy of 0·02 second per day. The Junghans 750 quartz movement is powered by a 1·5V battery which lasts a year.

QUARTZ CONTROLLED WATCHES

Quartz crystal controlled wrist-watches have been available since April 1971. Special CMOS (Complementary Metal Oxide Silicon) integrated circuits have been developed which consume a current only during the pulses and which are small enough to be fitted into a normal wrist-watch. In many cases a number of manufacturers have pooled their resources to produce quartz watch movements. The quartz crystals used have to be specially aged so that they provide high accuracy at all times. They are normally sealed in a vacuum enclosure.

The first types of quartz wrist-watches to become available to the public employed the "Beta 21" movement developed by the Centre Electronique Horloger S.A. and marketed in various models under many brand names. The quartz crystal oscillator in this movement operates at 8,192Hz. An integrated circuit divides this frequency by a factor of 32 to produce a 256Hz signal. The current consumption averages about $16\mu A$ and the accuracy is about one minute per year.

CYBERNETIC WATCH

The Longines "Ultra-quartz" wrist-watch was first made available on 21st August, 1971. It is especially interesting because it does not contain any integrated circuits, but only a small printed circuit containing miniature electronic components.

The quartz resonator in this watch operates at 9,350Hz and a mechanical vibrator at 170Hz. The signals from the quartz oscillator are used to correct

The Girard-Perregaux quartz watch. The quartz crystal can be seen on the left-hand side, the integrated circuit near the top and the power cell on the bottom right-hand side

the mechanical vibrator 170 times per second. This correction is carried out by a relatively simple circuit employing only 14 transistors, 19 resistors and seven capacitors. The logical deductions made by this circuit are fed to the motor as correction signals. This watch is said to be the first cybernetic watch, since it employs a comparison circuit or "brain".

The vibrator motion is transformed into a rotary motion by means of a pawl system like that of Fig. 6. The toothed wheel rotates once per second. The centre second hand appears to rotate continuously without jumping. The accuracy is about one minute per year.

QUARTZ BALANCE WHEEL WATCH

The "μ-Quartz" or "TS Caliber" watch movement employs an electronically driven balance wheel having four magnets; the exact frequency of this balance wheel (about 4Hz) is controlled by a quartz crystal oscillator. The watch has been developed by B. Golay of Switzerland.

The hair spring fixed to the balance wheel has a special shape which results in the frequency of oscillation being somewhat dependent on the amplitude of movement; the frequency is slightly lower at small amplitudes and vice-versa. This effect is known as the isochronism defect.

The quartz oscillates at 32,768Hz. This frequency is divided down by part of a CMOS integrated circuit containing some 450 components. The strength of the pulse given to the balance wheel depends on the *phase* of its motion relative to the frequency divided signal from the quartz oscillator.

If the balance wheel is running too fast, the pulses to the coil which drives this wheel will be relatively weak, whereas if the wheel is running too slowly, they will be stronger. Thus the frequency of the balance wheel is stabilised at the value determined by the signals derived from the quartz oscillator.

If the isochronism defect amounts to 10 seconds per day for each degree of amplitude variation, the balance wheel frequency need only be adjusted to ±100 seconds per day if an amplitude variation of ± 10 degrees is acceptable.

As in other quartz controlled watches, the regulation is effected by means of a trimmer capacitor which adjusts the exact frequency of the quartz oscillator. In this watch the capacitor is adjustable in steps which correspond to a change of 0·25 second per day. The accuracy is about one minute per year.

QUARTZ WATCH WITH STEPPING MOTOR

The Girard-Perregaux "250" quartz watch employs a 32,768Hz quartz oscillator. The pulses from the latter are divided by an integrated circuit to produce 0·5Hz pulses. These operate a miniature stepping motor which causes the centre second hand to jump once per second.

QUARTZ WATCH KITS

The Motorola Company has a section which supplies kits of parts to large watch manufacturers. These kits each comprise a 32,768Hz NT cut quartz crystal, a CMOS integrated circuit and a miniature rotary stepping motor. The additional parts required are a power cell, a trimmer capacitor, a conventional watch dial and hands together with gearing to couple the motor to the hands.

The oscillator frequency chosen is a compromise between the size of the oscillator crystal and the current consumption of the integrated circuit. The use of a higher frequency would enable a smaller quartz crystal to be used, but the increased switching frequency results in a greater power consumption by the divider circuit.

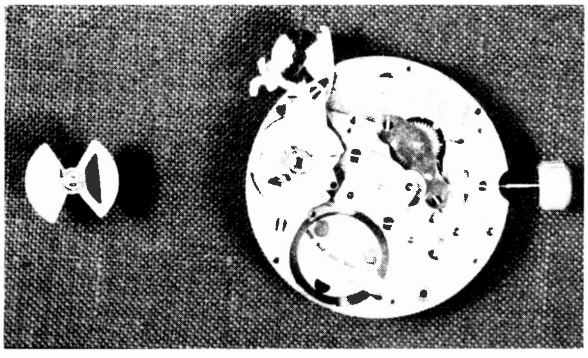
The MC 6061 integrated circuit divides the oscillator frequency by a factor of 65,536 so as to produce 0·5Hz pulses which can drive the motor.

The integrated circuit contains 312 transistors in a six lead ceramic package, but consumes only about 4·5μA from a 1·3V cell or 5μA from a 1·5V cell. Motorola use ion implantation techniques to dope the semiconductor material used in their integrated circuits.

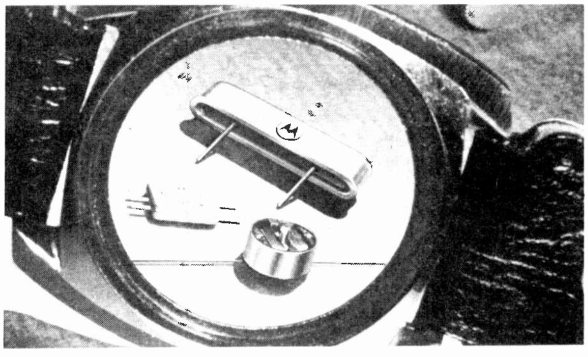
The 6mm diameter motor takes a mean current of about 7·2μA at 1·3V or 8·3μA at 1·5V. The 0·5Hz pulses from the integrated circuit have an amplitude of about 1V and a duration of about 31·25ms, successive pulses being of opposite polarity and separated by one second.

The motor rotates by 180 degrees at intervals of one second, all movements being in the same direction. It has a resistance of about 5 kilohms and contains about 50 metres of wire of a diameter about one-tenth of that of a human hair.

The Golay μ-Quartz movement partially dismantled. The magnets can be seen fixed to the balance wheel in the lower part of the photograph, whilst the driving coil is seen above after it has been swung out from the movement. The quartz crystal, which has been removed, is fitted above this coil



The three parts of the Motorola kit depicted inside an empty watch case. The quartz crystal is shown at the top, the integrated circuit on the left and the stepping motor on the lower right-hand side



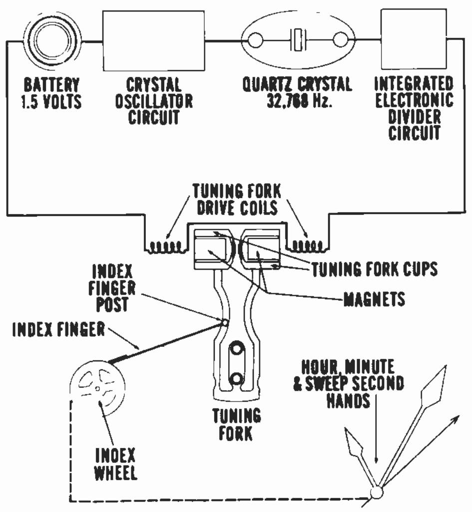


Fig. 8. The operation of the Bulova Accuquartz is depicted here

QUARTZ TUNING FORK WATCHES

The new Bulova "Accuquartz" watch is especially interesting because it contains a quartz oscillator which controls a tuning fork movement. This watch was introduced in the U.S.A. in December 1971 and became available in Europe towards the end of 1972 at prices from £115. It is much thinner than many other quartz models (including an earlier "Accuquartz" model which used the "Beta 21" movement). The new "Accuquartz" range for men and women display the day of the week and the date in addition to the time.

The "Accuquartz" crystal oscillates at 32,768Hz. This frequency is divided by an "Intersil" CMOS integrated circuit containing 126 transistors, etc. The tuning fork oscillates at 341⅓Hz, this being one-third of the frequency 1,024Hz. See Fig. 8.

The Bulova Accuquartz is shown in the foreground together with a much thicker Accuquartz model using the CHE movement

In this watch the tuning fork mechanism advances the gearing 341⅓ times per second by the same type of mechanism as used in the Bulova "Accutron" range. Thus the centre second hand appears to move continuously instead of jumping once per second as in some types of watch.

The "Accuquartz" has an accuracy of about 1 to 2 seconds per week.

THE ASTROQUARTZ

The Junghans "Astroquartz" watch is said to be the smallest quartz watch being manufactured. It employs a 32,768Hz quartz oscillator, but the quartz crystal used is unusual in that it is in the shape of a tuning fork, the prongs of which vibrate like an ordinary tuning fork but at a much higher frequency.

As illustrated in Fig. 9, an integrated circuit acts as oscillator and frequency divider. The 15 cascaded binary stages divide the pulse rate by 2^{15} to produce one output pulse per second. The size of the integrated circuit is only 1·6 × 2·1mm.

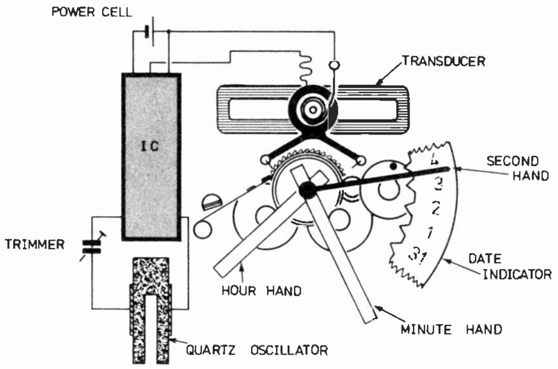


Fig. 9. The above illustration depicts the operation of the Junghans "Astroquartz" watch

The output pulses from this circuit drive an electro-magnetic transducer. The pulses are applied to the coil which turns in a strong magnetic field. The escapement fitted to the axis of this coil engages and turns a wheel with 60 teeth to which a centre second hand is fitted.

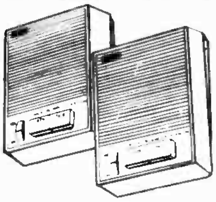
THE MEGAQUARTZ

The "Megaquartz" watch is probably the most accurate wrist-watch yet designed, although it is being produced only in small quantities. It has been designed by the Batelle Institute in collaboration with the Omega Watch Company. The accuracy is about 1 second per month.

The main feature of this watch is the use of a circular AT cut quartz crystal oscillating in a shearing mode at 2,359,296Hz—far higher than in any other design. An integrated circuit frequency divider is used.

Omega also offer a quartz watch which has an 8,192Hz oscillator. This frequency is divided by a factor of 32 to produce 256Hz pulses which drive an electro-magnetic motor. The accuracy is about 1 minute per year.

gspk (sales)



D1075 Wireless Intercom

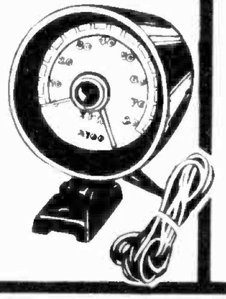
The great merit of wireless intercoms is that separate connecting wires are not necessary providing the stations are on the same electrical mains circuit. Communication can be up to a distance of ½ of a mile providing the power lines used are on the same side of the distribution transformer, and several stations can even be operated on the same circuit. Solid state model D1075 is fully transistorised and each unit incorporates a talk–listen button with locking bar; ON/OFF volume control and a pilot light. The fawn moulded cabinets can be desk located or wall mounted and are supplied already fitted with 1·25 metres of heavy duty lead. Operating Frequency: 160kHz. Speaker/Microphone: Dynamic 55mm. Power Output: 120mW. Size: 98 × 40 × 130mm. Printed Circuit: 3 transistors, 1 diode.

£11·60

SOLID STATE TACHOMETER

Functionally styled for under or over dashboard installation, this electronic tachometer fits all 4-cycle, 4-cylinder, or 2-cycle, 2-cylinder 12V vehicles. Negative or positive earth. Calibrated white on black 0–8,000 r.p.m. in 100 r.p.m. divisions together with setable "danger" line, simple installation—2 screws, 4 wires. 80mm (3in) dia. dial, 50mm deep. On adjustable angle bracket. Sealed black crackle finish.

£6·86



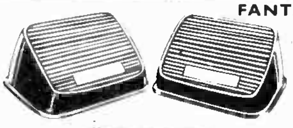
SPECIAL OFFER!

AUTO BURGLAR ALARM PLUS "POP-OUT" CIGARETTE LIGHTER

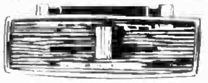
Designed for easy installation on any car (whether 6 or 12V) this device activates the horn when a theft is attempted of equipment or personal belongings. This neat unit reacts when the vehicle is disturbed or rocked and continues its warning for 15 sec. after tampering. The sensitivity of the device is adjustable and controlled by a separate ON/OFF panel which can be located wherever convenient. Supplied with connecting wires and screws in attractive bubble pack, containing installation instructions and diagrams. 150 × 65 × 20mm plus panel 65 × 45 × 20mm.

£2·10 FOR BOTH

FANTAVOX STEREO LOUDSPEAKER SYSTEM



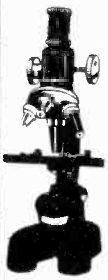
These high quality speaker enclosures are made of tough black moulded plastic and have been designed for fitting on to almost any vehicle surface. The smart louvred fronts are silver trimmed and house heavy duty 5in (125mm) ceramic loudspeakers rated at 3/5 watts. 8 ohms impedance. Already wired with generous length connecting leads and supplied in packs of speaker pairs complete with fixing screws. Each cabinet measures 190 × 105 × 165mm. Weight: 0·55 kg.



1052 FADER CONTROL

Neat, custom-made appearance slide fader control for balance of front and rear speaker volume. Simulated wood finish panel which can be quickly fitted below car dash. Supplied with generous connecting cable and fitting screws. Will suit 4, 8, 16 ohm installations. 100 × 38 × 30mm (including knob but excluding fitting bracket).

All for £4·70



420ES MICROSCOPE

An extremely modestly priced yet efficient microscope capable of magnification up to 750 times with clear sharp images. This model is of the self-illuminating type and incorporates an easily rotable four-position turret magnifying lens with rack and pinion focusing. The crackle black metal body houses the batteries for adjustable illumination. Packed in carton with built-in carrying handle and full notes for user. A sample slide also provided. 105mm at base; 180mm high. Weight: 0·40 kg.

£4·95

G5555 PROFESSIONAL STEREO HEADPHONE

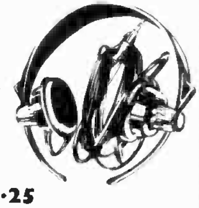
Lightweight materials are skilfully used in the construction of this model in black crackle moulding and kid-soft leathercloth with contrasting bright metal. Each ear pad houses a highly efficient 60mm reproducer unit and features ear muffs removable for cleaning. 10-self-coiled lead plug fitted.
Frequency Response: 20–20,000Hz. Impedance: 4–16 ohms. Sensitivity: 110dB. Power: 0·5W. Weight: 0·39kg.

£9·25

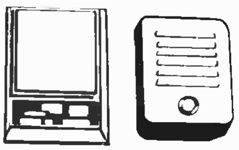
"SPRITE" LIGHTWEIGHT STEREO HEADPHONE

An outstanding achievement following lengthy development by one of the world's leading audio manufacturers, the T.T.C. "Sprite" offers the following specification:
Extreme lightness (only 150 grammes) (5oz);
Instant wearing adjustment with sliding ear-pieces and flexible headband;
Highly efficient Mylar reproducer units;
Removable, washable foam padded ear muffs;
3-metre lightweight lead with stereo plug fitted.
Frequency Response: 30–13,000Hz.
Sensitivity: 105dB. *Power*: 0·2W.
Impedance: 4–16 ohms. *Weight*: 0·15kg.

£2·25



D1019 "Doorphone" with Metal Unit



Three transistor solid state two-way intercom system with specially engineered weatherproof slave unit in heavy gauge metal. Sensible design features include rain protective speaker louvres, simple push-pull button, internal socket connecting lead and removable back plate for wall and door panel mounting. Master unit in high impact white moulding has complementary silver "pinhole" grille and silver/black panels with ON/OFF volume control and push-to-talk switch. 60mm dynamic speaker/microphones are used for both units. 120mW output. 9V internal battery operation. Master unit: 77 × 40 × 105mm. Slave unit: 70 × 32 × 90mm. Supplied with battery, lead and staples.

£3·90

DF100 MICROPHONE

Bijou sized model in matt silver finish with machined capping to insert housing and supplied with unique pocket/lapel clip which also doubles as a desk support. Supplied with lavalier cord, 2 metre lead fitted 3·5mm moulded plug and packed in the latest style click-fast case manufactured from smart durable padded plastic.

Impedance: 200 ohms. Sensitivity: 82dB. Frequency: 100–9,000Hz. Size: 13mm dia. × 92mm.

£3·50

TI-C1000 MINI-METER

£2·70

This is the most compact and reliable multimeter on the market and features easy switch selection, 1,000 ohm/volt 2-jewel meter movement with zero and needle adjustment. Easy to read scale in two colours. Ranges: A.C. Voltage: 0–10V, 50V, 250V, 1,000V. D.C. Voltage: 0–10V, 50V, 250V, 1,000V. D.C. Current: 0–1–100mA. Resistance: 0–150K ohms.

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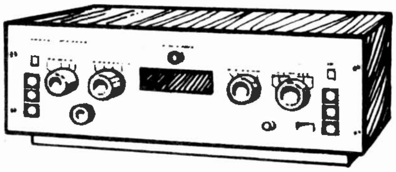

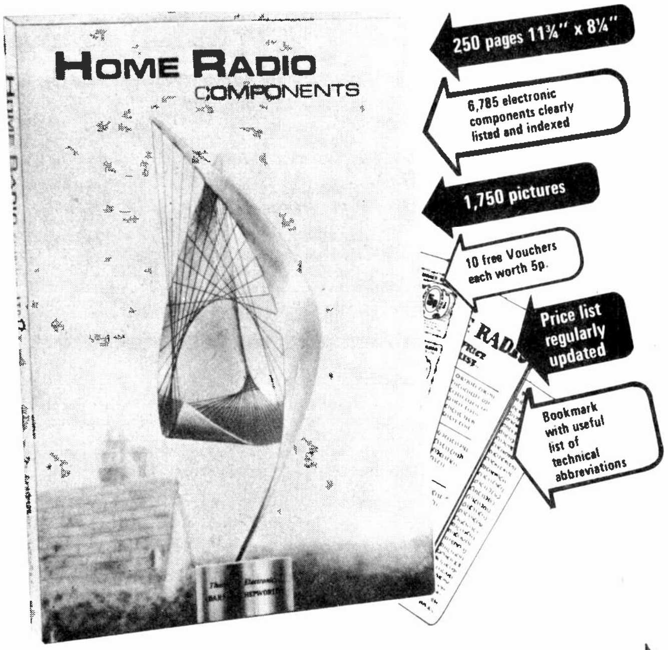

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(Right): the Avia watch which employs a liquid crystal display. This is expected to be available in the U.K. at about £135 soon

(Left): the Swissonic 2000 watch. This displays the date, the hours, minutes and seconds continuously by means of a liquid crystal system

DIGITAL WATCHES

Digital watches which employ no moving parts have just begun to appear on the market. They employ quartz oscillators and provide an accuracy of about one minute per year.

Two forms of display have been employed, namely electroluminescent diodes which provide a red display and liquid crystal displays.

ELECTROLUMINESCENT WATCHES

Watches employing gallium arsenide-phosphide electroluminescent diodes provide a display which shows the time in red digits. Unfortunately the display diodes require so much current that it is not possible for the time to be continuously displayed if the power cells are to have a reasonable life. A button on the watch must therefore be pressed each time the user wishes to read the time. The cell life is dependent on the number of times the time is displayed. The display may have to be shaded with the hand if the ambient light level is high.

The "Pulsar" watch manufactured by the Hamilton Company employs light emitting diodes. The brightness of the display is automatically adjusted to suit ambient lighting levels, although it requires shading from direct sunlight when the display is being read.

Each time the button is pressed, the hours and minutes are displayed for 1·25 seconds, but if the button is held down, the seconds are displayed for as long as it is depressed.

The watch employs a 32,768Hz oscillator and a CMOS integrated circuit containing over 1,200 transistors. It is powered by two silver oxide cells which have a life of over one year under normal use (about 25 time readouts per day).

A slight variation of this watch is offered by the Omega Company as their "Time Computer".

LIQUID CRYSTAL DISPLAYS

The other form of digital display used in watches employs liquid crystals. This type of display requires very little power, since it does not emit light. The liquid crystals simply reflect a different proportion of the incident light in regions where an electric field is applied to them. Thus the display cannot be viewed in the dark. A moderately high ambient light intensity is desirable.

The thickness of the liquid crystal material may be about 0·5mm. The special nematic material is placed between two electrodes like a capacitor, but the electrode nearest the face of the watch must be transparent.

In the absence of any field, the liquid is perfectly clear and transparent, any incident light falling on it being absorbed by a black background. When an electric field is applied by suitably shaped electrodes in certain regions (which are in the shape of the digit to be displayed), the liquid becomes opalescent as the crystals come into mutual alignment. They reflect the incident light back from these regions to the observer.

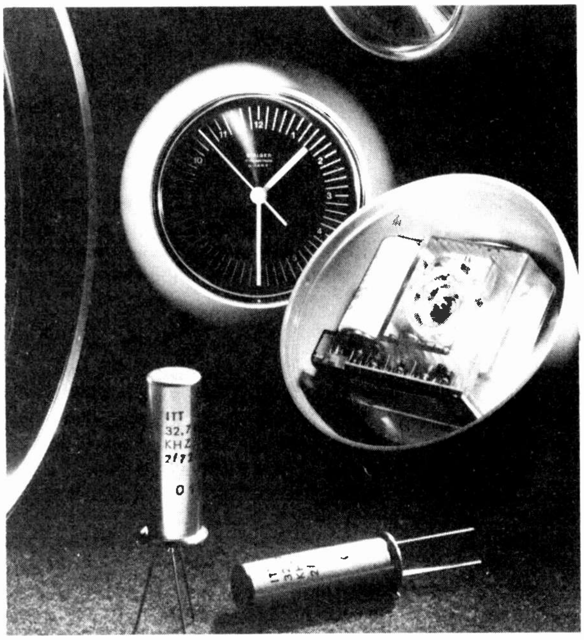
Although watches using liquid crystal displays have the advantage over those using luminescent diode displays in that the digits can be made visible at all times, the life of the present liquid crystal systems seems somewhat doubtful. Even when an alternating voltage is applied, some degradation of the material may occur so that the display gradually becomes less clear. The life should be considerably over one year, but it is too early to estimate it accurately. At least one manufacturer feels that liquid crystals may have an indefinite life if contamination is avoided. The price of replacement units should fall rapidly during the next few years.

THE AVIA WATCH

One watch with a liquid crystal display is marketed by Avia-S.G.T., the liquid crystal system for this watch being produced by the Optel Corporation of the U.S.A. The hours and minutes are continuously displayed, but the seconds are shown by means of two flashing points appearing between the hours and the minutes digits.

The quartz oscillator operates at 32,768Hz. This frequency is divided by a factor of 512 and the 64Hz output operates counters. The latter control the decoders which feed the display.

The 1·5V power cell has a life of 14 months. A circuit is employed to convert the 1·5V from the cell to the 15V required for the decoder-display operation.



The Staiger 2000 quartz crystal controlled clocks. The ITT crystals used are shown at the front

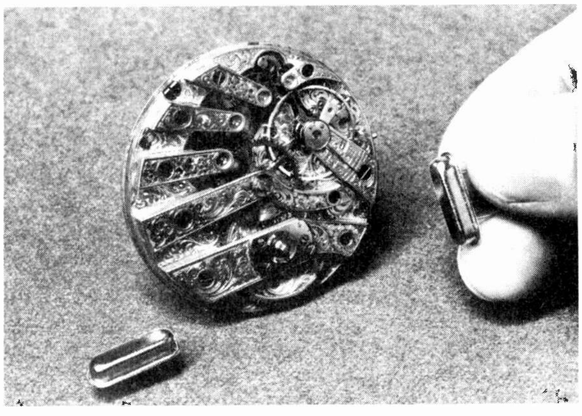
A DETAILED DISPLAY

Another liquid crystal watch has been developed by Texas Instruments, Ebauches S.A. and Longines. The eight character display provides a continuous readout of the day of the month, hours, minutes and seconds. The accuracy is about 1 minute per year. The watch contains two integrated circuits containing about 700 transistors and is powered by two 1·35V mercury cells.

The hour display can be set by an internal switch to provide either a 12 hour or a 24 hour cycle. The indicated time is set by four micro-switches on the back of the watch which alter the seconds, minutes, hours and date respectively.

Another watch with a liquid crystal display has been produced by the Seiko Company; it displays hours, minutes and seconds.

A Geneva lever movement (about 100 years old) from the Science Museum being compared with an ITT quartz crystal designed for use in a watch



CLOCKS USING LIQUID CRYSTALS

A limited number of clocks with liquid crystal digital displays are available, for example, from the Seiko Company. An impressive digital alarm clock (type S1736) has been constructed on a single chip by American Microsystems; it is interfaced with their liquid crystal readout.

ATOMIC CLOCK

In a totally different sphere it may be mentioned that the standard of time is now based on the frequency of radiation emitted between two hyperfine levels of the caesium-133 atom. The second amounts to 9,192,631,770 cycles of this radiation. This definition provides a more accurate measure of this unit than the motion of the earth.

Ebauches S.A. have made precision time centres using caesium atomic clocks which have an error of less than one microsecond per day (corresponding to one second in about three thousand years!).

POWER CELLS

The cells used to drive electronic watches pose many manufacturing problems. Three of the main manufacturers are Union Carbide, Leclanche and, in England, Mallory.

A new area has recently been opened by Mallory at Crawley for the manufacture of special mercury button cells used in watches. Such cells must give satisfactory service for at least one year after a variable period of storage before sale.

Extreme care must be taken to prevent contamination of the materials used in cell manufacture. All air is filtered before it enters the watch cell manufacturing area at Crawley to prevent dust from being sealed in the power cells. Great care must be taken to prevent the possibility of internal leakage of current.

The electrolyte used in watch cells is chosen for the lowest practical seepage rate, since if it escaped from a cell it would probably damage the delicate watch mechanism.

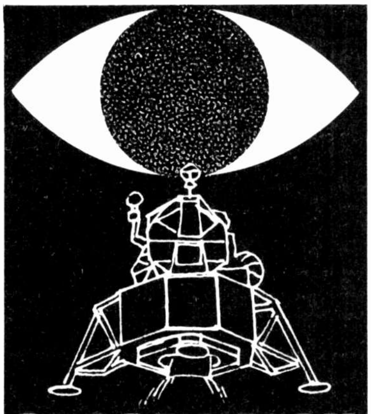
In conclusion it may be mentioned that the tweezers used to fit new cells into watches should be made of a plastic material, since metal tweezers can easily short the cell. Care should be taken to fit new cells in the correct way so that they provide the circuits with a voltage of the correct polarity.

CONCLUSION

We are in the midst of a revolution in watch design. Although no manufacturer has really broken through the price barrier with a moderately priced quartz controlled watch, it may not be too long before one company does so and the "quartz war" will have begun. The developments in the last few years have been very rapid and it is expected that many of the estimated 300 million watches per annum required by 1980 will be electronic ones.

The traditional place of watch making, Switzerland, has played a large part in the development of electronic watches, but the U.S.A. has initiated much of the work.

The normal skills of the watchmaker will be required to attend to watches employing moving parts, but if digital watches become common, the watch repairer may have to have a very elementary knowledge of electronic engineering with microminiature equipment. ★



SPACEWATCH

BY FRANK W. HYDE

SPACE BUDGET

The United States space agency will have more money to spend this year, 74 million dollars in fact. A total of 3,136 million dollars is set aside for space matters. This amount will cover a number of NASA projects, for example two new projects as well as the programme for space stations and shuttles.

The two new projects are a new kind of satellite for geodesy known as a Terrestrial Reference Satellite, and an advanced version of the *Nimbus* weather satellite to monitor pollution.

The reference satellite, due for launch in 1976, will use laser beams for the measurement of distances between locations on different continents. The accuracy that can be achieved is of the order of a few inches so that small changes of movement of land masses will be detected.

The new *Nimbus* satellites will monitor both air and ocean pollution. The programme is for the launch of two satellites, one in 1974 and the other in 1976.

The current major projects will continue to be developed, but there will be a phasing out of communications satellite interests. This is because the space agency consider that the viability of these programmes has been proved and the time is now ripe for commercial responsibility for this activity.

The Science Foundation will increase their programme of investigations and some major projects involve visual and radio astronomy. Some 10 million dollars will go to the rail mounted mobile arrays of aerials in New Mexico for the large scale study of distant sources and the detection of signals from any civilisation that may exist in other parts of the Universe.

The visual telescope under construction at the Cerro Tololo inter-American Observatory in Chile, will be given 2·6 million dollars for the completion of the work on what will be the largest optical telescope in the southern hemisphere. The diameter of the mirror is 158 inches and the site offers spectacular advantages over other places for useful viewing time.

LUNOKHOD 2

The Russian moon vehicle, *Lunokhod 2*, which landed on the Moon in January has a special set of programmes. It was landed some 175km from the landing site of *Apollo 17*. The data obtained from the two sources should be complementary.

Landed in the Sea of Serenity, the *Lunokhod 2* task is to examine the boundary area where older rocks may be found. At the boundary area of the highland regions, from which anorthites rise up, the floor of the mare is covered with basalt type lava.

Other experiments will measure and observe the Zodiacal light near the Sun, observe the Milky Way and the centre of the Galaxy with a space photometer. It is hoped also to decide whether there are traces of cosmic dust in the Lunar atmosphere. The possibilities of studying the Universe by optical means from stations on the moon is another experiment which the Soviet team are known to be considering.

The vehicle is also carrying a French laser reflector for measuring the Earth–Moon distance.

The *Lunokhod*, which is of a similar design to the previous vehicle, carries on its outside an orientation device, a lunar surface photometer, soil analysis experiment, a fixed television camera, a steerable television camera, the space photometer, a solar battery, a magnetometer, a photo receiver and aerials which include a corner reflector and a high gain system.

MOON GRAVITY

Analysis of the gravitational variations of the moon recorded by the command module of *Apollo 15* has yielded data about mascons, and the lunar orbiter added to this data when being precisely tracked.

This problem, to which selenologists have devoted considerable time and study, can now be set up as a model. The model now suggested agrees well with the idea that the mascon of Mare Serenetatis is a thin body with well defined boundaries. The previous speculations on this theme have been borne out for Mare Nectaris also.

So far as Serenetatis is concerned the model fits the surface features extremely well. At the moment the data gives support to the volcanic hypothesis.

ORBITING WORKSHOP

As the launch date for the *Skylab*, the first orbiting space station, draws near it may be useful to describe the project and the sequence of events which will be the step in space that many have waited for almost impatiently.

The first crew will be an all Navy one and Charles Conrad, veteran of *Apollo 12*, is the only member of the team who has had astronaut experience. The other two men are J. P. Kerwen, a doctor, and P. J. Weitz, an aeronautical engineer.

Skylab will go into a 270-mile orbit. The sequence is to be the launch of the skylab unit unmanned into the prescribed orbit, the next day, May Day, the launch of the command module with the crew to the calculated rendezvous. When linked up the total length of the units will be 118ft. The diameter will be 22ft at the workshop section.

The arrangement of the airlock and docking sections allow normal joining of the command vehicle to the end of the whole unit. There is also a second docking point on the side of the docking module which could be used for a second command module to attach itself or for rescue purposes.

When the space station is launched the telescope covers the docking section. On attaining its correct location in orbit the telescope will swing to the side and the solar power paddles will open. The ports for docking will then be uncovered.

LIFE SUPPORT SYSTEMS

The station main body is 48ft by 22ft and there is an intermediate section next in the sequence which is 17ft long and is an airlock section. Here all the power control and distribution systems are located.

The air conditioning system, the life support system together with communications control and data management are also arranged there. There is room for two fully suited astronauts with personal life support systems in the section. From here the crew can pass to the docking module to work outside the vehicle or to pass to and from the command module.

The whole assembly with the launcher, a *Saturn 5* rocket, will stand 334 feet high at take off. The combined weight at the time will be 3,110 tons.

Hi-Fi Tape Link

By P. S. EWER

LAST month the circuit of the Tape Link was described in detail. In this the final part, the construction of the Tape Link, the fitting of the heads and the setting up procedure will be described.

TWO ASSEMBLIES

The Tape Link is made up of two assemblies (the amplifier and the power supply) in order to keep the mains transformer away from hum sensitive circuits and enabling the power supply to be positioned where it induces the minimum hum in the replay head.

The folding of the metal should present no problems to a handyman equipped with a vice. Cutting the metal to size is not quite so easy and is best done with a guillotine and a fly press for the cut out parts. Constructors may find it convenient to purchase the metal cut to size from a sheet metal shop.

POWER SUPPLY CONSTRUCTION

Dealing first with the power supply, drill the chassis and bend up as indicated in the photograph.

Next, affix the mains transformer using 4BA × ½in screws and nuts. Do not tighten as they will have to be undone again when the power unit is finally mounted in the case. A tag strip carrying the rectifier diodes should now be assembled and bolted to the chassis.

Wiring between this and the mains transformer is best done at this stage as the tag strip will be difficult to get at once the smoothing capacitors are in place. These and the fuseholder can now be put into position and the wiring completed.

The power lead-out wires and the mains lead are secured by a plastic cable clip bolted down to the mains transformer. Having completed the power supply it can now be tested.

With mains applied and no load imposed upon the outputs, the supplies should read 56 volts and 28 volts respectively. Provided that the voltages measured are within a couple of volts either way and that the mains transformer and capacitors do not get hot after a few minutes' operation, all should be well.

AMPLIFIER CHASSIS

Mark out the front panel to suit components (see Fig. 7). Drill all the holes starting first with an ⅛in drill. Next, open out the holes for the record indicator lamp, the switches and potentiometers with the appropriate drill.

The DIN sockets are mounted beneath the panel and the ⅝in hole required to allow entry of the plugs is most neatly cut with a chassis punch, e.g. a "Q-max cutter". The cut outs for the meters are made by drilling all round just inside the edge with a small drill, pushing out the centre and then truing up to the marked line with a file.

A similar technique should be used for the meter switch cut-out. Drill two holes side by side and open up to the required size with a needle file. Finally countersink all the screw holes.

The strap for mounting the meters, and the U-channel complete the metal work. To make the folding easier, the front panel fixing flanges should be bent over first. The sheet can then be bent up to complete the chassis. Once again, the use of a chassis punch is recommended for the larger holes (see Fig. 4).

The front panel can be finished in any way desired. One method which gives a pleasing appearance is to satin finish it by stroking lengthwise with a wire brush such as is supplied for cleaning suede shoes. This results in a series of parallel scratches. The panel is then cleaned with a rag soaked in methylated spirit to remove loose material and grease.

Letraset may be used to label the panel, finally protecting the finish with two coats of lacquer.

After fixing the front panel to the chassis the B9A valve holders and the stand-off spacers are mounted and the components assembled to the front panel. The slider switch used by the author for the BIAS/VU selector was supplied with its mounting holes tapped at 8BA.

These were drilled out and retapped at 6BA. However if 8BA screws are used, allowance must be made for this in the front panel drilling.

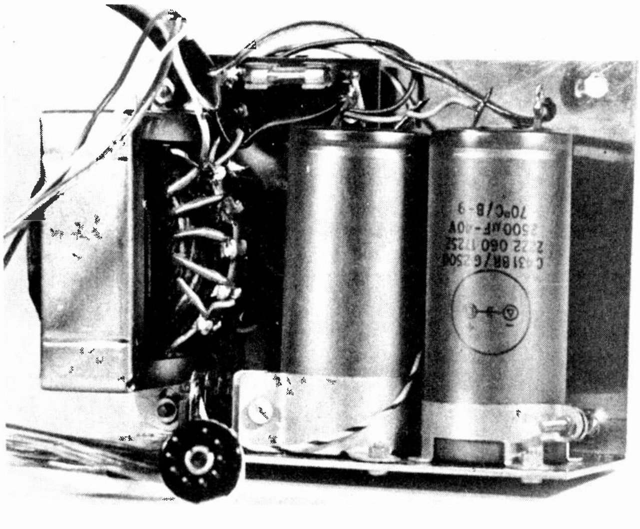
COIL WINDING

Because many readers find it difficult to obtain specified coils, the author wishes to point out that virtually any 14mm coil is suitable for L1 and L101. Most catalogues specify the number of turns per millihenry and because inductance is proportional to the square of the number of turns, twice this number will give the number of turns required for 4mH. Some easily available pot cores and their turns per millihenry are given in Table 1.

Using 34 s.w.g. enamelled copper wire, wind the required number of turns onto the bobbin. On completion the winding should be secured with a layer of adhesive tape (not Sellotape).

Before assembling the two halves of the pot core, slightly rub the mating surfaces with a sheet of paper to remove any dust which could alter the inductance of the completed coil. The lead wires should be brought out separately through adjacent slots at 90 degrees.

Photograph showing construction of the power supply for the Tape Link. The switch and indicator neon are mounted near the mains input Positioning of the power supply module within the finished tape deck is best found by trial and error being that which gives minimum hum



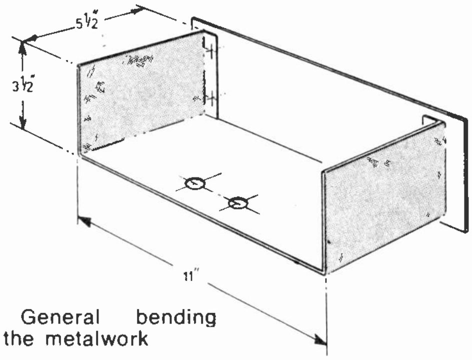


Fig. 4. General bending details of the metalwork

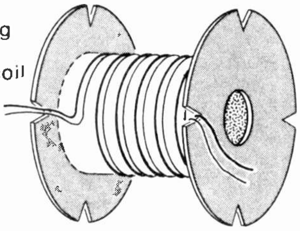
Table 1: ALTERNATIVE POT CORES FOR L1 AND L101

Type	Turns/mH	Turns required for 4mH
LA 2503	52	104
T26/2100R	47·5	95
FX 1636	34·8	70
FX 1011	24·3	49
FX 2236	32	64

Table 2: ALTERNATIVE POT CORES FOR BIAS AND ERASE OSCILLATOR T2

Type	Turns/mH	Turns required Primary	Turns required Secondary
LA 2301	53·8	5 + 5	80
LA 2105	54·7	6 + 6	96
LA 2517	42	5 + 5	80
N22/250A	40	5 + 5	80

Fig. 5. Method of winding the primary of the bias and erase oscillator coil

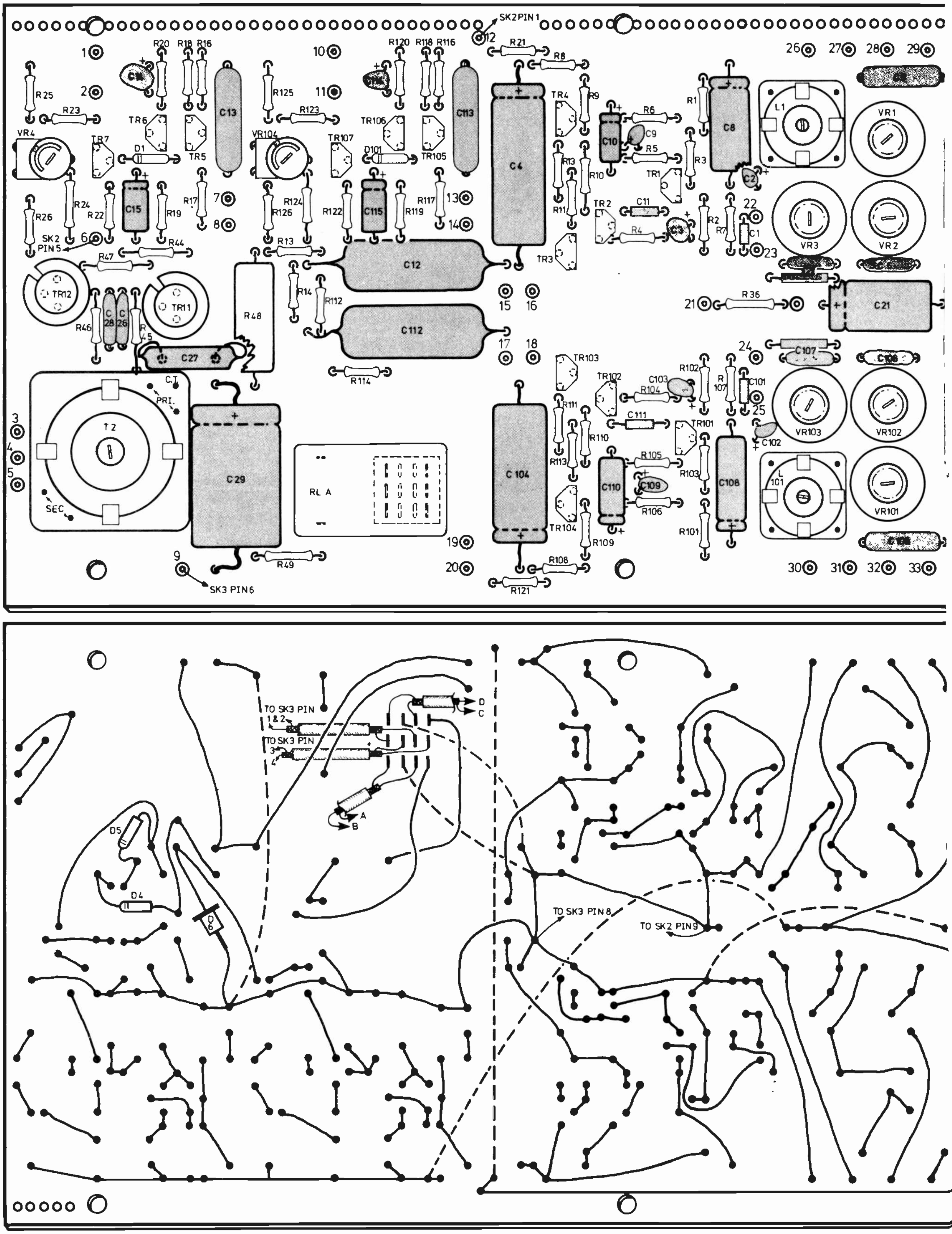


BIAS AND ERASE OSCILLATOR TRANSFORMER

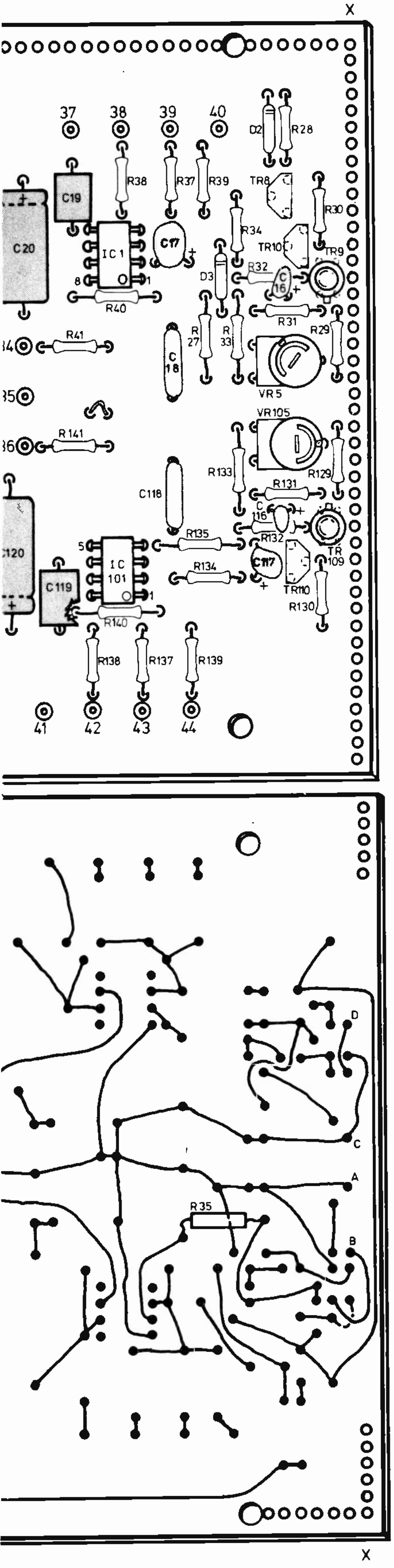
Again the pot core used for this transformer is by no means critical. A 25mm type was used in the prototype but any high frequency 18mm type will do just as well provided the inductance is that specified (see Table 2 above).

Measure off two 20in lengths of 21 s.w.g. wire and twist them lightly together. Allowing a few inches for leadout wires, begin winding the required number of primary turns making sure that the first turn of one half of the primary lies adjacent to the first of the other half and so on (see Fig. 5). After the required turns have been wound the windings should be secured with adhesive tape.

The secondary should then be wound using 30 s.w.g. wire starting in the same place and winding in the same direction. Cover this layer with one layer of tape. Then assemble the pot core with the same precautions as for the previous coil.



SK2 PIN 1
R20 R18 R16
R120 R118 R116
R21
R8
R25
R23
R125
R123
C13
C113
C4
C8
L1
VR1
VR4
VR104
TR6
TR5
TR7
D1
TR106
TR105
TR107
D101
TR4
R9
R6
C10
C9
R5
R1
R3
TR1
C2
R15
R24
R26
R22
C15
R19
R17
R124
R126
R122
C115
R119
R117
R13
R10
R11
TR2
C11
R4
C3
R2
R7
C1
VR3
VR2
SK2 PIN 5
R44
R47
R13
C12
R14
R112
C112
TR3
R36
C21
TR12
TR11
C 28
C 26
R46
R 45
R48
C27
R114
TR103
TR102
R102
R 107
C101
C103
R104
C107
C106
C111
TR101
R111
R110
R113
C102
VR103
VR102
C.T.
PRI.
T2
SEC
C29
RL A
C 104
C110
C109
R105
R103
R106
C108
L 101
VR101
TR104
R109
R101
C105
R49
R108
R121
SK3 PIN6
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33
TO SK3 PIN 1 & 2
TO SK3 PIN 3 4
D
C
A
B
D5
D4
D6
TO SK3 PIN 8
TO SK2 PIN 9



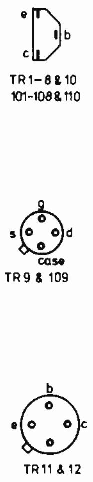


Fig. 6. Layout of the components on the perforated board. Note that there are some components under the board. C27 should be mounted away from board to avoid heat

The primary windings must now be identified with some form of continuity tester such as a bulb and battery. After scraping the enamel from the four primary wires select one wire and call this the start.

Next find the other end of this wire with the continuity tester. If the method of winding shown is followed then the starts of both primary halves will be at the top of the coil and the other ends at the bottom. The end of the identified wire should then be soldered to the start of the remaining wire, this becoming the centre tap. The remaining wire then becomes the other end of the total primary.

CIRCUIT BOARD

The amplifier is constructed on perforated board which accommodates all the components with the exception of the relay for which a cut-out must be made (Fig. 6). The holes will also have to be opened out for some of the pots and for the fixing screws.

The wiring should proceed logically from one end of the board to the other inserting Veropins where the flying leads are to be soldered to the board. The oscillator tuning capacitor is mounted up in the air on Veropins to keep it away from the hot components near it.

TR11 and TR12 are fitted with clip-on heat sinks (TO5 can). There are four components mounted underneath the board which must not be forgotten.

CONSTRUCTION

Upon completion thoroughly check the board wiring. The connections from the underside of the board to the B9A sockets are then wired, allowing sufficient slack to enable the board to be tilted up through 90 degrees to facilitate servicing should it be required.

The board is next screwed into position and the wiring completed. To facilitate identification, the use of an assortment of colours for the connecting wires is suggested, and screened leads of low capacity *must* be used where indicated (see Fig. 7).

For ease of assembly it is suggested that the switch wafers nearest to the metalwork are wired first. Note the screen between the wafers and the spacers required to give good isolation between the two sections. In the prototype three-pole three-way wafers were used for S1 but the easier to obtain four-pole three-way wafers are perfectly suitable.

Prevention of earth loops is essential with this equipment and the constructor should note that there is only one connection between the chassis and amplifier earth.

At this stage the wiring on the front panel and the chassis should be completed as in Fig. 7.

TESTING

After having thoroughly checked the wiring (mistakes can be expensive) the power supply is plugged into the appropriate socket on the amplifier and mains applied. Providing that there is now no obvious indication of a fault, e.g. smoke, it can be assumed that there are no serious errors.

Measure the supply voltages with a multimeter. These should be 55 volts and 27 to 28 volts approximately. It is then prudent to go around the circuit

Table 3: APPROXIMATE VOLTAGE SETTINGS

Junction of R1 and R2		17·3
TR1	emitter	18·0
	collector	0·7
Junction of R1 and R21		54·0
TR2	collector	25·3
	base	0·7
Junction of R11 and R13		27·0
TR4	base	28·7
	emitter	28·0
TR3	base	25·3
	emitter	26·0
TR5	base	7·7
	emitter	7·0
	collector	18·3
TR6	base	18·3
	emitter	19·0
	collector	7·0
TR7	emitter	6·0
	collector	26·0
VR4 wiper (dependent on setting)		6·0
Junction of R25 and VR4		8·0
Junction of R26 and VR4		4·0
TR8	base	28·0
	emitter	28·7
	collector	20·0
TR10	base	19·4
	collector (dependent on VR4)	12·0
Terminal 6 IC1 (dependent on VR5)		12·0

checking voltages in accordance with Table 3. These are the design figures obtained by calculation and, generally speaking, provided that correlation within plus or minus 20 per cent is obtained all should be well.

When these checks have been made rotate VR4 and VR104 fully clockwise. The meters should now show a reading.

Disconnect the mains and temporarily short pins 5 and 6 of SK3 together. Set the meter switch to BIAS and the function switch to STEREO. Then reconnect the mains. The record indicator light should come on and the meter show an indication which is adjustable by means of the bias control. Failure of the meter to read suggests an oscillator fault and the power should be switched off immediately to prevent damage. Remove the temporary link.

TAPE TRANSPORT

With the old heads and/or electronics stripped out, the new heads have to be fitted to the base plates. Two methods of accomplishing this for the record/replay head are depicted in Fig. 8. It is essential that the tracks interleave correctly and the baseplate may need to be packed up or filed down accordingly.

When correctly positioned, the upper edge of the top track lies just below the edge of the tape (about 0·15mm). With regard to the Collaro deck the slot in the baseplate had to be widened with a file and the

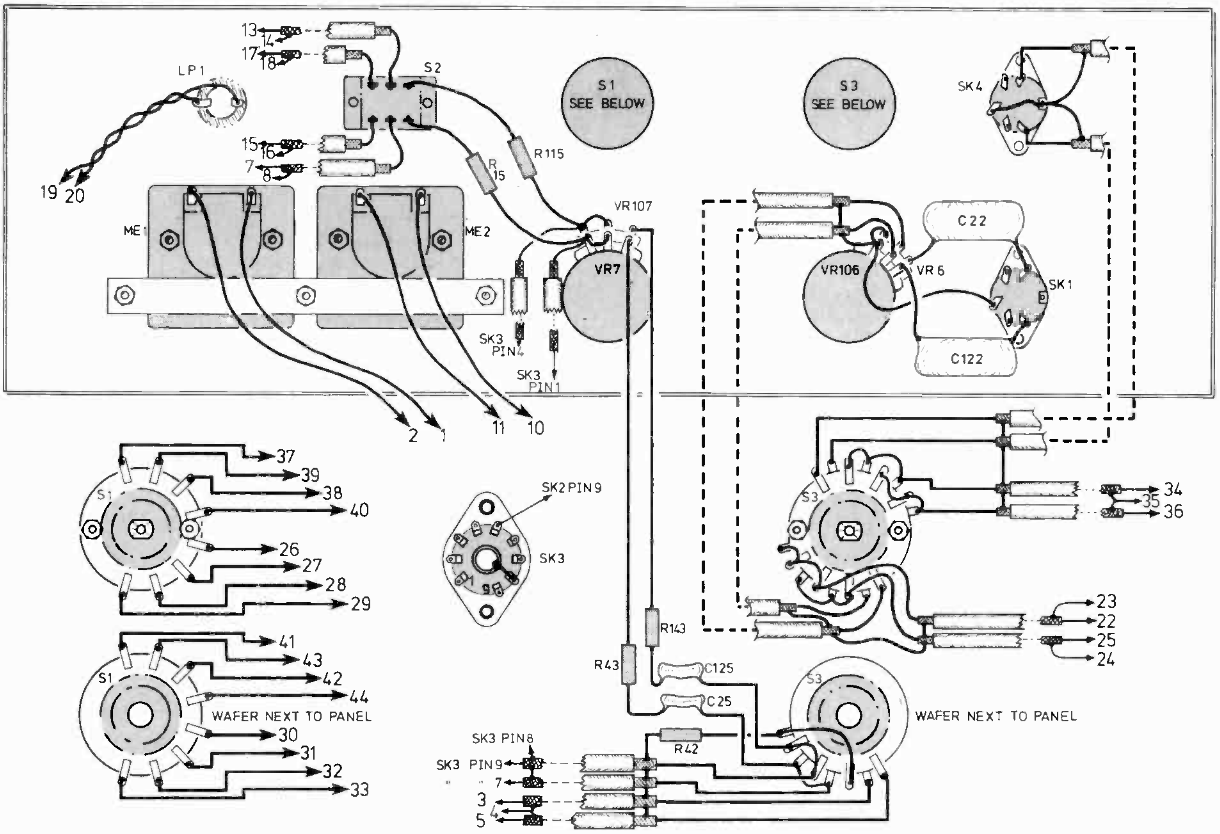


Fig. 7. Interwiring diagram showing the connections between the board and the other components. The numbers indicate the terminal pins on Fig. 6

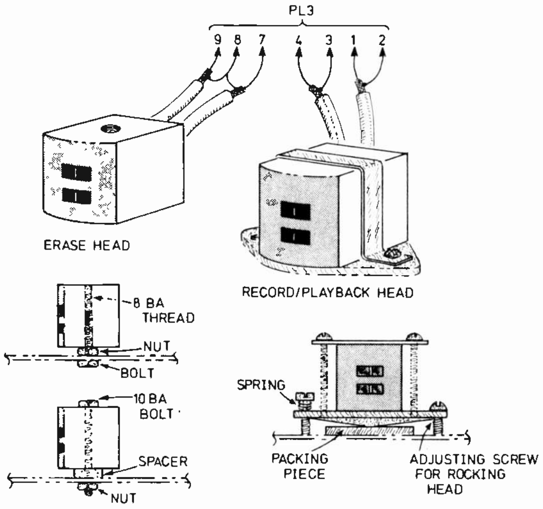


Fig. 8. Methods of fitting the new heads of the tape deck

baseplate packed up to raise the head. The dimensions of the strap are given and it was screwed to the baseplate with self-tapping screws.

The erase head has a single hole through it to clear 10BA, and this is the best means of securing it. The azimuth of the erase head gap is not critical and therefore a rocking plate is not required. On the author's deck this hole was tapped at 8BA and the head then secured directly to the head mounting plate stood-off by an 8BA nut drilled out to clear the thread. The top of the erase head upper track should extend to the edge of the tape.

PRESSURE PADS

A modification made by the author to his deck concerning the pressure pads may be of interest. The original pads were of hard felt requiring quite a high pressure to ensure contact between the tape and the head. These felt blocks were removed and replaced by a pad of composite construction, i.e. a layer of $\frac{1}{8}$in thick foam plastic covered finally with a $\frac{1}{16}$in layer of supple felt.

This gives improved contact at far less pressure thus reducing the wear on the heads and improving the flutter performance of the transport. At the same time a mu-metal screen cut from an old screening can was fixed to the rear of the RECORD/REPLAY head pressure pad to reduce the hum pick-up on playback.

RECORD/REPLAY SWITCH

Most tape recorders have their RECORD/REPLAY switch contacts interlocked with the function buttons. In order to change the function of the amplifier to RECORD, one set of "make" contacts are required. If these are not present on the recorder a switch must be provided and this should have contacts designed for switching capacitive loads.

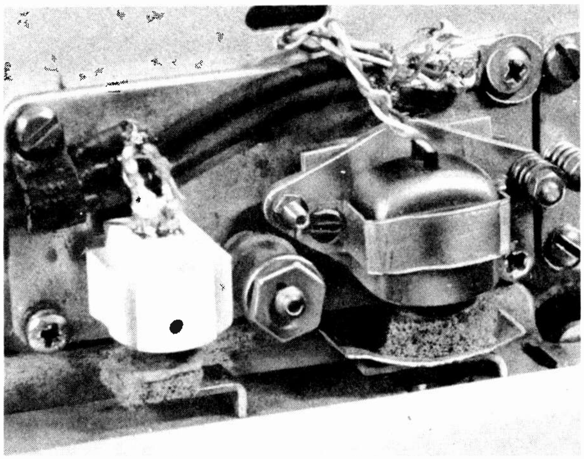
The heads are wired up to the plug using low capacity screened lead. The deck chassis is earthed to the screens of one of the record/play leads. Care should be taken to ensure that the metalwork of the amplifier does not touch the tape deck. If this is unavoidable the earth link mentioned above must be omitted.

The power supply should not be fixed down yet as its positioning is critical for minimum hum injection. To determine this position the deck should be set in motion as it would be when playing a tape. The power pack is then moved around the cabinet whilst listening to the replay hum level until it is subjectively at its lowest.

The recorder is now complete and ready for setting up.

SETTING UP PROCEDURE

The equipment required to set up the completed recorder is a d.c. voltmeter, an audio sine wave generator and an oscilloscope, or failing this an a.c. millivoltmeter. The setting up should follow the order outlined below as in some cases one stage depends on the setting of the previous.



Photograph showing the heads in position on the prototype

AZIMUTH SETTING

Before the electronics are adjusted the heads must be correctly aligned with the tape. Adjustment of the record/replay head gap in relation to the tape is known as azimuth alignment and is essential in order to facilitate the interchangeability of recordings between machines. This is correctly done with the aid of a professional test tape but any commercially prerecorded tape or a tape recorded on a machine with a known correct azimuth can be used. (Choose a tape with a good high frequency content.)

Whilst the tape is playing the head should be rocked up and down until the maximum high frequency output (measured simply by listening to the output) is obtained, then fixed in this position.

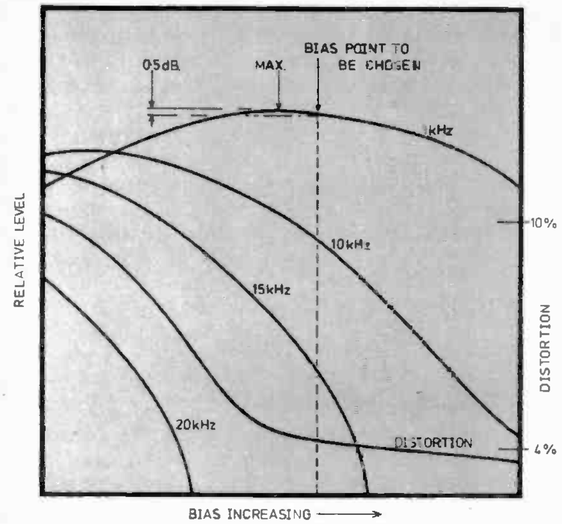
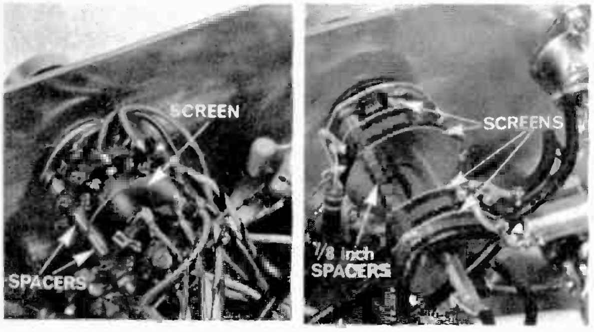


Fig. 9. Graph to show the dependence of frequency response and distortion on the bias level



Photographs showing the two wafer switches

REPLAY AMPLIFIER AND METERING ADJUSTMENTS

Using the voltmeter adjust VR5 and VR105 until the voltage at the emitters of TR9 and TR109 is 12 volts. Next rotate VR4 and VR104 fully clockwise (maximum resistance) then turn back so that the respective meters just read zero.

OSCILLATOR ADJUSTMENT

In the absence of suitable test equipment, a satisfactory result may be obtained by setting the adjuster to its mid position. The exact frequency of operation is not critical and in fact the tolerances of the frequency determining components are wider that the adjustment range.

If an oscilloscope or frequency meter is available then set the oscillator selector switch to STEREO, the bias control to mid range and the machine to the RECORD mode, then adjust the oscillator coil T2 until the frequency is as near to 100kHz as possible.

DETERMINATION OF BIAS SETTING

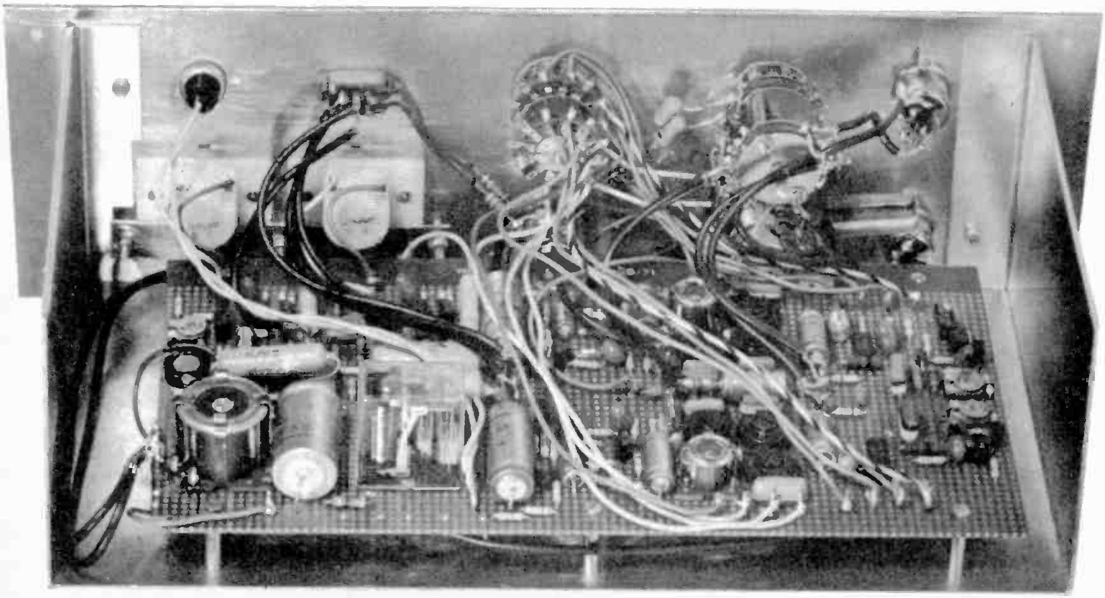
The correct bias setting is important as it affects many of the parameters of the recorder. The bias setting required depends on the tape speed, the tape in use and the mode of the recorder (MONO or STEREO). The settings should be determined as below and tabulated for reference.

7½ i.p.s.

Record a 1kHz sine wave at a level 6dB below the maximum modulation, adjusting the bias from −3dB to +3dB in ½dB steps. Replay the tape and note the amplitude of the output for each of the bias settings.

A series of results should be obtained which rise to a peak then fall off. The correct setting is that which gives a sensitivity ½dB (approximately 5 per cent) down from the maximum, i.e. slightly more bias than is required for maximum sensitivity (see Fig. 9).

continued on page 341



Photograph of the completed Tape Link. The meters are held on to the front panel by a strap which is shown

PE

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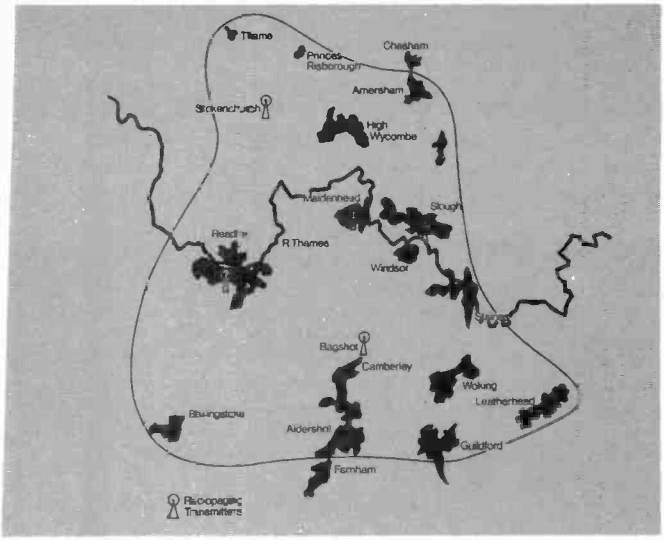
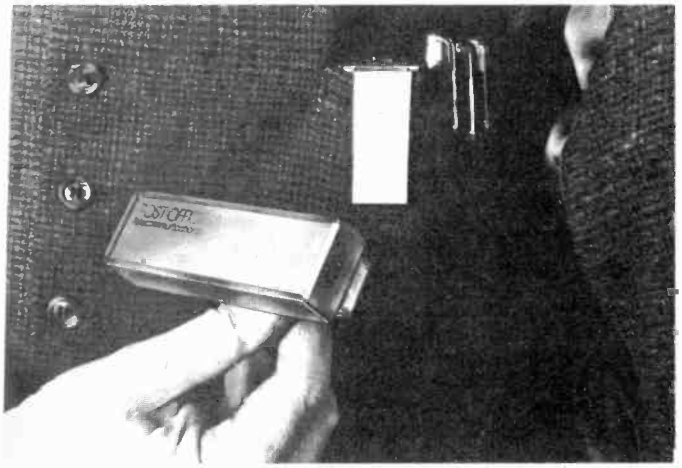
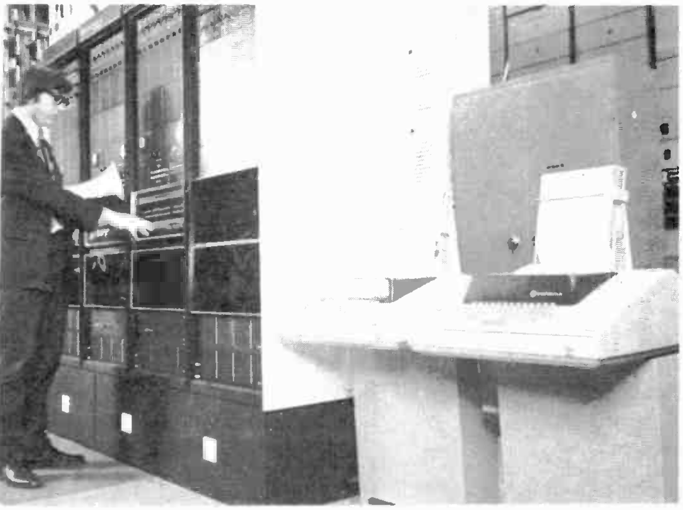


Area covered by the Post Office radio-paging service



One of the miniature pocket pagers

Computer control complex at Reading Trunk Exchange



Telephone Paging

WITH the aid of a new Post Office telephone paging system, the businessman, doctor, service engineer and many other people on call within a 500 square mile area of Reading can be easily contacted, even though their whereabouts is not known, simply by dialling a 10-digit telephone number.

The system consists of small "bleeper" pocket receivers; five f.m. transmitters, situated at Reading, Stokenchurch, Bagshot, Slough and Maidenhead; and computer-controlled terminal equipment at the Reading Trunk Exchange.

RECEIVERS

The receivers, small enough to be clipped into a pocket, give a high-pitched 10 second "bleep-bleep" signal when activated by a phone call. Powered by a 1·5V alkaline battery, each receiver will operate for approximately 900 hours, representing three months of average use.

The f.m. receivers are basically a double superhet built around six CMOS integrated circuit modules. Sensitivity is better than 10μV/m and reception is in the 150MHz band. Following detection, the paging tones are decoded by two plug-in active filter modules; 60 frequencies are employed in the range 288·5 to 1,433·5Hz and a two-tone sequence is used to provide a system usable by 3,540 customers. Later the system will cater for 100,000 customers.

Detection of the first coded tone switches the receivers on, reception of the second tone is decoded and once accepted will sound a 2kHz bleep note.

The only control on the receiver is a three position switch: "on", "off" and "memory". In the memory position, used when the person does not want to be disturbed, the incoming signal is stored in a CMOS bistable memory device and when the receiver is switched back to the on position the bleeper will emit its signal.

Each receiver has its own 10-digit number (the first four digits are an STD code common to all receivers) and dialling this number instructs the transmitting equipment to send a signal to activate the bleeper. Communication is one-way only, so the user must prearrange the action to be taken on receipt of a radio-paging call.

COMPUTER CONTROL

The heart of the system is a Digital Equipment, type PDP11, mini-computer with a basic storage capacity of 192,000 bits. Installed at the Reading Trunk Exchange, the computer receives the "telephone calls", converts them (by an interfacer between the telephone network and computer) into a binary-coded format.

The calls are queued and released in batches at 15 second intervals. When the number dialled is recognised and accepted an announcement to replace the telephone handset is given. Once accepted the call is converted to the pager code by the computer, and passed to a frequency synthesiser and then to the relevant transmitters.

The transmitters are switched by command signals from the control complex slightly ahead of the transmission of the pager-code modulation.

Although the system is only a feasibility study, plans have already been made to extend the service to other regions, such as London, Manchester and Birmingham.

More advanced pagers are already being developed and the present receivers are claimed to work inside buildings, cars and on trains. Engineers have, it is claimed, achieved more than a 95 per cent reception in the defined boundary limits.

The radio-paging receivers will cost £5 a month to rent, with an initial fee of £5. Call to a receiver will be free during the introductory service.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AD162 *pnp* germanium medium power	**40p**
AF139 *pnp* germanium UHF	**33p**

NPN: BC107 **13p**, BC108 **12p**, BC109 **13p**, BC167 **10p**, BC168 **9p**, BC169 **10p**.

PNP: BC177 **15p**, BC178 **14p**, BC179 **15p**, BC257 **9p**. BC258 **8p**, BC259 **9p**.
Standard groupings available.

BD135 *npn* medium power	**26p**
BD136 *pnp* medium power	**27p**

DIODES

OA90, OA91, OA95, **6p** each; OA200, **9p**; OA202, **10p**.

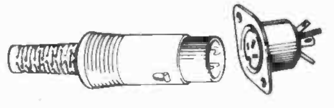
Other semiconductors: AC128, **17p**; AF117, **35p**; BFY51, **19p**. Full lists and technical data will be found in Catalogue No. 6.

SIEMENS' THYRISTORS
0·8A 400V **56p**, 600V **70p**.
3A 400V **60p**, 600V **88p**.

ZENER DIODES full range E24 values: 400mW: 2·7V to 36V, **14p** each; 1W: 6·8V to 82V, **21p** each: 1·5W: 4·7V to 75V, **48p** each. Clip to increase 1·5W rating to 3 watts (type 266F) **4p**.

DIN PLUGS AND SOCKETS

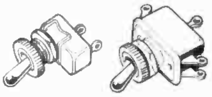
by Hirshmann, 4A rating



2 way LS —socket **10p**, plug **12p**
3 way scr.—socket **10p**, plug **12p**
5 way scr.—socket **11p**, plug **15p**

TRANSISTOR ACCESSORIES
TO3 cover, **7p**; Heat sinks 1°C/W, type 6W1. undrilled, **60p**.

SWITCHES

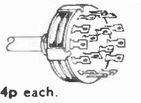


1011 SPST toggle, **20p**; 40S DPDT toggle, **29p** (these are chrome plated, 2·5A rating); 7201 sub-miniature DPDT 250V a.c./2A, **48p**.

ROTARY SWITCHES

Radiospares Miniature Maka-switch (in assembly kit form). Shaft, **48p**. Wafers, MBB-2P5W, 1P11W: BBM1P12W, 2P6W, 3P4W, 4P3W, 6P2W, **6p** each.

WAVECHANGE SWITCHES



1P12W, 2P6W, 3P4W, 413W, **24p** each.

ELECTROLYTIC CAPACITORS AXIAL LEAD

Rated voltage: Capacity μF	3V	6·3V	10V	16V	25V	40V	63V	100V
0·47	—	—	—	—	—	—	**7p**	**7p**
1·0	—	—	—	—	—	**7p**	—	**7p**
2·2	—	—	—	—	**7p**	—	**7p**	**7p**
4·7	—	—	—	**7p**	—	**7p**	**7p**	**7p**
10	—	—	**7p**	—	**7p**	**7p**	**7p**	**7p**
22	—	—	**7p**	**7p**	—	**7p**	**7p**	**8p**
47	**7p**	—	**7p**	**7p**	**7p**	**7p**	**8p**	**12p**
100	**7p**	**7p**	**7p**	**7p**	**7p**	**8p**	**12p**	**18p**
220	**7p**	**7p**	**7p**	**8p**	**9p**	**10p**	**17p**	**26p**
470	**7p**	**8p**	**9p**	**9p**	**12p**	**17p**	**24p**	**41p**
1,000	**9p**	**12p**	**12p**	**17p**	**20p**	**23p**	**40p**	—
2,200	**14p**	**16p**	**22p**	**25p**	**36p**	**40p**	—	—
4,700	**23p**	**26p**	**37p**	**40p**	—	—	—	—
10,000	**37p**	**40p**	—	—	—	—	—	—

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RESISTORS – 10%, 5%, 2%

Code	Power	Tolerance	Range	Values available	1 to 9	10 to 99 (see note below)	100 up
C	1/20W	5%	82 Ω–220K Ω	E12	**9**	**8**	**7·5**
C	1/8W	5%	4·7 Ω–470K Ω	E24	**1**	**0·9**	**0.75 nett**
C	1/4W	10%	4·7 Ω–10M Ω	E12	**1**	**0·9**	**0·75 nett**
C	1/2W	5%	4·7 Ω–10M Ω	E24	**1·2**	**1**	**0·8 nett**
C	1W	10%	4·7 Ω–10M Ω	E12	**2·5**	**2**	**1·6 nett**
MO	1/2W	2%	10 Ω–1M Ω	E24	**4**	**3**	**2 nett**
WW	1W	10% ± 1/20 Ω	0·22 Ω–3·9 Ω	E12	**7**	**7**	**6**
WW	3W	5%	1 Ω–10K Ω	E12	**7**	**7**	**6**
WW	7W	5%	1 Ω–10K Ω	E12	**9**	**9**	**8**

Codes: C = carbon film, high stability, low noise.
MO = metal oxide, Electrosil TR5, ultra low noise.
WW = wire wound, Plessey.
Values:
E12 denotes series: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82 and their decades.
E24 denotes series: as E12 plus 11, 13, 16, 20, 24, 30, 36, 43, 51 62, 75, 91 and their decades.

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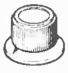
F14

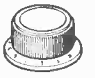


F13

F12

F19

F18



F17

KB4

K30/3

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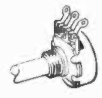
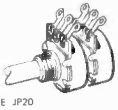
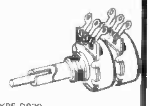
Rotary, carbon track, double wipe



TYPE P20



TYPE JP20



TYPE DP20

SINGLE P20 lin. 100 Ω to 2·2M Ω, **12p**; JP20 Log. 4·7K Ω, to 2·2M Ω, **12p**; **Dual gang** lin. 4·7K Ω to 2·2M Ω, **42p**; Dual log. 4·7K Ω to 2·2M Ω, **42p**; Log/antilog, 10K, 22K, 47K, 1M Ω only, **42p**; Dual antilog. 10K only, **42p.** Any type with 2A D.P. mains switch, **12p** extra.
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ELECTROVALUE

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Strictly

by K. Lenton-Smith

POPULAR MUSIC is a lucrative and highly competitive field these days and the net is cast to take in an even younger age group each year. Ten-year-olds now have their own idols! To be successful in the "pop" field involves a constant search for new sounds by electronic processes, especially as there is a practical limit to what can be done with the vocal if the lyrics are to remain intelligible. (Some readers may query the use of the word "intelligible" in this context!)

The Survey of Electronic Musical Instruments, published as a supplement to the November 1972 edition (issues unobtainable), showed how manufacturers are catering for this search for new tonal ideas. Though initially featured by recording artists, new effects are copied by local groups as they struggle to keep abreast of the times. Amateur musicians, who prefer "pop" music though never play publicly, like to re-create at home some of the sounds they hear on radio, tape and discs. The younger generation has always, as a tradition, looked for change and new experience, the popular music field being no exception. Over the years, the specification of available electronic musical instruments has taken this into account increasingly.

LIGHT MUSIC TODAY

A certain line in "Fings ain't wot they used to be", referring to the light music scene at that time, mentioned musicians "backing themselves with three chords only". When that song was written, there was an element of truth in Lionel Bart's cynicism: a number of performers only seemed able to strum the tonic, sub-dominant and dominant seventh chords on their highly-amplified guitars. This deficiency was often covered up by a show of vocal and physical gymnastics!

The advent of the Beatles brought more tuneful melodies and the use of less closely related chords. Though the Beatles, as a group, no longer exist they underlined the fact that, if a song is to survive, the melody must be original and tuneful. Many modern "pop" numbers will be forgotten a few months hence, but the Lennon and McCartney compositions have already taken their place with those of the established Old Masters such as George Gershwin, Cole Porter, Jerome Kern and Richard Rodgers.

Burt Bacharach is today's prime example of a composer who writes enjoyable music which will be remembered many years hence: Antonio Carlos Jobim is in the same category, specialising in the Latin-American field. The reader who plays their music, or attempts the transcriptions of Dave Brubeck or Dudley Moore, will appreciate that the days of "three chords only" have long passed and things certainly ain't what they used to be! These composers frequently use complex chord sequences which demand a high degree of musical ability to perform them.

Whereas our sphere of electronics—especially integrated circuitry—has enjoyed a spin-off from space research, classically trained musicians who have turned to lighter music have also benefited that field. The music for a number of West End shows running currently has come from composers with classical backgrounds, whilst we have previously commented on Walter Carlos, Robert Moog and the music for "Clockwork Orange".

RETROGRADE

Today's standard of compositions and the requisite musicianship in light music is higher than it was a generation ago. At the same time, the true standard of many electronic musical instruments has fallen. Manufacturers appear to be attempting to get the proverbial quart into a pint pot, especially where organs are concerned. Perhaps this is understandable where many instruments are sold to be installed in clubs, or other public places, where the audience expects a really professional performance—by their standards.

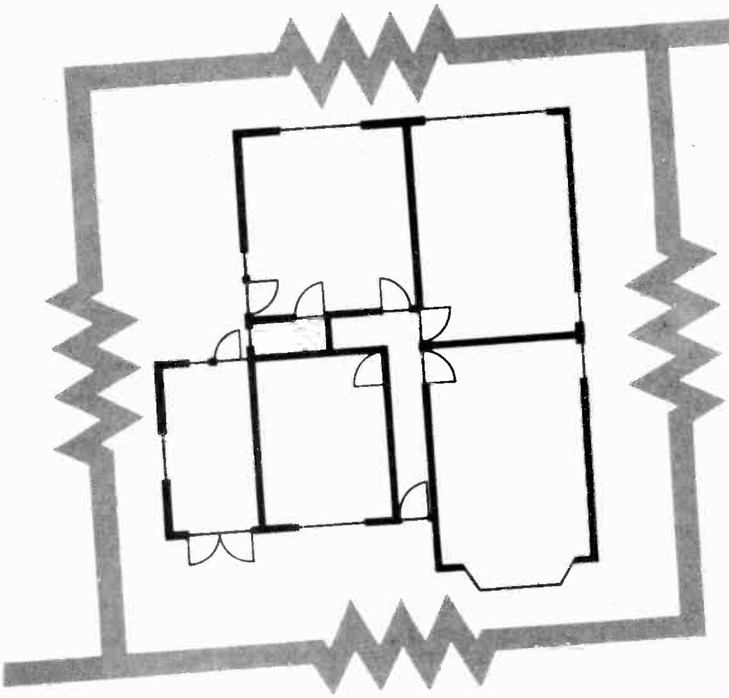
The organ studio demonstrator will show convincingly what a wonderful instrument you are about to purchase. It will no doubt have many extras such as a built-in rhythm unit, waa waa, percussion, arpeggiator, automatic chord unit, Leslie speaker, cassette tape recorder and perhaps a small synthesiser keyboard, to name but a few. Underneath all this, how much real organ is there? All these additions are expensive and the makers are probably working to a given price range, so something has to give.

The accompaniment manual is usually the victim, and the buyer is lucky if he is offered more than one pitch on that keyboard. We should perhaps remember that not all users of electronic organs are light music orientated or require the help of automatic chord/rhythm units. No serious organist would consider a single-pitch manual, or for that matter a short spinet manual of 44 notes and a set of stub-pedals. A number of users are primarlly interested in baroque music or are simply church organists who require a home organ for practice purposes which will produce conventional pipe-organ tonal quality.

SOUND SYNTHESISER

For those who wish to experiment with unusual effects, the synthesiser is ideal. Mr Shaw's P.E. Sound Synthesiser should prove to be a fascinating project for readers seeking new musical sounds: we hope it will also alert organ makers to the fact that organs should sound as such and not attempt to compete with the synthesiser. Both are separate and distinct musical devices with identities of their own.

Incidentally, readers who went to the Audio Fair to hear Mr Shaw's synthesiser last year might also have listened to some of the stereo demonstrations on various stands. One of the records used for this purpose was "Moog Indigo" (VSD 6549) featuring Jean Jacques Perrey, is recommended to those who like the Moog and can appreciate the performer's skill and have a strong sense of humour.



Simple All-Around

SECURITY ALARM

By J. Andrews

THIS alarm system was developed to protect the house and buildings remote from it, for example, garage, workshop, etc., which might be subject to burglary or vandalism. It can of course be used to protect all other types of property.

SEARCH LOOP SYSTEM

Many alarms use the search loop system in which the doors and windows have micro-switches fitted. The switches are wired in series and should any one switch be opened the circuit is broken. When the loop is connected to a simple alarm breaking the search loop will cause a bell or other device to sound. However, if the loop can be shorted out before the switches the alarm can be rendered inoperative.

This is particularly easy if the building protected is remote from the house as the search loop wires may be run back together and offer an opportunity for short circuit. Short circuits could be caused in a number of ways, by accident, fire or deliberately.

BALANCED BRIDGE

To overcome these problems a simple bridge was devised for the prototype security alarm as seen in Fig. 1.

Here, one arm is made up of the search loop wire resistance Rx. With the bridge balanced, that is, when Rx × R2 = R1 × R3, no voltage will appear at the alarm input points XY. If the search loop is made either open or short circuit, outputs will appear at these points but of opposing polarity.

POLARISING DIODES

To overcome this and to provide voltages of a single polarity for the open and short circuit conditions, a diode bridge was arranged so that any change of balance in the resistance bridge provides a negative going input to the alarm circuit as in Fig. 2.

In this, the finalised circuit of the Security Alarm, the resistance bridge is made up of R1, R2, R3, VR1 and the loop resistance Rx.

Arm resistances are made 150 kilohms so that the standing current is low. VR1 is included to balance any difference in the bridge arms and also provides a test facility as described later.

LATCH CIRCUIT

As the output resistance of the bridge is relatively high it is necessary to multiply the input impedance

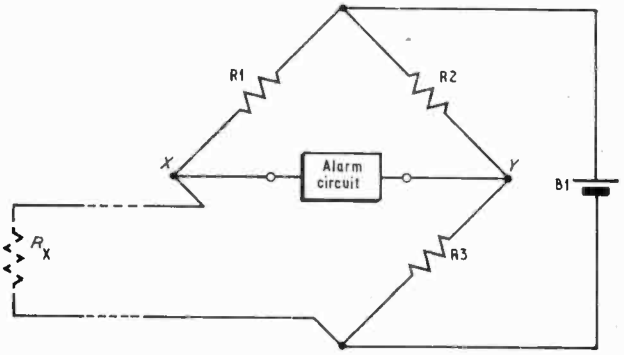
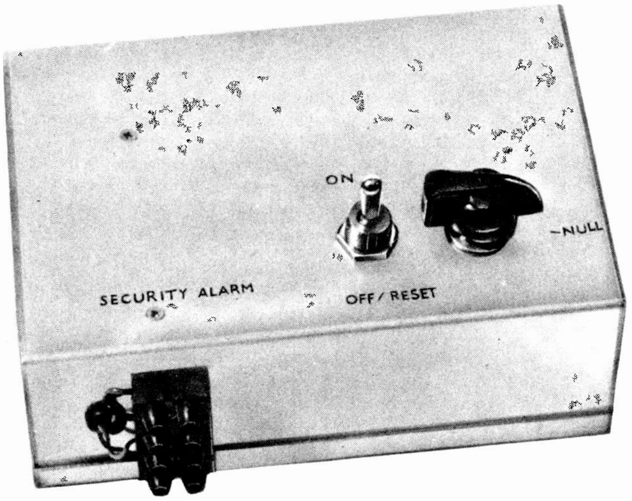


Fig. 1. Basic bridge system



The completed security alarm control unit

of any device connected across it. In the latch circuit this is achieved by connecting TR1 and TR2 as a Darlington pair.

TR2 output drives TR3 which is a higher power device suitable for driving a relay or lamp up to 800 milliamps when saturated.

Latching or hold on is achieved as follows. When TR3 is turned on by TR2 the collector voltage falls due to the drop across the relay and when TR3 is saturated is approximately 0·3V.

As TR3 collector goes negative, this turns TR2 on harder and positive feedback holds TR2 and TR3 in saturation regardless of input current to TR1.

The current to TR3 base is limited by R5. Once tripped the circuit will stay on until the supply is interrupted. C2 is included to ensure the circuit resets.

In the prototype a relay was used to switch on an external bell. It could also be used to turn on lights or activate other warning systems.

CONSTRUCTION

Most of the small components given in the circuit diagram can be assembled on a piece of 3in × 1½in Veroboard as is Fig. 3. When assembled and wired, 6in sleeved flying leads should be connected where indicated.

The choice of housing for the board and ancillary pieces was a 4in × 6in × 2½in standard aluminium chassis. First the mounting holes for VR1 are drilled together with those for the double-pole switch and Veroboard spacers.

With these items fitted interwiring can be completed as in Fig. 4.

TESTING

To test the assembled alarm connect up batteries B1 and B2 only and fit a 200 kilohm resistor across the loop terminal. If a high impedance multimeter is available connect across capacitor C1 as seen in Fig. 2.

Set the meter to the ten volt range, and switch the unit on. If now VR1 is rotated from end to end a null should be found.

If all is in order, connect B3 and switch on. The relay should stay out. If this is not so check that the null balance is correct.

Now rotate VR1 in a clockwise direction and the relay should pull in. If the null is now reset the relay should remain in.

Now reset the alarm by flicking switch S1 off and on, then rotate VR1 anticlockwise when the

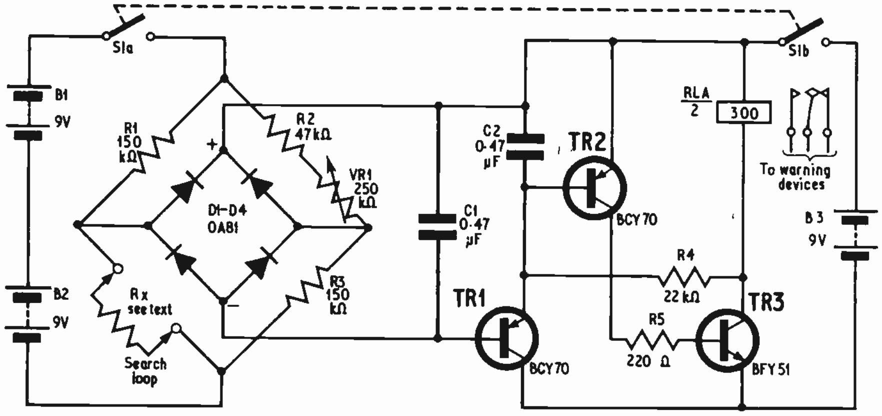


Fig. 2. Circuit diagram of the security alarm

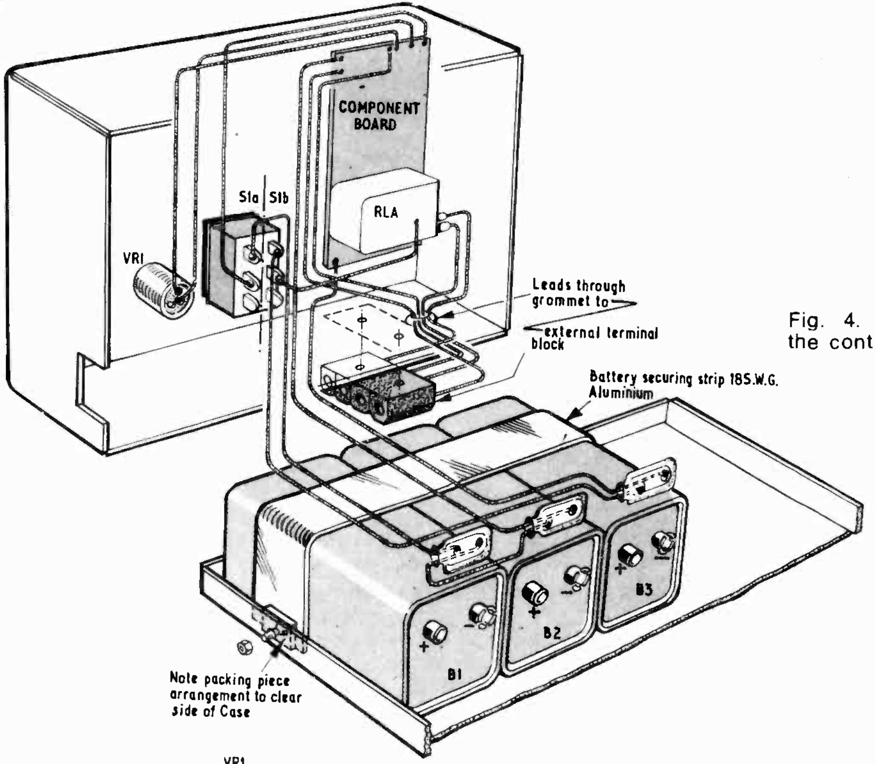


Fig. 4. Interwiring details of the control unit

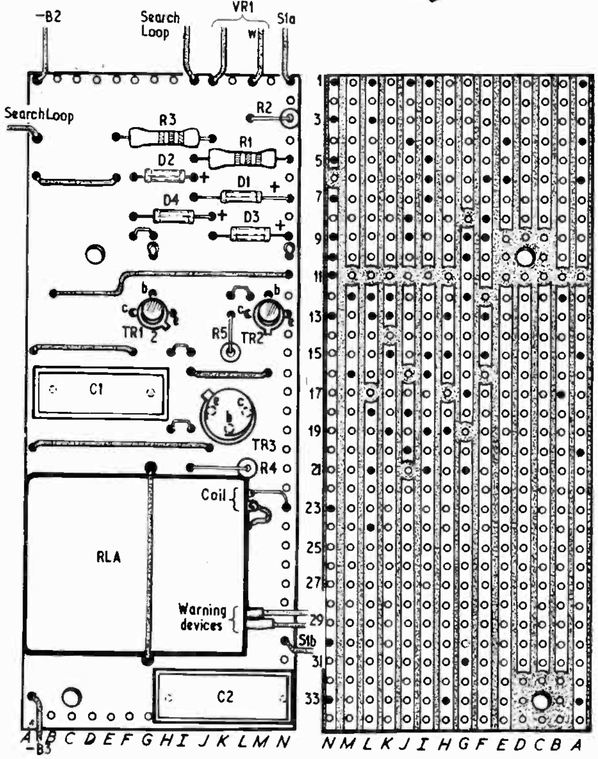


Fig. 3. Component board layout and wiring

COMPONENTS . . .

Resistors

R1	150k Ω	R4	22k Ω
R2	47k Ω	R5	220 Ω
R3	150k Ω		

All ½ watt 10% carbon

Capacitors

C1	0·47uF	C2	0·47uF

Potentiometer

VR1 250k Ω carbon lin.

Transistors

TR1–TR2 BCY70 (2 off) TR3 BFY51

Diodes

D1–D4 OA81 (4 off)

Switch

S1 Double-pole, single throw mains on/off

Relay

RLA 100–300 Ω coil, 6V with contacts to suit application

Miscellaneous

B1–B3 9V Vidor VT6 (3 off), aluminium chassis 4in × 6in × 2½in, Veroboard and wire to suit relay should again pull in. Return VR1 to null and reset the alarm with the switch.

Note that the relay cannot be reset unless VR1 is at null.

TESTING WITHOUT A METER

Disconnect R4 from the base of TR2 and connect a 200kΩ resistor across the loop terminals as before. Connect all batteries and switch on.

Rotate VR1 until the relay pulls in, then back off until the relay drops out. Note the point at which the relay pulled in.

Rotate VR1 in the opposite direction until the relay pulls in again, and note this point. The centre of the two points at which the relay pulled in is the null point of the bridge.

Reconnect R4 and check that when VR1 is rotated in either direction the relay pulls in and remains when VR1 is set to null.

FINISH

Once the instrument has been checked and the null and test points have been determined, Letraset may be used to apply a legend to the front panel. A coat of clear varnish will ensure the case stays bright.

INSTALLATION

As explained previously the search loop resistance must total 150kΩ–200kΩ. This is extremely high and any amount of wire used to make up the search loop will not affect this figure, therefore it is necessary to insert resistance in the form of two 100kΩ resistors in the loop

Arrangement of switches in the loop need not be confined to microswitches on doors and windows. Switches can be placed under carpets, etc., depending on the amount of security required. One further idea to protect windows apart from microswitches, is to fix a screen of fine copper with tape or clear varnish directly to the glass. This is included in the search loop; should the window be broken, the alarm will sound.

The alarm control unit would normally be installed in some part of the house, perhaps in a cupboard or concealed behind furniture. However, when siting the alarm, bear in mind the wires will have to run to parts of the house or outbuildings to be protected.

WARNING DEVICE

No actual warning device is shown as this will be governed by personal requirements, possibly only a warning light will be required, however the relay could turn on house lights or ring a large bell.

Once installed and assuming the alarm has been tested as above, no difficulty should be encountered. Before connecting the search loop check with an ohmmeter for continuity and correct resistance. Connect the search loop to the control unit and set VR1 to null; switch on the alarm and check that both shorting and open-circuiting the search loop cause the alarm to operate.

When in use periodically check the alarm by rotating VR1 first clockwise and then anticlockwise. In both cases the alarm should sound. This forms a test of battery condition. Batteries should operate the unit for their shelf life. ★

HI-FI TAPE LINK

continued from page 332

3¾ i.p.s.

Repeat as for 7½ i.p.s. using a test frequency of 500Hz.

1⅞ i.p.s.

As for 7½ i.p.s. but using 250Hz.

The bias must be determined separately for mono and stereo modes.

PRE-EMPHASIS

Adjustment of the pre-emphasis gives a maximally flat overall frequency response.

7½ i.p.s.

Apply an input signal from a signal generator at 15·4kHz and adjust L1 until peak output is obtained at the output of the replay amplifier (junction of R11 and R13). Next set the generator frequency to 4kHz and record at a level of −10dB. Replay the tape and note its output as this is to be used as a reference.

Reset the frequency to 15·4kHz and make another recording leaving the level control untouched. Note the playback level and then make successive recordings adjusting VR1 to give a playback level at 15·4kHz which is ½dB greater than at 4kHz. The overall response should now be reasonably flat. However, a check should be made at a number of points between 4kHz and 15·4kHz adjusting VR1 so that the undulations in the response curve lie equally about the 4kHz figure.

Then repeat this procedure for the other channel.

3¾ i.p.s.

Record a 800Hz reference level once again at −10dB. Set the generator to 9·6kHz and repeat the above procedure but this time adjusting VR2 then VR102.

1⅞ i.p.s.

In this case a 200Hz reference level is used at −10dB. The generator is set initially to 6·0kHz and VR3 then VR103 are set up as above.

MODIFICATIONS

Readers wishing to save the expense of two meters can parallel the outputs of the meter drive amplifiers into one storage capacitor. The meter will then show the larger of the two input signals.

If this design is to be used with the P.E. Gemini amplifier then it is advisable to fit attenuators to the input and output sockets. This allows reasonable use of the gain control to be made when recording and on playback gives an output consistent with the input sensitivity of the Gemini. ★

Correction: In the first part (March 1973) Figs. 2b and 2c should be transposed.

PE Digi-Cal

By R.W.COLES

PART 10

M COUNTER BOARDS

THIS month's article deals with the M(COUNTER) boards which are the last of the arithmetic unit plug-in cards to be described.

M COUNTER FUNCTION

The basic system used to enable the MULTIPLICATION and DIVISION operations to be carried out was described in Part 1, where it was mentioned that the successive additions and subtractions carried out were counted in a counter circuit.

It is this counter which is housed on the two identical M boards, together with the COMPARATOR circuit required during MULTIPLICATION to register an equality between the count and the contents of the E REGISTER.

BLOCK DIAGRAM

A block diagram of the COUNTER/COMPARATOR circuits and their related data paths is shown in Fig. 10.1, which can be placed in context by reference to the overall system block diagram, Fig. 1.3 of Part 1.

The counter itself consists of a serial string of six, four-bit, decade counter units which have a maximum count capacity of 999999.

The COUNTER can be cleared or preset by appropriate control signals from the programme, and is triggered by the PLUS/MINUS COMPLETE signal from board CB, which is produced during each addition and subtraction.

The six, four-bit, B.C.D. outputs from the counter are fed to the comparator circuit and also to the A REGISTER into which they can be entered at the end of a DIVISION sequence as required.

When the COMPARATOR registers an equality between the count and the E REGISTER contents during a multiplication, it sets a latch which produces the COMPARATOR EQUAL signal, which in turn stops the arithmetic clock.

Before a MULTIPLICATION sequence, the EQUALS LATCH is cleared by a signal from the PROGRAMME.

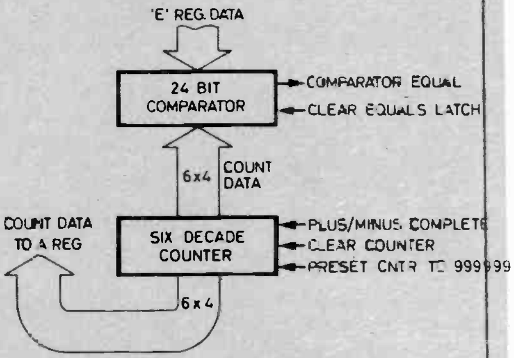
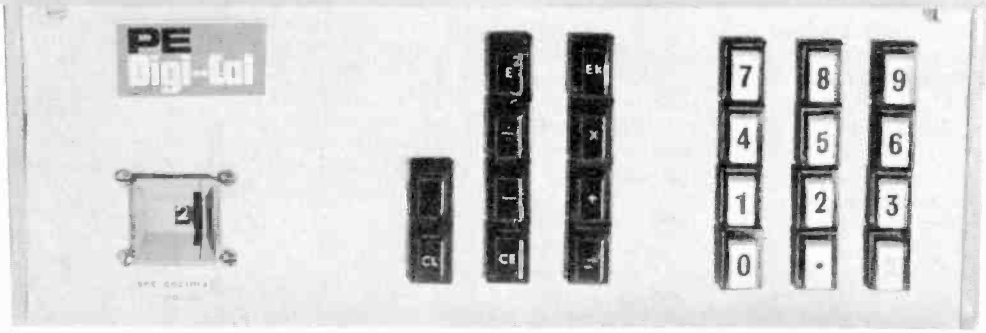


Fig. 10.1. Block diagram of the COUNTER/COMPARATOR circuits and their related data paths



PARTITIONING

A six decade counter and comparator requires too many i.c.s, even when using M.S.I. devices, for it to be housed on a single DL109 card, so the circuit is split into two identical sections, each comprising a three decade counter and a commensurate amount of comparator circuitry. This is described more fully in Fig. 10.2.

Only one EQUALS LATCH is required, but in practice a latch is incorporated on each board to ensure interchangeability, which is an advantage in fault finding, and initial testing.

The latch in use is determined by the external edge connector wiring, no connection being made to the latch inputs and outputs on the board in the M2 position.

FULL CIRCUIT

The full circuit of one of the M COUNTER boards is shown in Fig. 10.3. The counter chain is easily identified as IC's 123, 124 and 125 which are SN7490 devices connected to count in a B.C.D. code by connection on the A output to the B input.

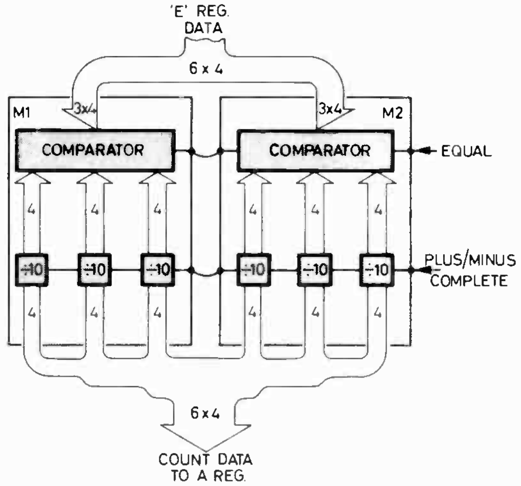


Fig. 10.2. Partitioning of the COUNTER/COMPARATOR between the two M boards

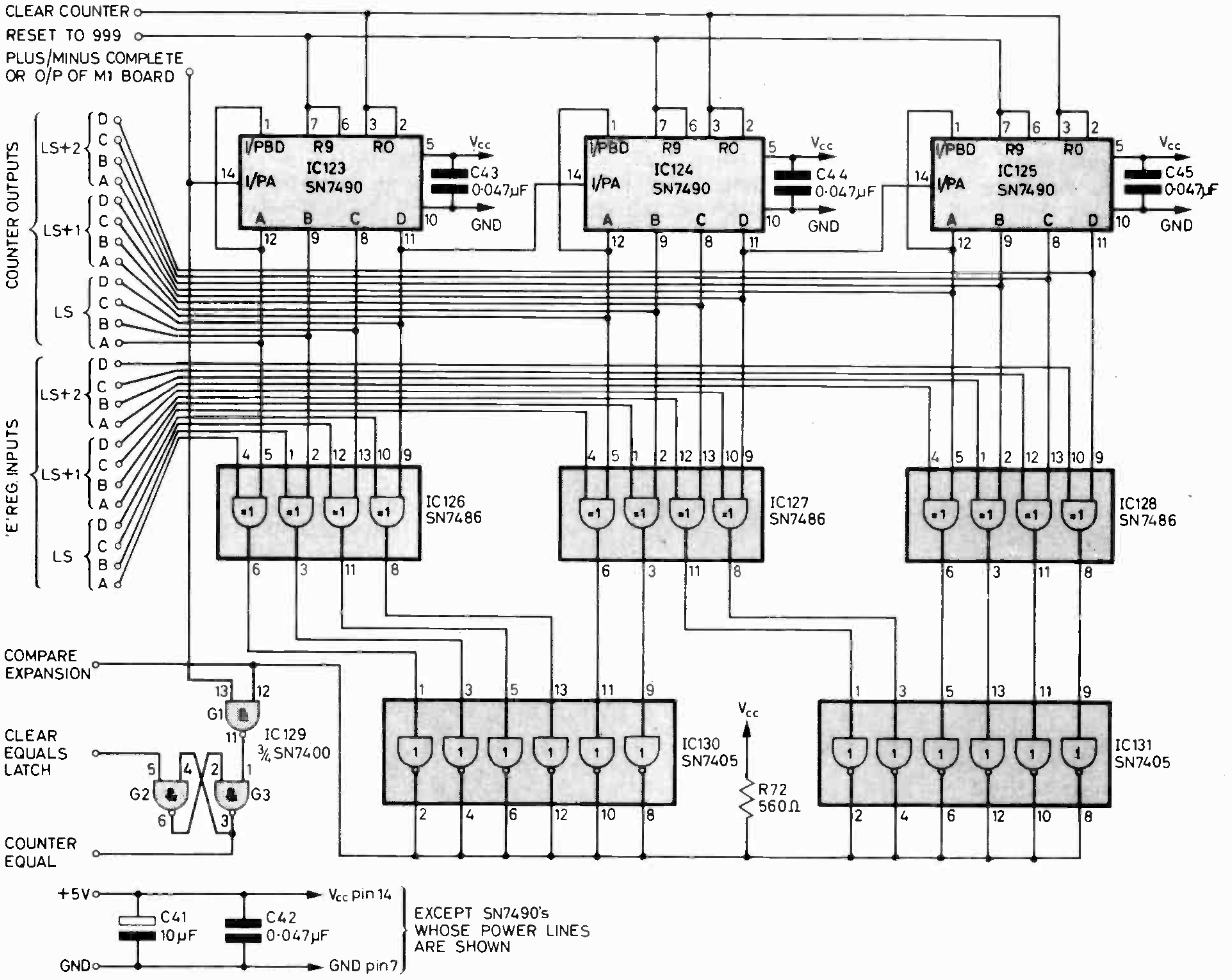


Fig. 10.3. Circuit diagram of one of the M boards. The other board is identical to this, both being built on DL109/44 boards

The count input to the board comes either from the PLUS/MINUS COMPLETE line (in the case of M1) or from the LS+2, D output of board M1 (in the case of M2).

Each of the SN7490 devices has a decoupling capacitor connected between its power supply lines, in addition to the two standard board decoupling capacitors C41 and C42.

LINE DRIVING

Special precautions are necessary for absolute integrity of the count, without false triggering or commutation, because the ABCD counter outputs are taken off the board as inputs to the A REGISTER.

Line driving from counters in this way can cause problems due to the high peak current required to charge the stray capacitance of the line during a 0 to 1 transition. Having an extra reservoir of charge available directly across the i.c. power pins goes a long way toward preventing the mistriggering problems which could result.

COUNTER PRESETS

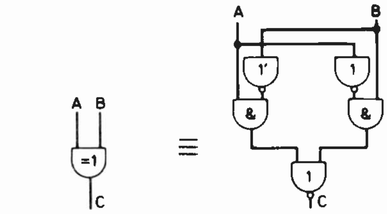
The RESET 0 (R0) and RESET 9 (R9) inputs to the SN7490 set the COUNTER outputs to 0000 or 1001 respectvely.

The R0 inputs are connected together to form the CLEAR COUNTER line, controlled by the PROGRAMME, and the R9 inputs together make up the RESET to 999 line.

As mentioned in Part 1, it is necessary to preset the M COUNTER to 999999 before a division so that the final number of subtractions counted when the A REGISTER contents go negative and stop clock generation, is not the full number of subtractions performed, but the full number minus one.

Setting the count to 999999 is the same as starting to count from minus one, since on the first PLUS/MINUS COMPLETE pulse, the count will change to 000000, the number registered by the counter always being one behind the true number of subtractions performed.

During MULTIPLICATION the true number of additions performed has to be counted—the PROGRAMME ensuring this by energising the CLEAR COUNTER input and not the RESET to 999 input.



POSITIVE LOGIC
(NON-EQUIVALENCE)

A	B	C
0	0	0
1	0	1
0	1	1
1	1	0

NEGATIVE LOGIC
EQUIVALENCE

A	B	C
0	0	1
1	0	0
0	1	0
1	1	1

Fig. 10.4. Equivalent logic for an EXCLUSIVE-OR gate and truth tables for both positive and negative logic conventions

COMPONENTS . . .

Resistors

R72, R73	560Ω ¼W ±10% (2 off)

Capacitors

C41, C46	10μF 15V elect. (2 off)
C42–45, C47–50	0·047μF (8 off)

Integrated Circuits

IC123–125, IC132–134	SN7490 (6 off)
IC126–128, IC135–137	SN7486 (6 off)
IC129, IC138	SN7400 (2 off)
IC130, IC131, IC139, IC140	SN7405 (4 off)

Printed Circuit Boards

Type DL109/44 Shirehall (2 off)

In each case components are divided equally between the two M boards

COMPARATOR

The COUNTER as described is all that is needed to allow the DIVISION operation to take place, but during MULTIPLICATION comparison of the count with the E REGISTER contents is required.

The COMPARATOR is made up of the remaining i.c.s on each board and is concerned solely with detecting the equality of E REGISTER and COUNTER outputs so that a control signal can be produced to stop the clock at this point.

The 24 bits of E REGISTER data and the 24 bits of COUNTER data are individually compared on a one-to-one basis in a series of 24 EXCLUSIVE-OR gates formed from six SN7486 packages, housed three to a board.

EQUIVALENCE GATE

The SN7486 package is a member of the M.S.I. family and is described as a quad EXCLUSIVE-OR gate in TTL literature. The very useful EXCLUSIVE-OR function has its own logic symbol, but is in fact made up of a series of simpler gates, as has its own logic symbol, but is in fact made up of a series of simpler gates, as shown in Fig. 10.4.

Readers may recognise the equivalent logic as being simply the common AND-OR-INVERT function together with a couple of inverters to produce the NOT version of the A and B inputs.

The reason for the EXCLUSIVE-OR name becomes obvious when the basic (positive logic) truth table is examined. The output from the gate is a logic 1 if either input A OR input B is a logical 1 but *not* if both are logical 1's.

This response is that of a non-equivalence gate since a logic 1 output is produced only when the inputs are different, but the situation is changed when the gate is examined in operation as a negative logic system, as the second truth table demonstrates.

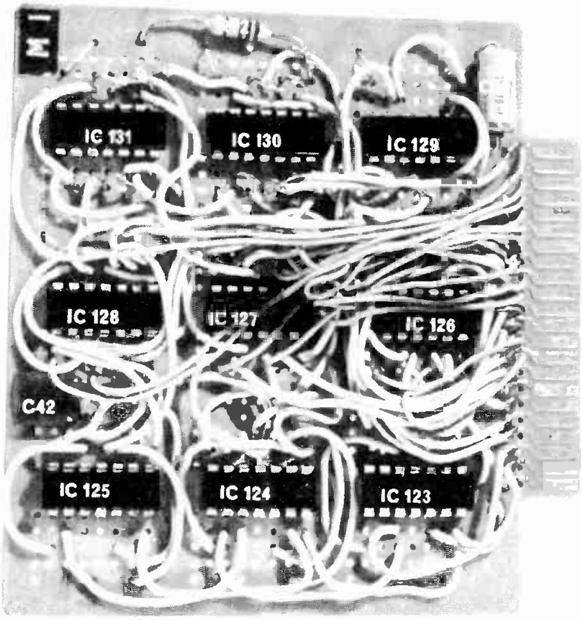
NEGATIVE LOGIC

In the second truth table we can see that when a low voltage is interpreted as a logic 1, rather than as a logic 0, the output of an SN7486 gate is a logic 1 when the inputs are identical, giving the equivaence function.

M COUNTER BOARDS

M1

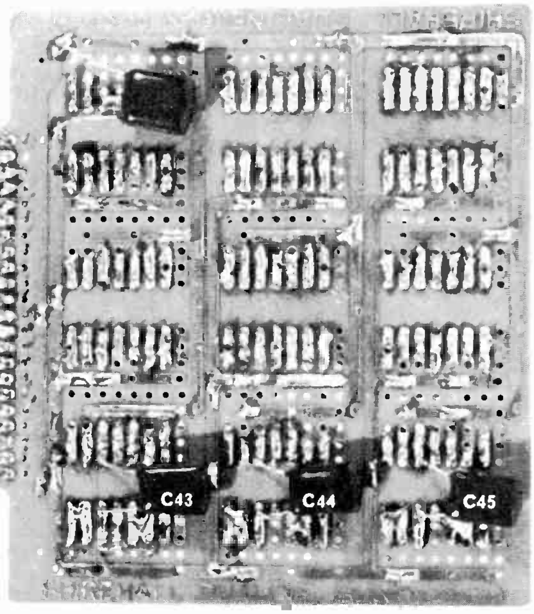
M2/1	1	23	A2/35
not used	2	24	A2/36
not used	3	25	A1/35
not used	4	26	A1/36
E2/35, M2/22	5	27	A2/37
E2/36	6	28	A2/38
E2/37	7	29	A1/37
E2/38	8	30	A1/38
E1/29	9	31	A2/39
E1/30	10	32	A2/40
E1/31	11	33	GND
E1/32	12	34	+5V
E1/35	13	35	A1/39
E1/36	14	36	A1/40
E1/37	15	37	not used
E1/38	16	38	not used
CB/31	17	39	not used
not used	18	40	not used
CL LATCH (fr prog)	19	41	not used
CL CNTR (fr prog)	20	42	not used
RESET to 999 (fr prog)	21	43	not used
CB/41	22	44	not used



1	COMPARE EXPANSION		
2	not used		
3			
4			
5	D	LS + 2	E REG INPUTS
6	C		
7	B		
8	A		
9	D	LS + 1	
10	C		
11	B		
12	A		
13	D	LS	
14	C		
15	B		
16	A		
17	COUNTER EQUAL		
18	not used		
19	CL EQUALS LATCH		
20	CL CNTR		
21	RESET to 999		
22	COUNT INPUT		

Layout of components on upper side of M COUNTER board, and interconnection details of the M1 edge connector. See Fig. 6.9 for disposition of edge connectors

CNTR OUTPUTS	LS + 2	D	23
		C	24
		B	25
		A	26
	LS + 1	D	27
		C	28
		B	29
		A	30
	LS	D	31
		C	32
		GND	33
		+5V	34
	LS	B	35
		A	36
		not used	37
		not used	38
		not used	39
		not used	40
		not used	41
		not used	42
		not used	43
		not used	44



M2

M1/1	1	23	A2/27
not used	2	24	A2/28
not used	3	25	A1/27
not used	4	26	A1/28
E3/29	5	27	A2/29
E3/30	6	28	A2/30
E3/31	7	29	A1/29
E3/32	8	30	A1/30
E3/35	9	31	A2/31
E3/36	10	32	A2/32
E3/37	11	33	GND
E3/38	12	34	+5V
E2/29	13	35	A1/31
E2/30	14	36	A1/32
E2/31	15	37	not used
E2/32	16	38	not used
not used	17	39	not used
not used	18	40	not used
not used	19	41	not used
CL CNTR (fr prog)	20	42	not used
RESET to 999 (fr prog)	21	43	not used
M1/5	22	44	not used

Layout of capacitors on underside (ignore unmarked capacitor) and interwiring details of M2 socket

To disbelievers, all this talk of switching logic conventions to suit the circumstances can be confusing, and really it is only a convenient way of looking at things.

In practical terms, the output of an SN7486 gate will go low when its inputs are identical, so to determine when all 24 gates have low outputs, i.e. when M equals E, we need a 24 input NAND gate which responds to negative logic inputs.

NEGATIVE LOGIC NAND GATE

No such gate is available in the standard TTL range, but if it were, it would be listed as a NOR gate because TTL is described in the positive logic convention.

All is not lost however since by using an open-collector inverter connected in the input of each SN7486, and then joining all the open collectors through a single common resistor to V_{CC}, i.e. by performing the WIRED-OR function at their outputs, a negative logic NAND gate of virtually unlimited size can be formed (Fig. 10.5).

The way a gate operates is fairly straightforward: if all SN7486 outputs are low, i.e. if M equals E, then the output of all inverters will be high, and the common resistor ensures a high voltage output.

If any one or more of the SN7486 outputs is high, however, one or more of the inverter outputs will go low and pull the common output to a low level.

INVERTERS

The inverters used on the M boards are type SN7405, which have the required open collector output circuitry. Note that the SN7404 devices are not suitable for use in this position due to their standard totem-pole outputs.

Although only one "pull-up" resistor is required for the full 24 inverters, electrically speaking in fact a separate resistor is used on each board to allow the boards to operate autonomously when required.

The inverter outputs from the two boards are united by means of the COMPARE EXPANSION input/output line, so that the two resistors are effectively in parallel.

LATCH FUNCTION

When an equality is registered by the comparator, the common output line rises to a high level and this signal is used to set the simple latch flip-flop made from cross-coupled SN7400 gates G2 and G3.

Setting the latch is carried out via another gate G1, which is controlled by the clock input line to the first SN7490. In practice this line will carry the PLUS/MINUS COMPLETE waveform, since only the latch on the M1 board is wired into circuit.

The reason for this gated latch input circuit is explained in Fig. 10.6, which shows the PLUS/MINUS COMPLETE waveform from the COUNTER board.

The SN7490 counters are triggered from the negative going signal, but because these devices operate in the ripple count mode, there will be a significant count propagation delay time down the chain which can and will lead to transient spurious outputs from the COMPARATOR gating.

Using the PLUS/MINUS COMPLETE signal to gate the COMPARATOR output prevents the spurious outputs from setting the EQUALS LATCH until count propagation is complete, since G1 is enabled by the positive going edge of the waveform.

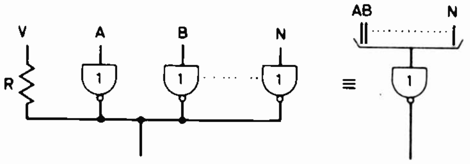


Fig. 10.5. The use of inverters to form a 24 input NOR gate

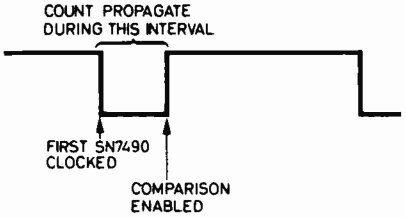


Fig. 10.6. PLUS/MINUS COMPLETE waveform from the COUNTER board

EQUALITY

When a genuine state of equality exists between the COUNTER and E REGISTER the latch is set, energising the COUNTER EQUAL line which in turn stops the supply of clock pulses to the A, Z and ADDER boards.

Before a further MULTIPLICATION sequence is initiated, the PROGRAMME clears the EQUALS LATCH ready for a new comparison.

CONSTRUCTION

Construction of the two M boards follows the by now familiar pattern, two DL109/44 cards being used. All wiring should be kept as short as possible whilst avoiding "bird's nests".

Speed problems decrease by a factor of ten for each stage of the COUNTER meaning in effect that only the first stage could be a problem in this respect. For this reason it is best to select which board is to be installed in the M1 position during test calculations, since the first stage of one board might perform better than the other at speed.

TESTING

The M boards are easy to check in isolation if required, but if the recommended sequence of construction has been followed and the calculator is operational on ADD/SUBTRACT, it is easier to test the boards in situ, using the MULTIPLY/DIVIDE programmes—but more of this next month.

Next month: E^2 Logic, Error Detection and Testing

MAIL ORDERS: Some items have a postage and handling charge shown against them. Where p. & p. is not shown the charge is 13p for any selection. When both classes of goods are ordered the charge is 13p plus any p. & p. charges shown. (Overseas extra). Telephone 01-692 4412.

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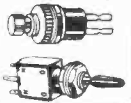
Wafer switches
(rotary)—26½p each
SW4—1 pole, 12 way
SW5—2 pole, 6 way.
SW6—3 pole, 4 way.
SW7—4 pole, 2 way.
SW8—4 pole, 3 way



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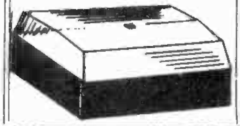

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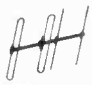

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for constructional projects. White, with lid and screws.
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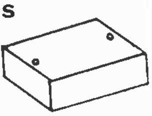

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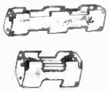
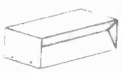


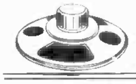
EQUIPMENT CASES

in plain aluminium with sloping front panel.

Type	H.	W.	D.	Price	p. & p.
SF1	2in	5¾in	2½in	50p	13p
SF2	2in	7¾in	3½in	66p	17½p
SF3	2in	9¾in	4½in	83p	20p



MINIATURE SPEAKERS



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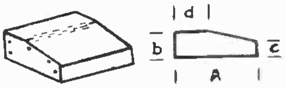
GB21	10	9	3½	2	3	£1·74	33p
GB22	12	9	3½	2	3	£1·89	33p



ALUMINIUM BOXES

with lids and screws

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GB8*	4in	4in	1½in	42p	16p
GB9*	4in	2¾in	1½in	42p	14p
GB10*	5¼in	4in	1½in	49p	19p
GB11	4in	2½in	2in	42p	14p
GB12	3in	2in	1in	36p	15p
GB13	6in	4in	2in	57p	20p
GB14	7in	5in	2½in	69p	21p
GB15	8in	6in	3in	89p	29p
GB16	10in	7in	3in	£1·00	29p

* These sizes fit standard veroboards

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Complete with cable and stereo jack plug.
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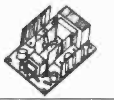

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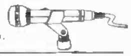

MICROPHONE HOLDER

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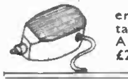

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2·2μF	63V	7p	150μF	63V	15p
3·3μF	63V	7p	220μF	4V	7p
4·7μF	63V	7p	220μF	10V	7p
6·8μF	40V	7p	220μF	16V	8p
6·8μF	63V	7p	220μF	25V	13p
10μF	25V	7p	220μF	40V	15p
10μF	63V	7p	220μF	63V	22p
15μF	16V	7p	330μF	4V	7p
15μF	40V	7p	330μF	10V	8p
15μF	63V	7p	330μF	16V	13p
22μF	10V	7p	330μF	63V	26p
22μF	25V	7p	470μF	6·3V	8p
22μF	63V	7p	470μF	10V	13p
33μF	6·3V	7p	470μF	25V	15p
33μF	16V	7p	470μF	40V	22p
33μF	40V	7p	680μF	6·3V	13p
47μF	4V	7p	680μF	16V	15p
47μF	10V	7p	680μF	25V	22p
47μF	25V	7p	680μF	40V	26p
47μF	40V	7p	1000μF	4V	13p
47μF	63V	8p	1000μF	10V	15p
68μF	6·3V	7p	1000μF	16V	22p
68μF	16V	7p	1000μF	25V	26p
68μF	63V	13p	1500μF	6·3V	15p
100μF	4V	7p	1500μF	10V	22p
100μF	10V	7p	1500μF	16V	26p
100μF	25V	7p	2200μF	6·3V	22p
100μF	40V	8p	2200μF	10V	26p
100μF	63V	15p	3300μF	6·3V	26p
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150μF	16V	7p			

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D.I.N. 5 pin, 180°	14½p
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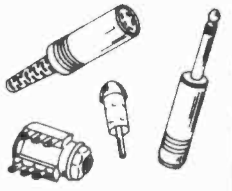
Jack, 2½mm unscreened	10p
Jack, 2½mm screened	11p
Jack, 3½mm unscreened	9p
Jack, 3½mm screened	13p
Jack, ¼in unscreened	13p
Jack, ¼in screened	22p
Jack, stereo, unscreened	22p
Jack, stereo, screened	38p
Phono, plastic top	5½p
Phono, plated metal	13p
Wander, red or black	3½p
Banana 4mm, red or black	6½p



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D.I.N. 5 pin, 240°	17½p
Jack, 3½mm	16½p
Jack, ¼in screened	54p
Jack, stereo, screened	37p
Phono, plated metal	15½p

SOCKETS

Car aerial	9p
Co-axial, surface	9p
Co-axial, flush	10p
D.I.N. 2 pin (speaker)	11p
D.I.N. 3 pin	10p
D.I.N. 5 pin, 180°	10p
D.I.N. 5 pin, 240°	10p
Jack, 2½mm	11p
Jack, 3½mm	11p
Jack, ¼in unswitched	16½p
Jack, ¼in switched	18½p
Jack, stereo, switched	26p
Phono, single	5½p
Phono, 2 on a strip	7½p
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2μF	450V	22p	2000μF	25V	43p
4μF	350V	15½p	2000μF	50V	58p
8μF	450V	18½p	2500μF	25V	50p
16μF	450V	20p	2500μF	50V	66p
25μF	25V	7½p	3000μF	25V	53p
25μF	50V	11p	5000μF	25V	66p
32μF	450V	30p	5000μF	50V	£1·21
50μF	50V	11p	8–8μF	450V	20p
100μF	50V	12p	8–16μF	450V	22p
250μF	25V	15½p	16–16μF	450V	30p
250μF	50V	19p	16–32μF	450V	69p
500μF	25V	20p	32–32μF	450V	54p
500μF	50V	27½p	50–50μF	350V	42p
1000μF	25V	30p			

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Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. 10 transistors plus 3 diodes. Fine tone moving coil speaker. Ganged tuning condenser with VHF section. Separate coil for Aircraft Band. Volume/on/off, wave change and tone controls. Attractive case in black with silver blocking. Size 9in × 7in × 4in.

Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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P.P. & INS. 50p (OVERSEAS P. & P. £1)

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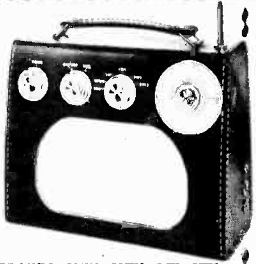

NOW WITH VARIABLE TONE CONTROL

7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Built-in ferrite rod aerial for MW and LW. Retractable chrome plated telescopic aerial for short waves. Push-pull output using 600mW transistors. Car aerial and tape record sockets. Selectivity switch. 8 transistors plus 3 diodes. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning, wave change and tone controls. Attractive case in rich chestnut shade with gold blocking. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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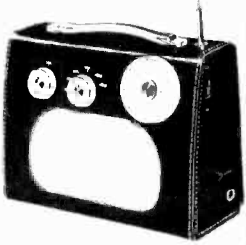

7 TUNABLE WAVEBANDS: MW1, MW2, LW, SW1, SW2, SW3 AND TRAWLER BAND. Extra medium waveband provides easier tuning of Radio Luxembourg, etc. Built-in ferrite rod aerial for MW and LW. Retractable 4 section 24in chrome plated telescopic aerial for SW. Socket for car aerial. Powerful push-pull output. 7 transistors and 2 diodes, including micro-alloy R.F. transistors. Fine tone moving coil speaker. Air spaced ganged tuning condenser. Volume/on/off, tuning and wave change controls. Attractive case with carrying handle. Size 9in × 7in × 4in approx. Easy to follow instructions and diagrams. Parts price list and easy build plans 25p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

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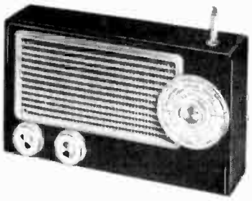

6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, TRAWLER BAND PLUS AN EXTRA MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages— 6 transistors and 2 diodes including micro-alloy R.F. transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2¾in approx. Easy build plans and parts price list 25p (FREE with parts).

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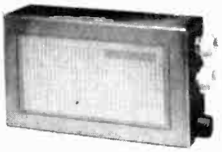
POCKET FIVE



3 TUNABLE WAVEBANDS: MW, LW, TRAWLER BAND WITH EXTENDED MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 5¼in × 1¼in × 3½in. Easy build plans and parts price list 10p (FREE with parts).

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TRANSONA FIVE

5 TRANSISTORS AND 2 DIODES

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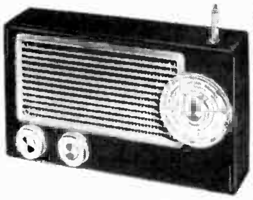

8 TRANSISTORS AND 3 DIODES

6 TUNABLE WAVEBANDS: MW, LW, SW1, SW2, SW3 AND TRAWLER BAND. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9in × 5¼in × 2¾in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker. Parts price list and easy build plans 25p (FREE with parts).

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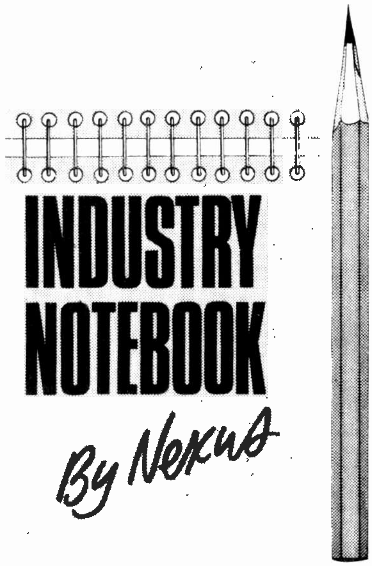


INDUSTRY NOTEBOOK

By Nexus

FIRST AWARDS

The Society of Radio and Electronic Technicians, now almost 6,000 strong, has awarded its first three Honorary Fellowships. Proud recipients were Lord Orr-Ewing, Edwin Spreadbury and Kenneth Tempest, all of whom have played a major role in establishing the Society.

The awards were made at a dinner in The Cholmondeley Room, House of Lords, with this year's SERT president, James Redmond, director of engineering BBC, in the chair. Among the distinguished guests were Sir Eric Eastwood, chief scientist and director of research GEC, and Sir Cyril English, director general of the City and Guilds of London Institute.

Of the three Honorary Fellows it was probably "Spread" who enjoyed the distinction most keenly for it was he who helped in the formation of the Radio Trades Examination Board back in 1941 and, later, as chairman of RTEB, he was instrumental in founding SERT of which he became first chairman.

Lord Orr-Ewing, top man in Ultra Electronics, was first president of SERT in 1966 and gave influential support. Immediate past chairman Kenneth Tempest had the satisfaction of seeing membership pass the 5,000 mark during his term of office.

SERT has not wavered in its policy of insisting on good qualifications for members and thus has helped raise the status of technicians and brought them into the professional class of employment.

The properly qualified electronic technician engineer deserves his professional status and quite clearly the work of SERT and the IEETE (which caters more broadly for the electrical technician engineer although many members are in electronics) is important in establishing a better business and industrial status for members.

MAGIC MILLION

A million pounds is a nice round figure for turnover—indeed a magic figure to aim at for those with the guts to go it alone without benefit of shelter from working within a big group.

Bill Coates, top man in Leicester-based component distributor Townsend-Coates gets his taste of magic this year. He started up in 1961 with a first year sales turnover of £2,500, largely to local concerns. Now he has a staff of 46, stocks 16,000 different items from nearly a dozen manufacturers and sells on a nation-wide basis.

Two go-it-aloners who are working on the magic million, although still with some way to go, are Ray Vincent and Jim Griffith. In 1966 they took over ailing Plastronics Ltd., at Watford, a moulding and sub-assembly shop serving the electronics industry. Staff today is 40 after a move to new premises in 1969 and, says Jim, it will be necessary to make another move for expansion before long.

Among the more important customers for Plastronic moulded products are Garrard, BSR, British Radio Corporation, Lotus cars and Scammell lorries. The computer industry is also a big customer.

EXHIBITION NEWS

The first commercial full scale exhibition and conference on Automatic Testing Equipment—fastest growing sector of the instrument industry—will take place at the popular Metropole Convention Centre, Brighton, opening on November 26. Stands are already being booked by leading manufacturers and a call for papers has gone out.

Microwave 73, also at the Metropole is a sell-out. It will be opened officially on June 19 by His Royal Highness the Duke of Kent in his capacity as a member of the National Electronics Council and a Companion of the IERE.

Sir Gerald Narbarro is to hop over to the USA to open Coil Winding-Chicago 73 organised by British-based Electromation Exhibitions Ltd. and opening on March 27. Sir Gerald is first president of the International Coil Winding Association.

The International London Electronic Components Show opening at Olympia on May 22 is to have 350 exhibitors. Biggest stand is occupied by a consortium of French companies who are clearly determined to cash in on the opportunities of the enlarged EEC.

The Soviet Union will be showing valves, passive components and test gear through British agents Z & I Aero Services. Previous showings of Russian components both in the UK and France have left me totally unimpressed—perhaps there will be more of interest this year.

BIPOLAR PROCESS

Plessey's Bipolar Process III technology for integrated circuits has now moved from pilot production at the Allen Clark Research Centre at Caswell, to full production at the main semiconductor plant at Swindon.

Whole families of new devices have been planned and with higher speeds now available a new range of applications has been opened up. Among the first commercially available products are high speed dividers capable of accepting an input of 1·2GHz, and a range of logic circuits compatible with Motorola's MECL III range. Selected variants, say Plessey, have a considerable performance gain over standard MECL III.

The production technique uses an epitaxial layer only 4 microns thick with emitter-base and base-collector junctions well under a micron deep. This is obviously not a cheap process but every milestone on the path to improved performance must exact its price.

HALF CENTURY

Eddystone Radio is approaching its 50th birthday with record growth and a firmer policy than it has had for years. Eddystone's Big Three, managing director Dick Carroll, chief engineer Bill Cooke, and sales manager Ken Wilkins are now dedicated to total solid state equipment and minimum production targets of 10,000 receivers on any new models.

The last of the Eddystone valve receivers, the popular 830, has been delivered and is being superseded by the new solid state 1830 range of general purpose receivers which have already won full approval from the British and a number of other PTT administrations.

During a visit to Eddystone's Birmingham works, I was told that the 958 Series of high-stability receivers, of which over 1,000 have now been delivered, is now available in nine versions. What has given Eddystone this flexibility in production is a big switch to modular construction and this has also had its effect on manufacturing and testing methods.

Designing with Integrated circuits

BY A.FOORD

7 Counters and Displays

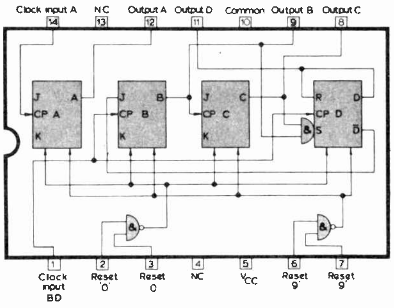
WE HAVE spoken in general about digital instrumentation and counters and this month will consider how the counters can be constructed. We will first examine in detail the individual integrated circuits used in a typical decade counter.

SN7490N DECADE COUNTER

The SN7490N consists of four master-slave bistables internally interconnected to provide a divide-by-five and a divide-by-two counter. There are also gated direct reset lines to inhibit the count inputs and return all the outputs to a logical 0 or binary coded decimal (BCD) count of nine.

The output from the first bistable is not internally connected to the next stage, and so three different count modes are possible, Fig. 7.1.

1. The BD input is externally connected to the A output, and the A input receives the incoming count. A count sequence is obtained as shown in the truth table. The outputs can be reset to a conventional zero or to a BCD count of nine for nines complement decimal applications.
2. Where a symmetrical divide-by-ten count is required (the previous arrangement divides by ten, but not symmetrically) the D output is connected to the A input. The input count is applied to the BD input and a divided-by-ten symmetrical square wave is obtained at the A output. The circuit thus divides by five first and then by two.
3. For divide-by-two and divide-by-five operations the two counters can be used independently. Bistable A is used to divide-by-two while the BD input is used to obtain a divide-by-five operation at the B, C, and D outputs. However the



MODE 1 BCD			
A	B	C	D
0	0	0	0
1	0	0	0
0	1	0	0
1	1	0	0
0	0	1	0
1	0	1	0
0	1	1	0
1	1	1	0
0	0	0	1
1	0	0	1

MODE 2 SYMMETRICAL÷10			
A	B	C	D
0	0	0	0
0	1	0	0
0	0	1	0
0	1	1	0
0	0	0	1
1	0	0	0
1	1	0	0
1	0	1	0
1	1	1	0
1	0	0	1

MODE 3 ÷5		
B	C	D
0	0	0
1	0	0
0	1	0
1	1	0
0	0	1

Fig. 7.1. The three count modes possible with the SN7490N

BINARY CODED DECIMAL

A binary numbering system for coding decimal numbers in groups of four bits. The binary value of these four-bit groups ranges from 0000 to 1001 and codes the decimal digits 0 to 9. To count to 9 takes four bits, to count to 99 takes two groups of four bits, etc.

RESET

Also called clear. It is an input which makes the output go to a desired state, usually 0 or 9.

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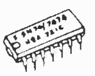

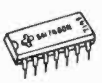

Type	1/11 p	12/24 p	25/99 p
SN7400	0·20	0·18	0·16
SN7401	0·20	0·18	0·16
SN7402	0·20	0·18	0·16
SN7403	0·20	0·18	0·16
SN7404	0·20	0·18	0·16
SN7405	0·20	0·18	0·16
SN7406	0·30	0·27	0·25
SN7407	0·30	0·27	0·25
SN7408	0·20	0·19	0·18
SN7409	0·45	0·42	0·35
SN7410	0·20	0·18	0·16
SN7411	0·23	0·22	0·20
SN7412	0·42	0·40	0·35
SN7413	0·30	0·27	0·25
SN7416	0·30	0·27	0·25
SN7417	0·30	0·27	0·25
SN7420	0·20	0·18	0·16
SN7422	0·48	0·44	0·40
SN7423	0·48	0·44	0·40
SN7425	0·48	0·40	0·35
SN7427	0·42	0·39	0·35
SN7428	0·50	0·45	0·42
SN7430	0·20	0·18	0·16
SN7432	0·42	0·39	0·35
SN7433	0·70	0·61	0·44
SN7437	0·65	0·60	0·50
SN7438	0·65	0·60	0·50
SN7440	0·20	0·18	0·16
SN7441AN	0·75	0·72	0·70
SN7442	0·75	0·72	0·70
SN7443	1·00	0·95	0·90
SN7445	2·00	1·75	1·60
SN7446	2·00	1·75	1·60
SN7447	1·75	1·60	1·45
SN7448	1·75	1·60	1·45
SN7450	0·20	0·18	0·16
SN7451	0·20	0·18	0·16
SN7453	0·20	0·18	0·16
SN7454	0·20	0·18	0·16
SN7460	0·20	0·18	0·16
SN7470	0·30	0·27	0·25
SN7472	0·30	0·27	0·25
SN7473	0·40	0·37	0·35
SN7474	0·40	0·37	0·35
SN7475	0·55	0·52	0·50
SN7476	0·45	0·42	0·39
SN7480	0·80	0·75	0·67
SN7481	1·25	1·15	1·10
SN7482	0·87	0·80	0·70
SN7483	1·00	0·90	0·85
SN7484	0·90	0·85	0·80
SN7486	0·45	0·41	0·38
SN7490	0·75	0·70	0·65
SN7491AN	1·00	0·95	0·90
SN7492	0·75	0·70	0·65
SN7493	0·75	0·70	0·65
SN7494	0·80	0·75	0·70
SN7495	0·80	0·75	0·70
SN7496	1·00	0·97	0·95
SN7497	6·25	5·50	5·00
SN74100	2·50	2·30	2·00
SN74104	1·45	1·35	1·20
SN74105	1·45	1·35	1·20
SN74107	0·50	0·45	0·40
SN74110	0·80	0·70	0·60
SN74118	1·00	0·95	0·90
SN74119	1·90	1·78	1·65
SN74121	0·60	0·55	0·50
SN74122	1·35	1·25	1·10
SN74123	2·70	2·55	2·47
SN74141	1·00	0·95	0·90
SN74145	1·50	1·40	1·30
SN74150	3·35	2·95	2·15
SN74151	1·10	0·95	0·90
SN74153	1·35	1·27	1·20
SN74154	2·00	1·75	1·55
SN74155	1·55	1·47	1·35
SN74156	1·55	1·47	1·35
SN74157	1·80	1·70	1·50
SN74160	2·60	2·40	2·25
SN74161	2·60	2·40	2·25
SN74162	3·40	3·25	2·70
SN74163	3·40	3·25	2·70
SN74164	2·75	2·30	2·10
SN74165	4·00	3·50	3·00
SN74166	4·00	3·50	3·00
SN74167	6·25	5·60	5·10
SN74170	4·10	3·55	3·05
SN74174	2·00	1·75	1·30
SN74175	1·35	1·27	1·15
SN74176	1·60	1·35	1·20
SN74177	1·60	1·35	1·20
SN74180	1·55	1·30	1·20
SN74181	7·00	6·00	5·50
SN74182	2·00	1·80	1·60
SN74184	2·40	2·00	1·80
SN74185A	2·40	2·00	1·80
SN74190	1·95	1·85	1·75
SN74191	1·95	1·85	1·75
SN74192	2·00	1·90	1·80
SN74193	2·00	1·90	1·80
SN74194	2·50	2·25	1·90
SN74195	1·85	1·70	1·60
SN74196	1·50	1·40	1·30
SN74197	1·50	1·40	1·30
SN74198	4·60	3·70	3·35
SN74199	4·60	3·70	3·35

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AC127	25p
AC128	25p
AC176	25p
AC187	25p
AC188	25p
ACY17	30p
ACY20	20p
ACY21	20p
ACY39	55p
AD140	50p
AD149	50p
AD161	35p
AD162	35p
AF117	20p
AF118	50p
AF124	25p
AF139	30p
AF186	40p
AF239	40p
ASY27	30p
ASY28	25p
BA102	30p
BA115	7p
BA145	15p
BAX13	5p
BAX16	7p
BC107	10p
BC108	10p
BC109	10p
BC109C	12p
BC113	15p
BC117	20p
BC143	35p
BC147	12p
BC169C	12p
BC182	10p
BC214	15p
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BCY34	35p
BCY39	1·00
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BSY27	15p
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BY100	15p
BY126	15p
BY127	15p
BYZ13	35p
C106D	65p
GET111	55p
GET115	55p
GET880	45p
LM309K (T03)	1·87
MAT121	25p
MJE340	50p
MJE370	70p
MJE520	75p
MJE2955	1·10
MJE3055	75p
MPF105	40p
NKT214	20p
NKT216	40p
NKT217	40p
NKT403	70p
NKT404	50p
OA5	50p
OA10	35p
OA81	10p
OA91	7p
OA200	7p
OA202	10p
OC16	75p
OC20	95p
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OC71	15p
OC72	25p
OC77	45p
OC81	25p
OC83	25p
OC140	55p
OC170	25p
OC171	30p
OC200	45p
OC201	75p
OC202	80p
OC203	50p
OCP71	1·25
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ORP60	40p
P346A	20p
RAS310AF	45p
RAS508AF	55p
TAA263	75p
TIL209	39p
TIP29A	50p
TIP30A	60p
TIP31A	60p
TIP32A	70p
TIP33A	1·00
TIP34A	1·50
TIP35A	2·50
TIP36A	3·00
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TIP42A	85p
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V405A	25p
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ZTX341	20p
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ZTX503	17p
2G301	30p
2N404	20p
2N527	35p
2N696	15p
2N697	15p
2N706	10p
2N930	20p
2N987	45p
2N1131	25p
2N1132	25p
2N1302	18p
2N1304	22p
2N1305	22p
2N1307	25p
2N1308	25p
2N1613	20p
2N1671	1·00
2N2147	75p
2N2160	59p
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2N2221	20p
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2N2906	20p
2N2926 (all cols)	10p
2N3053	20p
2N3054	50p
2N3055	55p
2N3440	75p
2N3442	1·25
2N3525	75p
2N3614	59p
2N3615	75p
2N3702	10p
2N3704	10p
2N3705	10p
2N3714	1·80
2N3771	1·75
2N3773	2·00
2N3790	2·25
2N3819	35p
2N3820	50p
2N3866	85p
2N3903	15p
2N3906	12p
2N4061	12p
2N4062	12p
2N4126	15p
2N4871	35p
2N5457	30p
2N5777	55p
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Metal Case
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25+	18p
100+	16p
500+	12p
1000+	10p

Any one type.

3 Watt Plastic
Wire Ends 5%
3EZ Range

All voltages
6·8 – 100 Volts
30p each.

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1 amp miniature		
IN4001	50	6
IN4002	100	7
IN4003	200	8
IN4004	400	8
IN4005	600	10
IN4006	800	12
IN4007	1000	15
1·5 amp miniature		
PL4001	50	8
PL4002	100	9
PL4003	200	10
PL4004	400	10
PL4005	600	12
PL4006	800	15
PL4007	1000	16

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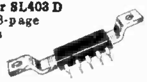

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SC35B	200	79p
SC35D	400	85p
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SC40A	100	85p
SC40B	200	90p
SC40D	400	£1·00
SC40E	500	£1·20
10 AMP RANGE (TO48)		
SC45A	100	95p
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3 Amp
T048


15 Amp
T048

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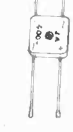
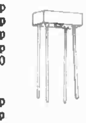
BO5/10	100	25p
ONE AMP ¼ × ¼ H TUBULAR		
B1/05	50	25p
B1/10	100	25p
B1/20	200	30p
B1/60	600	35p
ONE AMP (G.I.) TUBULAR		
W005	50	30p
W01	100	35p
W02	200	40p
W06	600	45p
TWO AMPS ¼ H × ¼ L × ⅛		
B2/05	50	35p
B2/100	100	40p
B2/200	200	45p
B2/600	600	50p
B2/1000	1000	60p
FOUR AMPS ¼H × ¼L × ⅛		
B4/100	100	60p
B4/200	200	65p
B4/400	400	70p
B4/600	600	75p
B4/800	800	£1·00
SIX AMPS ¼H × ¼L × ⅛		
B6/100	100	70p
B6/200	200	75p
B6/400	400	90p
B6/600	600	£1·00

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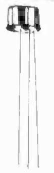
CRS 1/10	100	30p
CRS 1/20	200	30p
CRS 1/40	400	35p
CRS 1/60	600	45p
THREE AMP (TO48)		
CRS 3/05	50	30p
CRS 3/10	100	30p
CRS 3/20	200	35p
CRS 3/40	400	45p
CRS 3/60	600	55p
FIVE AMP (TO66)		
CRS 5/400	400	60p
SEVEN AMP (TO48)		
CRS 7/100	100	60p
CRS 7/200	200	65p
CRS 7/400	400	70p
CRS 7/600	600	95p
SIXTEEN AMP		
SCR 16/100	100	65p
SCR 16/200	200	70p
SCR 16/400	400	80p
SCR 16/600	600	£1·00


1 Amp
T05


3 Amp
T048

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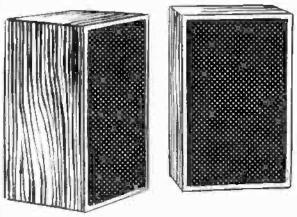
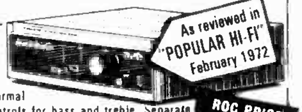


R.088 MATCHED STEREO LOUD SPEAKERS. Here's real value in stereo speakers! Each unit comes complete with 10-foot lead and phono plug, and look really smart. Power handling per speaker: 4 watts rms, 8 watts peak. Frequency range: 40-16,000 Hz. Flux density: 8,500 gauss. Impedance: 8 ohms. Dimensions: 9" high, 5½" wide, 4¾" deep. Finish: oiled walnut.

ROC PRICE £9·50 pair.

Normal Price £10 75



As reviewed in "POPULAR HI-FI" February 1972

ROC PRICE £35.20

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REALISTIC 30 WATT STEREO AMPLIFIER MODEL SA-500

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ROC PRICE £31.20

Normal Price £50·00

OLSON RA-310 AM/FM/MPX STERED TUNER

This ROC Tuner is especially designed to match the Olson AM-395 Stereo Amplifier. In price and value, as well as it's good looking design! But of course it's also ideal for use with any other amplifier. The RA-310 costs £10 00 less than the normal retail value, and yet it is a highly sophisticated unit, incorporating the latest solid state techniques. Operation is drift free for supreme station-holding capability. You can connect this Tuner to a stereo amplifier, to a tape deck or a tape recorder. And of course it covers all the stations in the AM and FM bands. FM: 87-108 MHz; AM: 525-1605 kHz. FM Sensitivites: FM, 3µV; AM, 250µV. Stereo separation 30dB at 1kHz, image rejection 60dB. Size: 11$\frac{7}{16}$" wide, 4" high, 7½" deep.

ROC PRICE £12.45

Normal Price £21·00

REALISTIC SA-100B 6-WATT STEREO AMPLIFIER

Here's fabulous, exciting value in miniature! This high quality stereo amplifier measures only 9" wide × 3" high × 5⅜" deep. And yet it has separate ganged volume, balance and tone controls. Plus speaker in/out, mono/stereo, phono/tuner and power on/off slide switches. The ends are oiled walnut, with matching enamelled metal top. The front panel is satin aluminium and walnut-brown enamel. Frequency response is 50 to 10,000 Hz ± 3dB. Output 3 watts r.m.s. per channel into 8 ohms. Inputs are 100mV for both phono and tuner.

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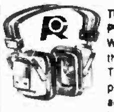

TEC HR-007 HEADPHONE RADIO

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Normal Price £7·65 **ROC PRICE £5·00**

EAGLE LC.07 STEREO MOVING-MAGNET CARTRIDGE

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ROC PRICE £6·37

ROC PRICE £24.10

Normal Price £39·60

OLSON AM-395 40-WATT STEREO AMPLIFIER

An ideal unit for your new stereo separate system. It is more than £10 00 below the normal retail price! Making the AM-395 one of Britain's best hi-fi buys. It takes in signals from magnetic or ceramic pick-ups, tuners (see Olson RA-310) and tape decks. And it's got outputs for taping and for headphones. There are separate bass and treble controls, separate Left and Right channel volume controls. And a loudness switch for boosting the bass and treble notes when listening at low output levels. Frequency response: 20-20,000 Hz ± 3dB. Output: 20 watts r.m.s. per channel into 8 ohms. Inputs: magnetic phono 3·0mV RIAA, crystal phono 100mV, tape 160mV; tuner 100mV. Size 11$\frac{7}{16}$" wide, 4" high, 7½" deep. The specification reads well – sounds even better!

ROC PRICE £28.00

Normal Price £35·70

A-3000 36-WATT SOLID STATE STEREO AMPLIFIER

The A-3000 looks as good as it sounds! Giving you a big performance this superb audio amplifier has a full range of facilities on the front and rear panels. On the front – all the controls you're ever likely to need plus a headphone socket. On the rear – signal inputs, speaker outputs and a line fuse for circuit protection.

Specifications: 18 watts rms per channel into 8 ohms. Frequency response 20-35,000 Hz (± 2db) Inputs Magnetic, Ceramic, Tuner, Tape, Aux, Tape Play. Size: 345mm × 300mm × 130mm.

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R.446 3-WAY MATCHED SPEAKERS

These will do justice to your amplifier – and to your pocket. At only £20·00 a pair, they are real value-for-money. Each cabinet is heavily lagged and teak finished. They handle 16 watts rms (8 watts rms each). Each loudspeaker contains a 6½" base unit plus tweeter. Frequency range: 40 to 19,000 Hz. Size 14" high, 9" wide, 6¼" deep.

ROC PRICE £10.50

Normal Price £15·70

OLSON AM400 4-WATT STEREO AMPLIFIER

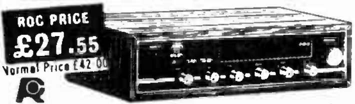
Here's marvellous value for someone just starting to set themselves up in audio! At only £10·50, you get a fine amplifier in a scratch resistant metal cabinet, with a smart brushed aluminium front panel. It incorporates separate tone and volume controls for each channel. Inputs are provided for turntable (ceramic cartridge), tuner and tape deck or recorder. Frequency response: 70-20,000 Hz ± 3dB. Output: 2 watts r.m.s. per channel into 8 ohms. Inputs: phono 80mV; tunar/aux 80mV. Size 8" wide, 2½" high, 4½" wide.

ROC PRICE £27.25

Normal Price £39·95 each.

25-WATT 3-WAY CRYSLER 'LIVING AUDIO' SPEAKER CE-56

This high quality speaker has its own built-in 3-way sound response switch, giving you the ideal frequency response for hi-fi, natural or mood music listening. Its beautiful, heavy, oiled walnut cabinet incorporates two separate speaker units an 8" woofer, and a 5" mid-range with 2" concentric tweeter. Power handling capacity: 25 watts r.m.s into 8 ohms. Overall frequency response: 35-20,000 Hz. Cabinet size: 10½" × 7½" × 8¾". Exactly right for matching the most modern decor.



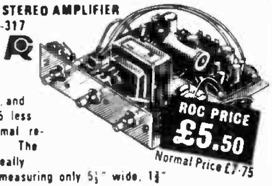
ROC PRICE £27.55

Normal Price £42·00

PALACE AM/FM/MPX STEREO TUNER AMPLIFIER SSA-18

This is one of the lowest priced stero tuner amplifiers on the market. It covers the full range of both AM and FM broadcast frequencies. And when you're switched to FM, an indicator lights up when a stereo signal is received – that's the time to switch to 'Stereo'! The SSA-18 has all the facilities you'd expect to find on tuners costing twice as much – separate volume, bass, treble, balance and tuning controls. Selector switch for tape, phono, AM, FM, stereo. Jack socket on front panel for stereo headphones. Frequency range: FM 88-108 MHz, AM 535-1605 kHz. Frequency response: 50-10,000 Hz ± 3dB. Power output: 4 watts total music power into two 8 ohm speakers. Size: 16" wide, 4½" high, 8" deep.

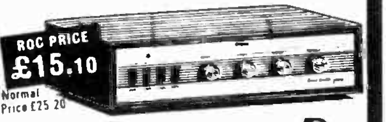
ROC 7-WATT STEREO AMPLIFIER CHASSIS SK-317



ROC PRICE £5.50

Normal Price £7·75

This exclusive ROC Stereo Chassis is completely self-contained, and it costs £2·25 less than the normal retail value! The SK-317 is a really compact unit measuring only 5½" wide, 1¾" high and 6¾" deep. It contains its own mains power supply, and has a ganged volume control and separate treble controls for each channel. Specification: frequency response 40-17 000 Hz ± 3dB; output 3 5 watts music power per channel into 8 ohms; input, phono, 600mV; signal-to-noise ratio better than 45dB.



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OLSON AM-372 16-WATT STEREO AMPLIFIER

Here's a really good amplifier at a really down-to-earth price – nearly £7 less than the normal retail value! Just look at what the AM-372 will do for you – reproduce signals from ceramic or crystal cartridges, AM and FM tuners, and tape recorders. And it gives you outputs for two sets of speakers, headphones and tape recorders. Frequency response is 30 to 20,000 Hz ± 3dB. Output 3 watts r.m.s. per channel music power into 8 ohm speakers. Phono input 200mV. Tuner input 200mV. Size: 12¼" wide, 3¼" high, 7½" deep.

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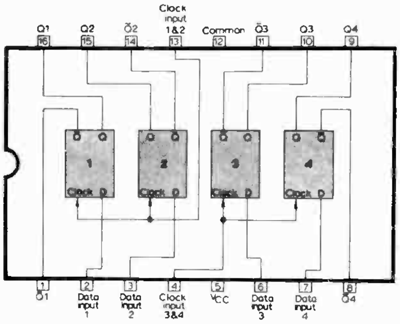
SN7475N QUADRUPLE BISTABLE LATCH

The SN7475N is a bistable latch which is used as a temporary store for binary information, Fig. 7.2. Information which is present at a data input (D) is transferred to the Q output while the clock is high. The Q output follows the data for as long as the clock is high but the last information is retained at the data output when the clock goes low.

SN74141N DECODER-DRIVER

The SN74141N is one of several decoder-drivers available in the TTL range and is designed to drive



TRUTH TABLE (Each Latch)	
t_n D	t_{n+1} Q
1	1
0	0

Fig. 7.2. The SN7475N quadruple bistable latch (t_n = bit time before clock negative-going transition, t_{n+1} = bit time after clock negative-going transition)

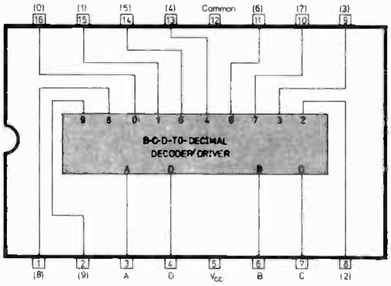


Fig. 7.3. The SN74141N decoder-driver for cold cathode indicators

TRUTH TABLE

INPUT				OUTPUT ON
D	C	B	A	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	NONE
1	0	1	1	NONE
1	1	0	0	NONE
1	1	0	1	NONE
1	1	1	0	NONE
1	1	1	1	NONE

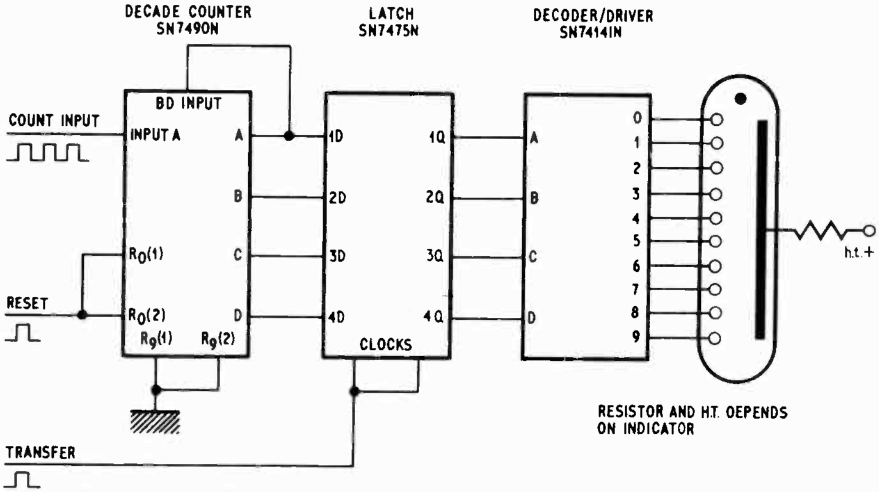


Fig. 7.4a. A typical counting module

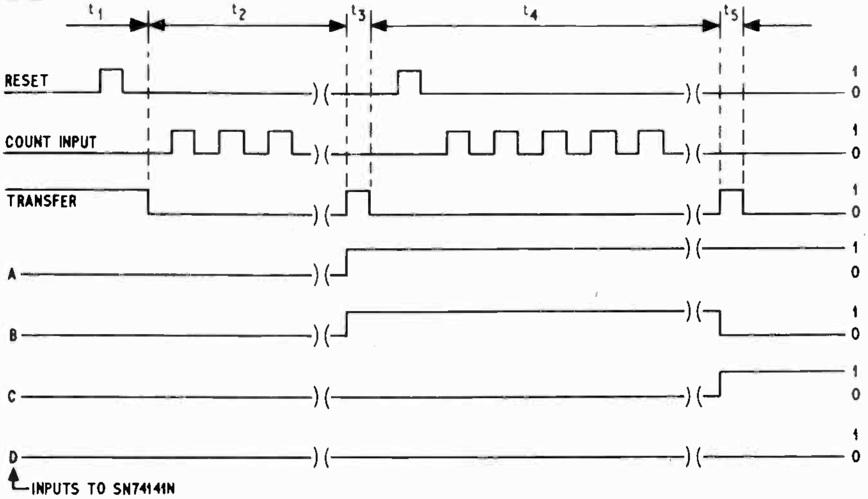


Fig. 7.4b. Typical waveforms in the circuit above

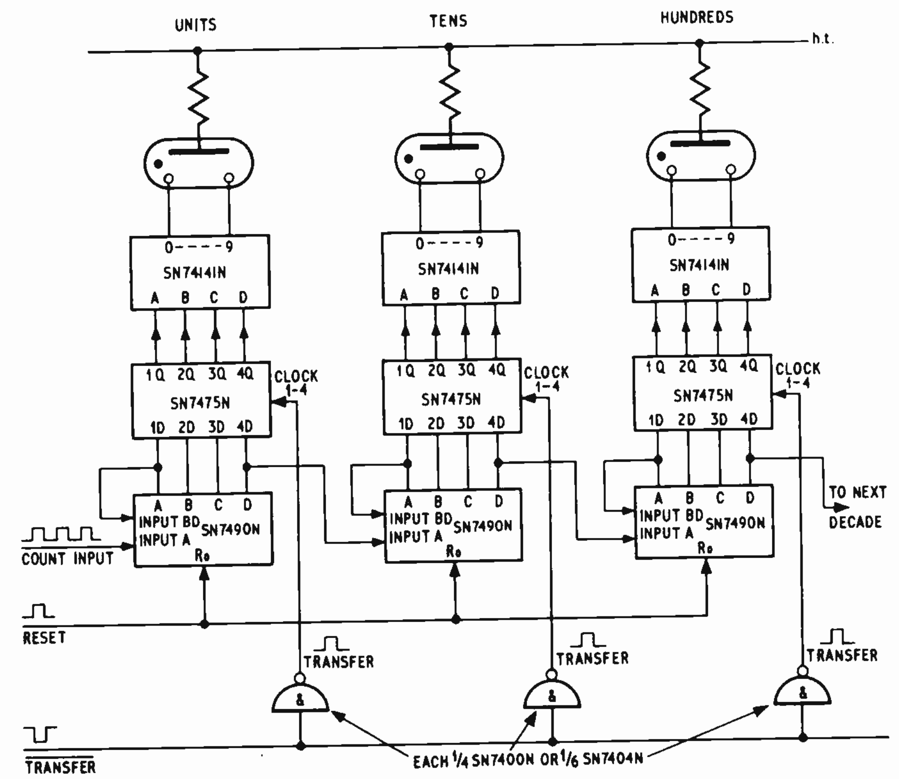


Fig. 7.5. Cascading the modules for multi-decade operation

cold cathode indicator tubes. It accepts a BCD input which it decodes to drive the cathodes of an indicator tube without the need for external components, as in Fig. 7.3.

SINGLE COUNTER MODULE

A typical application for a single counting module is shown in Figs. 7.4a, b, with the counting sequence.

(a) During t_1 the decade counter is reset to 0.

(b) During t_2 a BCD count of three is available at the output of the SN7490N, but the indicator still displays 0.

(c) At the start of t_3 the indicator will display 3, and at the end of t_3 the BCD count of three is committed to the memory of the SN7475N. The decade counter is free to count again.

(d) During t_4 the decade counter is reset to 0 and will then repeat the cycle to display five.

For multi-decade operations the modules may be cascaded as shown in Fig. 7.5.

PRACTICAL DETAILS

For those constructors who wish to experiment with these applications, R.S. Components produce the three integrated circuits, a printed circuit board, and the indicator tube.

The 5V logic supply and the h.t. can be derived from a transformer which gives 6·3 volts and 250 volts.

For testing purposes the reset and transfer lines may be derived from switches, and the input signal derived from a Schmitt trigger SN7413N oscillator.

FAN-IN PROBLEMS

(a) RESET (SN7490)
The reset line of the SN7490 can have a fan-in of one if the other reset input is returned to V_{CC}, so that an SN7400 (fan-out of 10) can drive an adequate number of decades.

(b) COUNT INPUTS (SN7490)
The A or BD inputs of the SN7490 can be driven from an SN7400.

(c) TRANSFER CLOCK (SN7475)
The transfer line of each SN7475 has a fan-in of eight (two per latch). The solution is to use one quarter of an SN7400 for each SN7475 package or to use a buffer (such as the SN7437 or SN7440) which has a fan-out of 30.

CONCLUSION

This article has shown how three integrated circuits can be used to interface with cold cathode indicator tubes. Where the intermediate outputs are not required the new SN74142N combines these three circuits into one 16 pin dual-in-line package, with a considerable space saving.

For driving displays other than cold cathode indicators the SN74141N would be replaced by one of the other drivers in the range. Although seven segment indicators (for example) are popular because they only need a 5V rail, cold cathode indicator tubes are still preferred by many people, since the required h.t. is not difficult to provide.

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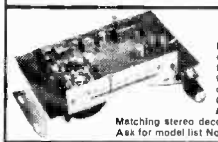
BA130	10p	OA91	7p	IN4003	8p
BA145	20p	OA200	10p	IN4004	8p
BA148	20p	BY100	15p	IN4005	10p
BA154	13p	BY126	15p	IN4006	12p
BA155	14p	BY127	15p	IN4007	15p



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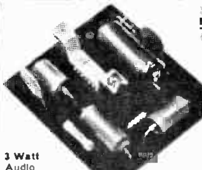

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100+ less 33⅓%

5 Watt Audio Amplifier

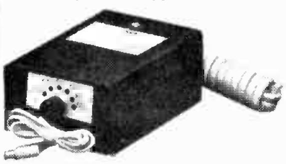
Our Price **£3·99**
Less quantity discount.

Potentiometers

5KΩ	50KΩ	500KΩ
10KΩ	100KΩ	1MΩ
25KΩ	250KΩ	2MΩ

log or lin less switch (& 1KΩ lin)	12p
log or lin with switch	24p
dual less switch	40p
dual with switch 10K, 100K & 1M log only	52p
10K log · 10K antilog less switch	40p

Eliminators



9 volt @ 20mA (PP3)	£1.25
6 volt @ 50mA	£1.50
9 volt @ 50mA	£1.50
6 + 6 volt, 50mA	£2.50
9 + 9 volt, 50mA	£2.50
7½ volt for cassette recorders	£2.00
6, 7½ or 9 volt	£3.00
3, 4½, 6, 7½, 9, 12 @ 500mA (illus.)	£3.99
Car Battery Converter **fully stabilised** to provide 6, 7½ or 9 volts	**£4.99**

(p. & p. **15p** on all types)

Presets

Vertical or Horizontal

0·1 watt 5p		0·25 watt 7p		
100	1K Ω	10K Ω	100K Ω	1M Ω
250	2·5K Ω	25K Ω	250K Ω	2 5M Ω
500	5K Ω	50K Ω	500K Ω	5M Ω

Capacitors

dise ceramic			**low voltage**		
·01μF	18v	5p	0·1μF	30v	5p
·022μF	18v	5p	0·22μF	6v	5p
·047μF	12v	5p	0 47μF	3v	5p

ceramic plate		**30V**	
1000pf	10p	4700pf	10p
2200pf	10p	10,000pf	10p

Ceramic –	plate	63V (C333)	
1·8pf	8·2pf	33pf	120pf
2·2pf	10pf	39pf	150pf
3 3pf	12pf	47pf	180pf
3·9pf	15pf	56pf	220pf
4 7pf	18pf	68pf	270pf
5·6pf	22pf	82pf	330pf
6·8pf	27pf	100pf	

all 5p. each

mylar film		**100V**			
1000pf	2p	01μF	3p	·068μF	4p
2000pf	2p	·02μF	3p	·1μF	4p
5000pf	2p	·04μF	3p	·2μF	5p
		·05μF	3p		

polystyrene **160V**
10pf to 10,000pf in multiples of 10, 15, 22, 33, 47 & 68. **3p each**

metallised polyester		**250V (C280)**			
·01μF	3p	·068μF	3½p	·47μF	8p
·015μF	3p	·1μF	4p	·68μF	11p
022μF	3p	·15μF	4p	1μF	13p
033μF	3p	·22μF	5p	1 5μF	20p
·047μF	3p	·33μF	6½p	2·2μF	24p

metallised polyester		**400V (C281)**			
·01μF	4½p	·047μF	6p	·22μF	10p
·015μF	4½p	068μF	6p	·33μF	14p
·022μF	4½p	·1μF	7p	·47μF	15p
·033μF	5½p	·15μF	8p		

silvered mica 1% (>50pf) 500V			
2·2pf—820pf	7p	4·7nF—5600pf	19p
1nF—2 2nf	9p	6800pf— 01μF	29p
2·7nF—3·6nF	16p		

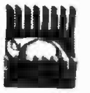
mixed dielectric		**600V**			
01μF	7p	·047μF	7p	22μF	16p
·022μF	7p	068μF	8p	·47μF	24p
033μF	7p	·1μF	8p	1μF	33p

CHROMASONIC electronics

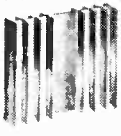
MAIL ORDERS Where no p & p. charge is shown, a minimum of 7p applies, p & p. on overseas orders is charged at cost.
ADDRESS TO: **M. O. Dept.**
56, Fortis Green Road, London N10 3HN.
Telephone 01-883 3705

Heat Sinks

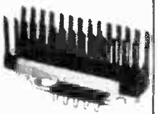
TO5 TO18 5p



TO66	14p
TO3	15p
Power Tab	13p



10D 50p



DIP10/2 for SL403D 15p

Veroboard

	Copperclad 0.1"	Copperclad 0.15"	Plain 0.15"
2½" x 1"	6p	6p	–
2½" x 3¾"	20p	16p (9)	10p
2½" x 5"	24p	21p (7)	12p
3¾" x 3¾"	24p	21p (8)	–
3¾" x 5"	27p	27p (10)	17p
17" x 2½"	67p	50p	37p
17" x 3¾"	90p	70p	52p
17" x 5"	–	–	75p

Spot-face Cutter	36p
Pin Insertion Tool	47p
Terminal Pins	18p per pack of 36

NEW LISTS
BOXES, CHASSIS, etc. No. 7
TRANSISTORS, I.C.'s, etc. (soon)
(postage 5p)

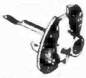
Aluminium Boxes

Including baseplate and screws

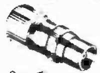
No.	L.	W.	D.	Price	p. & p.
(7)	2¾"	x 5¼"	x 1½"	35p	8p
(8)	4"	x 4"	x 1½"	35p	8p
(9)	4"	x 2¾"	x 1½"	35p	8p
(10)	4"	x 5¼"	x 1½"	40p	8p
11	4"	x 2½"	x 2"	35p	8p
12	3"	x 2"	x 1"	32p	9p
13	6"	x 4"	x 2"	50p	10p
14	7"	x 5"	x 2½"	58p	12p
15	8"	x 6"	x 3"	75p	18p
16	10"	x 7"	x 3"	85p	20p

Transistors & Integrated Circuits

AC107	25p	BC147	10p	BF196	15p	OC81	19p	2N1304	22p	2N5172	15p
AC126	17p	BC148	10p	BF197	15p	OC140	20p	2N1711	25p	BZY88 ZENERS SERIES	10p ea.
AC127	15p	BC149	10p	BF272	53p	OC170	23p	2N1893	30p		
AC128	15p	BC157	12p	BFY50	24p	OC171	30p	2N2926 all	10p	LO05TI	£1.50
AC176	15p	BC158	10p	BFY51	21p	ZTX107	15p	2N3053	23p	LO36TI	£1 50
AC187	25p	BC159	12p	BRY39	36p	ZTX108	12p	2N3054	50p	LO37TI	£1.50
AC187K	25p	BC169	15p	BSX21	26p	ZTX109	15p	2N3055	49p	MC1303L	£1.75
AC188	25p	BC268	15p	BSY95A	14p	ZTX300	12p	2N3702	12p	MC1330	80p
AC188K	25p	BD115	67p	BU105/02	£1.75	ZTX301	15p	2N3703	12p	MC1350	75p
ACY20	20p	BD131	70p	MJE340	67p	ZTX302	20p	2N3704	10p	MC1351	£1.00
AD140	40p	BD132	70p	MPF192	40p	ZTX303	20p	2N3705	10p	MC1352	£1 00
AD149	40p	BD131/2M.P		MPF103	37p	ZTX304	25p	2N3706	10p	MFC4000B	49p
AD161	60p		149p	MPF104	37p	ZTX341	20p	2N3707	15p	MFC4010A	55p
AD162		BF160	21p	MPF105	40p	ZTX500	15p	2N3708	12p	LM380	£1.45
AF114	18p	BF167	20p	MPF106	45p	ZTX501	15p	2N3709	12p	SL403D	£1.50
AF115	18p	BF173	20p	OC28	40p	ZTX502	20p	2N3710	12p	TAD100	£1.50
AF116	18p	BF180	25p	OC35	40p	ZTX503	17p	2N3711	12p	FILTER LP1175	£1.50
AF117	18p	BF181	30p	OC44	15p	ZTX504	50p	2N3819	35p		
AF139	28p	BF184	25p	OC45	15p	ZTX531	25p	2N3903	15p	μA709C	45p
BC107	10p	BF185	25p	OC71	11p	2N697	18p	2N3904	17p	μA710	45p
BC108	10p	BF194	15p	OC72	17p	2N706	12p	2N3905	21p	μA723C	£1.05
BC109	10p	BF195	15p	OC76	15p	2N708	15p	2N3906	12p	μA741C	50p



Phono Socket 4p



Coax Plug 8p

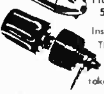
Din Plug 15p

Coax (Flush) Socket 8p

Coax (Surface Socket 8p

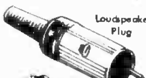
Phono Plug 5p

Din Socket A, B or C 8p

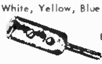


Insulated TERMINALS 13p each takes 4mm plug

Available in Red, Black, Green, White, Yellow, Blue and Grey.



Loudspeaker Plug



8p each

4mm PLUG Stackable same colours (except Grey) as terminals.

Loudspeaker Socket 10p

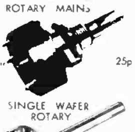
ADCOLA INVADER

L706 ⅛"	£1 70 p.& p.	10p
L646 3/16"	£1 85 p.& p.	10p

Savbit Solder Dispenser. Contains 12 ft. of coiled 18 s.w.g. Ersin Multi-core Savbit Alloy

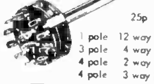
18p each

ROTARY MAINS



25p

SINGLE WAFER ROTARY



25p

1 pole	12 way
3 pole	4 way
4 pole	2 way
4 pole	3 way

SLIDE D.P.D.T 17p

TOGGLE S.P.S.T. 250V. 1 A 18p

TOGGLE D.P.D.T. 250V. 1 A 26p

mixed dielectric		**1000V**			
1000pf	6p	6800pf	9p	1μF	12p
2200pf	6p	·01μF	9p	·22μF	22p
3300pf	6p	022μF	9p	47μF	30p
4700pf	6p	·047μF	12p		

Ceramic

12KV.d.c.		8KV.d.c.		HI-K 750V.	
10pf	9p	200pf	9p	1000pf	5p
15pf	9p	220pf	9p	1500pf	5p
22pf	9p	250pf	9p	2000pf	5p
68pf	9p	270pf	9p	3000pf	5p
82pf	9p	300pf	9p	5000pf	5p
100pf	9p	750V DISC		10,000pf	5p
120pf	9p	470pf	5p	feed-through	
140pf	9p	1000pf	5p		
150pf	9p	5000pf	5p		
180pf	9p	10,000pf	5p	1000pf	5p

Mullard & Siemens Electrolytics

CAP μF	VOLTAGE 4	6.3	10	16	25	40	63
1	—	—	—	—	—	—	6p
1·5	—	—	—	—	—	—	6p
2·2	—	—	—	—	—	—	6p
3·3	—	—	—	—	—	—	6p
4·7	—	—	—	—	—	—	6p
6·8	—	—	—	—	—	6p	6p
10	—	—	—	—	6p	—	6p
15	—	—	—	6p	—	6p	6p
22	—	—	6p	—	6p	—	6p
33	—	6p	—	6p	—	6p	—
47	6p	—	6p	—	6p	6p	6p
68	—	6p	—	6p	—	—	10p
100	6p	—	6p	—	6p	6p	12p
150	—	6p	—	6p	6p	10p	12p
220	6p	—	6p	6p	10p	12p	18p
330	6p	—	6p	10p	—	—	21p
470	—	6p	10p	—	12p	18p	40p
680	—	10p	—	12p	18p	21p	—
1000	10p	—	12p	18p	21p	40p	60p
1500	—	12p	18p	21p	—	—	—
2200	—	18p	21p	40p	45p	55p	93p
3300	—	21p	—	—	—	—	—
4700	21p	—	—	60p	75p	93p	—

CAP μF	VOLTAGE 16	25	40	64
500			33p	40p
1250			50p	—
1600			—	75p
2000	40p	50p	—	—
2500	—	—	75p	93p
3200	50p	—	—	—
4000		75p	93p	—
6400	75p	93p	—	—

Quantity Prices on application.

Hi~Volt Electrolytics

1: 2, 4: 8μF	450V	14p	32μF	450V	20p
16μF	450V	15p	50μF	350V	20p
8 · 8μF; 450 V.W		18p	32 + 32μF; 350 V.W		25p
8 · 16μF, 450 V.W		20p	32 · 32μF, 450 V W		43p
16 · 16μF, 450 V.W		25p	50 · 50μF, 350 V W		35p

BSR LATEST SUPERSLIM
STEREO & MONO

Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13½ × 11½in. Above motor board 3¾in. below motor board 2½in.

with STEREO and MONO XTAL **£8·75** Post 25p

RCS BARGAIN 4 TRANSISTOR MONO AMPLIFIER

Powerful 3 watts output, 15 ohm. AC mains operated with transformer. 3-Controls, volume, treble, bass and On/Off switch with knobs. Ready made on printed circuit board. Fused inputs and outputs. Famous make, size 8" wide × 4" deep × 3" high.

PRICE **£5·50** Post 25p

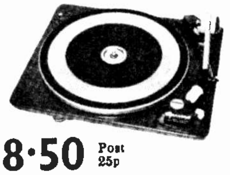
RCS DE-LUXE 3 WATT AMPLIFIER. Ready made, tested. Printed circuit. 3 watts output. Tone and volume controls. Complete with output valve and rectifier, two knobs, and high performance loudspeaker. Double wound fully isolated mains transformer. A.C. mains 200/250V. Response 50-12,000 cps. Sensitivity 300mV. **£4** Post 25p

BSR JUNIOR
SINGLE PLAYER

Heavy duty 4-speed motor with separate pick-up arm fitted LP/78 turnover mono cartridge **£4·50** Post 25p

HI-FI PICK UP CARTRIDGES. Stereo/Mono 9TA £2·50; GP94 £2·50; GP93 £2. Sapphire Mono GP91 £1·50; Powerpoint LP/78 60p.

GARRARD DECCA DISCO DECK



Single play Stereo/ Mono Deram transcription head and arm. Four speeds. 10¾in. turntable. Anti-rumble filter. Bias compensation. Laboratory motor.

SPECIAL PRICE **£18·50** Post 25p

METAL PLINTH AND PLASTIC COVER

Cut out for most Garrard or B.S.R. Most will play with cover in position. Latest Design. Covered in black leatherette. Antimagnetic. 12½ · 14½ × 7½in. high. **£4·50** Post 35p

ALSO AVAILABLE IN SOLID NATURAL MAHOGANY WAX POLISHED FINISH—AT SAME PRICE

SPECIAL OFFER!
SMITH'S CLOCKWORK 15 AMP TIME SWITCH

Single pole two-way. Surface mounting with fixing screws. Will replace existing wall switch to give light for return home, garage, automatic anti-burglar lights, etc. Variable knob. Turn on or off at full or intermediate settings. Two types available 0 to 60 minutes or 0 to 6 hours. Fully insulated. Makers last list price £4·50. Brand new and fully guaranteed.

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ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 9p; 8 × 6in. 15p; 14 × 3in. 16p; 10 × 7in. 19p; 12 × 5in. 20p; 12 × 8in. 28p; 16×6in. 28p; 14×9in. 34p; 12×12in. 40p; 16 × 10in.. 50p

RADIO BOOKS (Post 3p)

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Practical Transistor Novelty Circuits	40p
Resistor colour code disc calculator	10p
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TV fault finding	50p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit. Bridge Rectifiers and Double Wound Mains Transformer input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. Size 3½ × 1½ × 1½in. **£2** Post Free

R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12v. or H.T. line 200-300v. D.C. operation. Size 1¾" × 1½" × ¾". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Details S.A.E. **90p** Post 10p

MAINS TRANSFORMERS

All post 25p each

250-0-250 80 mA. 6.3 v. 4 amp.	£1·50
250-0-250 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	£2.50
350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	£3
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	£3·25
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2½ × 2½ × 2in.	75p
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2¾ × 2½ × 2in.	90p
HEATER TRANS. 6.3 v. 3a.	60p
GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v.	£2·25
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60.	£2 25
2 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60.	£3·25
5 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60	£8·75
3 amp. 5, 8 and 13V	£1·00
5 amp. 5, 8 and 13V	£1·20
3 amp. 3, 5, 8, 10, 13 and 5-0-5V	£1·30
5 amp. 3, 5, 8, 10, 13 and 5-0-5V	£1·50

AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. 150w. £2·25; 500w. £6·25; 750w. £10; 1000w. £15.
CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp. £1·50; 2 amp. £1·80; 4 amp. £2·50
BATTERY CHARGERS—Ready built with leads and clips 1½ amp. £2; 4 amp. £4; 5 amp. £4·50.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p.
LUCAS 2DS500 Full wave Bridge 70v. 5 amp 95p.

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Primary 0–110–240v. Secondary 0–240v. 3 amps. 720 watts. Insulated terminals. Varnish impregnated. Fully enclosed in steel case with fixing feet. Famous make. (Value £19) OUR PRICE **£10** Carr. 50p
Can be used as 800 watt auto transformers 240-110V.

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	50+50/350V	35p
4/350V	14p	500/25V	20p	60+100/350V	58p
8/450V	14p	1000/25V	35p	32+32/250V	18p
16/450V	15p	1000/50V	47p	32+32/450V	33p
32/450V	20p	8+8/450V	18p	350+50/325V	50p
25/25V	10p	8+16/450V	20p	32+32+32/350V	43p
50/50V	10p	16+16/450V	25p	100+50+50/350V	48p
100/25V	10p	32+32/350V	25p		

LOW VOLTAGE ELECTROLYTICS.
1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p.
500mF 12V 15p; 25V 20p; 50V 30p.
1000mF 12V 17p; 25V 35p; 50V 47p; 100V 70p.
2000mF 6V 25p; 25V 42p; 50V 57p.
2500mF 50V 62p; 3000mF 25V 47p; 50V 65p.
5000mF 6V 25p; 12V 42p; 25V 75p; 35V 85p; 50V 95p.

CERAMIC, 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p. PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p. SILVER MICA. Close tolerance 1%. 2·2-500pF 8p; 560-2,200pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p each. TWIN GANG. "0-0" 208pF+176pF, 65p; Slow motion drive 365pF+365pF with 25pF+25pF, 50p; 500pF standard 45p; single gang 500pF 75p; small 3-gang 500 pF £1·60. SHORT WAVE SINGLE. 10pF, 30p. 25pF, 55p, 50pF, 55p.

SHORT WAVE SINGLE GANG. Precision Silver Plated Gangable Tuning Condensers. Values up to 100pF. **50p** each
Section Couplers supplied FREE with two or more gangs.

NEON PANEL INDICATORS 250V AC/DC Amber 20p. RESISTORS. ¼ w., ½ w., 1 w., 20% 1p; 2 w. 5p. 10Ω to 10M. HIGH STABILITY. ½ w. 2% 10 ohms to 6 meg., 10p. Ditto 5%. Preferred values 10 ohms to 10 meg., 4p. WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt. 10 ohms to 100K 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p. TAPE OSCILLATOR COIL. Valve type, 35p.

WEYRAD P50 — TRANSISTOR COILS

RA2W Ferrite Aerial	72p	Spare Cores	3p
Osc. P50/1AC	33p	Driver Trans. LFDT4	58p
I.F. P50/2CC 470 kc/s	36p	Printed Circuit, PCA1	58p
3rd I.F. P50/3CC	36p	J.B. Tuning Gang	65p
P51/1 or P51/2	36p	Weyrad Booklet	10p
P50/3V	36p	OPT1	58p

Mullard Ferrite Rod 8 × ⅜in. 20p. 6 × ¼in. 20p.

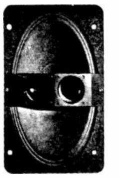
VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p.

80 Ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2.
FRINGE LOW LOSS Ideal 625 and colour **10p yd**

1½inch DIAMETER WAVECHANGE SWITCHES. 25p.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 25p each.
1 p.1 2-way, or 4 p. 2-way, or 4 p. 3-way 25p
TOGGLE SWITCHES, sp. 14p; dp. 22p; dp. dt. 22p.
Sub-miniature, sp. 30p; dp. 37; dp. dt. 45p.



E.M.I. 13½ × 8in. SPEAKER SALE!

With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£3·95** Post 25p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·25** Post 25p

TEAK CABINET 16 × 10 × 9in. Modern design **£5** Post 25p

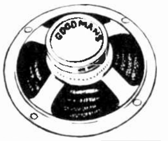
GOODMANS 6½in. HI-FI WOOFER

8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30–12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. Suitable cabinet 12 × 8 × 6 £4. **£4**

ELAC CONE TWEETER

The moving coil diaphragm gives a good radiation pattern to the higher frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3½ × 3½ × 2in. deep. Rating 10 watt, 3 ohm or 15 ohm models. Crossover 95p. **£1·90** Post 10p

GOODMANS 8 in WOOFER



8 ohm 12 watt. Deep cone. Heavy ceramic magnet. Bass resonance 35 cps. Frequency response 30-8,000 cps. **£4·50**

LOUDSPEAKERS P.M. 3 OHMS. 7 × 4in. £1·25; 6½in. £1·50; 8 × 5in. £1·60; 8in. £1·75; 10 × 6in. £1·90; 10in. £2.
SPECIAL OFFER! 80 ohm. 2½in. 2¾in. 35 ohm. 2in.; 3 in. 5in. 25 ohm, 2½in. dia.; 3in. dia.; 15 ohm, 3½in. dia. 5in; 6 × 4in; 7 × 4in; 8 × 5in. 3 ohm, 2½in. 2¾in. 3½in, 5in dia. (6 × 4in., 8 ohm, £1·50). **£1** EACH TYPE
RICHARD ALLAN TWIN CONE LOUDSPEAKERS 8in. diameter 4 watt; 10in. diameter 5 watt; 12 in. diameter 6 watt, 3 or 8 or 15 ohm models £2·20 each. Post 15p.
SPEAKER COVERING MATERIALS. Samples Large S.A.E. Horn Tweeters 2-16Kc/s, 10W 8 ohm or 15 ohm £1·95. De Luxe Horn Tweeters 2-18 Kc/s, 15W, 15 ohm £3. TWO-WAY 3,000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 95p.

TWO-WAY CROSSOVER NETWORK 3,000 c/s

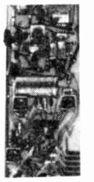
With variable tweeter attenuator giving accurate high/low frequency balance. Mounted on panel 5½in. × 4in. with control knob, tweeter and woofer leads and input terminals. Suitable for 3 to 8 ohm impedance. **£1·90** Post 10p

VALVE OUTPUT TRANS. 25p. MIKE TRANS. mu metal 100-1 £1·25. 5 WATT MULTI RATIO, 3, 8 and 15 ohms 80p.
PUSH-PULL VALVE OUTPUT TRANSFORMERS.
50 watt £9·50 100 watt £12·50

STEREO/MONO HEADPHONES

New model with new type slider volume controls. Stereo/Mono switch. 8 ohms. £10.
High Quality with tweeters and volume controls. 8 ohm. £7.
Budget Model. 8 ohm. £3·25.
HEADPHONE JUNCTION BOX with switch £1·75.
Mono Stethoscope 8 ohms. 65p.
EAR PIECES. Crystal 25p.
Magnetic 8 ohms. 13p.
Magnetic 250 ohms. 23p.
ACOS 1000 ohms. 53p.

BRITISH MADE STEREO MULTIPLEX DECODER



Brand New. 7 transistors plus integrated circuit. Fibre glass printed circuit board. Size 2¼ × 6½ × ¾in. Pre-aligned. Complete with stereo beacon indicator. 12V d.c. operation. 400mV output for 100µV input. Full instructions for any FM Tuner. Some technical experience essential. **£6·50**
DIPOLE LOFT AERIAL £1·50. Post 15p
CABLE 4p yard.

COAXIAL PLUG 10p, PANEL SOCKETS 10p. LINE 18p. OUTLET BOXES. SURFACE OR FLUSH 25p. BALANCED TWIN RIBBON FEEDER 300 ohms. 5p yd. JACK SOCKET Std. open-circuit 14p, closed circuit 23p; Chrome Lead Socket 45p. Phono Plugs 5p. Phono Socket 5p. JACK PLUGS Std. Chrome 15p; 3·5mm Chrome 12p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 15p. DIN PLUGS 3-pin 18p; 5-pin 25p. VALVE HOLDERS, 5p; CERAMIC 8p; CANS 5p.

ALL PRICES INCLUDE ANY V.A.T.

MINIMUM POST AND PACKING 15p.

RADIO COMPONENT

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E.M.I. WOOFER AND TWEETER KIT

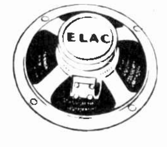
£5·75 THE PAIR Post 25p. (Available separately. Woofer £4·25; Tweeter £1·90).

Comprising a fine example of a Woofer 10¾ × 6½in. with a massive Ceramic Magnet, 44oz, Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3¾in. square has a special lightweight paper cone and magnet flux 10,000 lines. Crossover condenser and full instructions supplied.

Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	35 to 18,000 cps
Bass Resonance	45 cps

SUITABLE ENCLOSURE 20 x 13 x 9in. MODERN DESIGN. TEAK WOOD FINISH **£9** Post 25p

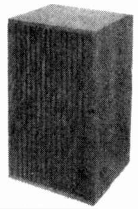
8in. or 10in. ELAC HI-FI SPEAKER



Dual cone plasticised roll surround. Large ceramic magnet. 50–16,000 cps. Bass resonance 55 cps. 8 ohm impedance. 8in. 10 watts, 10in. 12 watts music power. **£3·75** Post 25p

TEAK VENEER SPEAKER CABINET

Fluted Wood Front

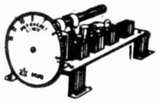


MODEL "A". 20 × 13 × 9in. For 12in. dia. or 10in. speaker. **£9** Post 25p

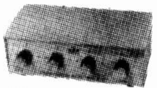
MODEL "B". 16 × 10 × 9in. For 13 × 8in. or 8in. speaker **£5** Post 25p

MODEL "C". 16 × 8 × 6in. For 10 × 6in. or 6in. speaker. **£4** Post 25p

LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft



BARGAIN AM TUNER. Medium Wave. Transistor Superhet Ferrite aerial. 9 volt. **£4·95**



BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. battery operated. **£3·95**

STEREO VERSION OF ABOVE £5·95

BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt. Printed circuit, Calibrated slide dial tuning, Walnut Cabinet. Size 7 × 5 × 4in. **£14·85**

BARGAIN FM TUNER as above less cabinet **£9·85**

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

THE "INSTANT" BULK TAPE ERASER & HEAD DEMAGNETISER. Suitable for cassettes, and all sizes of tape reels. A.C. mains 200/250V. Leaflet S.A.E. **£2·50** Post 15p

WAFER THIN HEATING ELEMENTS

OFFERING 1001 USES for every type of heating and drying applications in the home, garage, greenhouse, factory (available in manufacturing quantities). Approx. size 10⅜ × 8¼ × 1/16in. Operating voltage 200/250V. a.c. 250 watts approx. Printed circuit element enclosed in asbestos fitted with connecting wires. Completely flexible providing safe Black heat. British-made for use in photocopiers and print drying equipment.

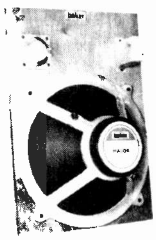
Ideal for home handymen and experimenters. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos, etc., to make efficient clothes dryers, towel rails—ideal for airing cupboards. Ideal for anti-frost device for the garage—preventing frozen radiators or acting as oil sump heater. Use in the green house for seed raising and plant protection. Invaluable aid for bird houses, incubators, etc., etc. Can be used in series for lower heat. Or in parallel for higher heat applications.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

BAKER 12in MAJOR £9

Post 25p

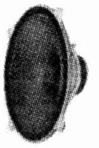


30–14,500 c.p.s., 12in. double cone, woofer and tweeter cone together with a **BAKER** ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c.p.s. Rated 20 watts. State 3 or 8 or 15 ohm. Post Free.

Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11·50** Post 25p

BAKER "BIG-SOUND" SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups. Useful response 30-13,000 cps. Bass Resonance 55 cps.



GROUP "25" 12in. 25 watt 3, 8 or 15 ohms. **£8** Post 25p

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GROUP "50" 15in. 50 watt 8 or 15 ohms. **£20** Post 25p

MAJOR 100 WATT ALL PURPOSE TRANSISTOR AMPLIFIER

4 inputs speech and music. 4-way Mixing. Response 10–30,000 cps. Matches all loudspeakers. 8/15 ohm A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£49** Post Free

CALLERS ONLY! DE-LUXE 100 WATT AMPLIFIER CHASSIS. 7 Valve version, 4 inputs, 10 wide range controls. For Mikes, Discos, Organs, Guitars, etc. 4, 8 and 15 ohm matching. **£55**

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A die, punch and Allen Screw

⅜in. Round . . 68p
7/16in. Round 75p
Key "T" for above 5p
½in. Round 83p
9/16in. Round 83p
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¾in. Round 88p
13/16in. Round 90p
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1in. Round 98p
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3in. Round £8·10
Key "E" for above . . . 18p
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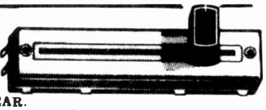
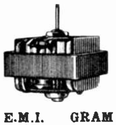
SLIDER VOLUME CONTROLS



MONO LOG or LINEAR.
Size 3 7/16 × ½ × 7/16in. with knobs.
5K, 10K, 25K, 50K, 100K,
250K, 500K, 1 MEG, 2 MEG. **65p** EACH



E.M.I. TAPE MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA. Spindle 0·187 × 0·75in. Size 3½ × 2½ × 2¼in. (illustrated). Post 15p. **£1·25**

BALFOUR GRAM. MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 50mA. Spindle ⅛ × 3/20. Size. 2½ × 2½ × 1¼in. Post 15p **85p**

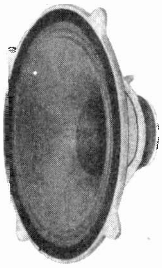
E.M.I. GRAM MOTORS. 120V or 240V a.c. 2,400 rpm. 2-pole 70mA. Spindle ⅛ × 5/16in. Size 2⅞ × 2½ × 2⅜in. **75p** Post 15p

BAKER HI-FI SPEAKERS

HIGH QUALITY — BRITISH MADE

REGENT

12in. 15 watts



An inexpensive unit for the beginner in high fidelity and for general purposes. May be used to improve any Radio, Amplifier, Hi-Fi or Television receiver.

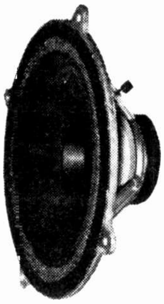
Bass Resonance	45cps
Flux Density	12,000gauss
Useful response	45-13,000cps

3 or 8 or 15 ohm models

£8 Post 25p

DE-LUXE Mk II

12in. 15 watts



Especially designed to provide full range reproduction at an economical cost. Suitable for use with any high fidelity system. Built-in concentric tweeter cone.

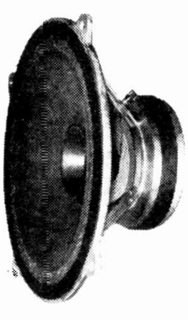
Bass Resonance	30cps
Flux Density	14,000gauss
Useful response	25-16,000cps

8 or 15 ohms models

£10 Post 25p

SUPERB

12in. 20 watts



A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.

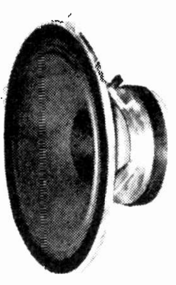
Bass Resonance	25cps
Flux Density	16,500gauss
Useful response	20-17,000cps

8 or 15 ohms models

£15 Post 25p

AUDITORIUM

12in. 25 watts



A full range reproducer for high power Electric Guitars, public address, multi-speaker systems, electronic organs. Ideal for Hi-Fi and Discotheques.

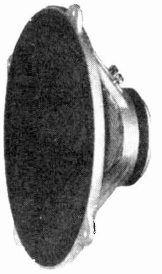
Bass Resonance	35cps
Flux Density	15,000gauss
Useful response	25-16,000cps

8 or 15 ohms models

£14 Post 25p

AUDITORIUM

15in. 35 watts



A high wattage loudspeaker of exceptional quality with a level response to above 8,000 cps. Ideal for Public Address, Discotheques, Electronic instruments and the home.

Bass Resonance	35cps
Flux Density	15,000gauss
Useful response	20-14,000cps

8 or 15 ohms models

£20 Post 25p

Hi-Fi Enclosure Manual containing 20 plans designs, crossover data and cubic tables. 42p. Post Free.

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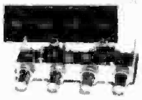

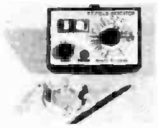

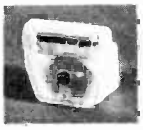

3W STEREO AMPLIFIER £3·90;

10W AMPLIFIER, £3·75.

R.F. FIELD INDICATOR
Model FL-30HA
Frequency
Range
(5 ranges)
1M/cs to
250M/cs, **£3.**

TAPE RECORDER LEVEL METER
500μA, 50p.

MINIATURE INDICATOR LAMPS (5 colours), **11p**; 6·3V or 12V Bulbs for above, **4p. MAINS NEONS** with long leads, **6p**; Panel mounting (red, green, clear), **15p. CARTRIDGES**: Compatible ACOS GP91-3SC, **90p**; Stereo GP93-1, **£1·15. HEADPHONES**: High Impedance (2,000 ohm), **90p**; Stereo 8 ohm, **£1·95**; Stereo/Mono 8/16 ohm, **£2·10. MICROPHONES**: Lapel, **28p**; ACOS Mic 60, **£1**; Cardioid Dynamic Microphone Dual Impedance 600 ohm and 50K, **£4·50. CONDENSER** Microphone, **£8·62. JUNCTION BOXES** JB3, **£1·20.**

Please note there will be 10% V.A.T. charge as from April 1.

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GUNTON ELECTRONIC IGNITION KIT £9·35 INC. VAT

READY BUILT UNIT GUARANTEED 5 YEARS £11·55 INC. VAT

Patents Pending. 12 volt only—state pos. or neg. earth.
Capacitive discharge ignition is recognised as being the most efficient system and will give you:

- ★ **Continual Peak-Tuned Performance**
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- ★ **Easier All-weather Starting**
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Kit includes absolutely everything for assembly: Ready drilled Case and Hardware Printed Circuit Board, Cables, Coil Connectors, Silicon Grease Nuts and Bolts, etc. 8 page illustrated instructions cover fitting of all types of tachometers. Call in for a workshop demonstration. S.A.E. all enquiries please, or Phone 33652. (Many letters from satisfied customers.)

SCORPIO: Transformer **£2·42.** Printed Circuit Board **83p**

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35 CARDIFF ROAD, WATFORD

C.W.O. Please. P. & P. please add 10p to order under £2.

RESISTORS
High stability, low noise, carbon film resistors. Tubular miniature high power resistors.

Power Watts	Tolerance	Range	Values Available	Price 1–99	Price 100+
¼	5%	2·2–2·2MΩ	E12	**1p**	**0·8p**
½	5%	2·2–10MΩ	E12	**1p**	**0·8p**
1	5%	2·2–10MΩ	E12	**2p**	**1·5p**
4	10%	1–10 ohm	E12	**6p**	—

Quantity prices available for any selection. Ignore fractions on total order.

CAPACITORS
Electrolytics, general purpose, miniature, axial lead. Mullard O15, O16, O17 series.

1μF	63V	**6p**	22μF	63V	**6p**
1·5μF	63V	**6p**	47μF	63V	**6p**
2·2μF	63V	**6p**	100μF	40V	**6p**
3·3μF	63V	**6p**	150μF	25V	**6p**
4·7μF	63V	**6p**	220μF	25V	**11p**
6·8μF	63V	**6p**	470μF	25V	**13p**
10μF	63V	**6p**	680μF	25V	**20p**
15μF	63V	**6p**	1,000μF	25V	**25p**

POLYESTER FILM CAPACITORS
Mullard C296 series
400V d.c.: μF: 0·001, 0·0015, 0·0022, 0·0033, 0·0047, 0·0068, 0·01, 0·015, 0·022, **2½p** each. μF: 0·033, 0·047, 0·068, 0·1, **4p** each. μF: 0·15, **6p.** μF: 0·22, **7p.** μF: 0·33, **10p.** μF: 0·47, **13p.**
160V d.c.: μF: 0·1, 0·15, **4p.** 0·22, **5p.** 0·33, **6p.** 0·47, **7p.** 0·68, **10p.** 1·0, **13p.**

Mullard C280 series. P.C. mounting
400V d.c.: μF: 0·01, 0·015, 0·022, **3p** each. 0·033, 0·047, **4p** each.
250V d.c.: μF: 0·068, 0·1, 0·15, **4p** each. μF: 0·22, 0·33, **5p** each. μF: 0·47, **7p.** μF: 0·68, **10p.** μF: 1·0, **11p.**

CERAMIC DISC CAPACITORS
Working voltage 50V d.c., Plaquette body with 25mm leads. Range: 22μF–10,000μF. **2p** each.

SLIDER POTENTIOMETERS
Single, 10kΩ, 25kΩ, 50kΩ, 100kΩ, log or linear, **35p.**
Dual gang, 10kΩ + 10kΩ, etc., above values, log or linear, **50p.**
Knobs for above, **10p.**

PRESET POTENTIOMETERS SKELETON
Horizontal or vertical mounting, 0·25W Miniature, **5½p each.**

SEMICONDUCTORS

TRANSISTORS

AC126	**10p**	BC148	**10p**	OC42	**11p**
AC127	**10p**	BC149	**10p**	OC44	**11p**
AC128	**10p**	BD131	**70p**	OC45	**11p**
AD161	**30p**	BD132	**70p**	2N2926R	**9p**
AD162	**30p**	BFY50	**22p**	2N29260	**9p**
AF117	**10p**	BFY51	**22p**	2N2926V	**9p**
BC107	**7p**	BFY52	**22p**	2N2926G	**10p**
BC108	**7p**	OC26	**40p**	2N3054	**55p**
BC109	**7p**	OC27	**40p**	2N3055	**55p**
BC147	**10p**	OC35	**40p**		

LINEAR INTEGRATED CIRCUITS
709 **35p**; 741 **40p**; 723 **80p**; DIL sockets 14 and 16 pin, **20p**
All IC's are in DIL package.

ZENER DIODES
BYZ88 series. Power rating: 400mW. 5% tolerance. Values available: 3·3V–30V, **12p.**

DIODES

OA85	**7p**	OA91	**5p**	IN4004	**7p**
OA90	**5p**	IN4001	**6p**	IN4007	**7p**

SILICON BRIDGE RECTIFIER WO1 **30p** (1 amp—100V)

POTENTIOMETERS
Carbon track, 1kΩ–2MΩ, log or linear, single Gang, **12p.** 5kΩ–2MΩ log or linear, dual gang, **37p.** 5kΩ–2MΩ, log or linear, single gang with switch, **24p.** Knobs for above: **10p** each.

VEROBOARD

	0·1 matrix	0·2 matrix		0.1 matrix	0.2 matrix
2½in × 3¾in	**22p**	**16p**	17in × 2½in	**75p**	**57½p**
2½in × 5in	**24p**	**24p**	17in × 5in (plain)	—	**82p**
3¾in × 3¾in	**24p**	**24p**	17in × 3¾in (plain)	—	**60p**
3¾in × 5in	**27p**	**27p**	17in × 2½in (plain)	—	**42p**

Pin insertion tool, **52p.** Spot face cutter, **42p.** Packet of 50 pins, both sizes, **20p.**

JACK PLUGS AND SOCKETS

Standard screened	**12p**	2·5mm screened	**8p**
Stereo screened	**30p**	3·5mm screened	**10p**
Standard socket	**12p**	2·5mm sockets	**7p**
Stereo sockets	**15p**	3·5mm sockets	**7p**

DIN PLUGS AND SOCKETS
2 pin, 3 pin, 5 pin (180 or 240). Plugs, **12p.** Sockets, **8p.**

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Please enclose 10p postage stamps for a copy of the catalogue which gives details of listed items listed in this advert, and more.

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AUTO—ELECTRIC CAR AERIAL

with dashboard control switch—fully extendable to 40in or fully retractable. Suitable for 12V positive or negative earth. Supplied complete with fitting instructions and ready wired dashboard switch. **£5·75** plus 25p post and insurance.

TAPE HEADS

We are gradually obtaining more information about the Truvox tape heads we have, we are told that these have been wound in a very ingenious way so that winding may be coupled either in parallel or in series depending whether high or low impedance is required. We also have matching erase heads and now offer these in pairs. 1 record and 1 erase head. Price of the 2 track **45p** per pair. 4 track **75p** per pair. Pair mounted on plate **45p** extra.

MAINS OPERATED CONTACTOR

220/240V 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10A. Extremely well made by a German Electrical Company. Overall size 2½ × 2 × 2in. **£1·50** each.

TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7½ to 47in. Hole in bottom for 6BA screw. **38p.** KNUCKLED MODEL FOR F.M. **50p.**

MAINS CLOCK & TIME SWITCH

Smith's main's driven clock with 15A programmable switch also notes showing how you can use this to wake up with music playing, kettle boiling or come home to a warm house, warn-off burglars, keeps pets warm, halves your heating bills etc., etc. **£1·75** **+20p p. & p.**

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. **50p** post free.

IMMERSION HEATERS BY REMPLOY

Standard fitting for domestic water tanks, made by the famous Remploy Company. Complete with sealing washers suitable for 200–240V a.c. Depth into tank 11in. 2kW or 3kW. **£1·50** plus 40p each post and insurance.

NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic pushrod suitable for operating, **5p** each, **45p** doz.

THERMOSTAT

Continuously variable 30°–90°C. Has sensor bulb connected by 33in of flexible tubing. On operation a 15A 250V switch is opened and in addition a plunger moves through approx. ⅛in. This could be used to open valve on ventilator, etc. **£1·50** plus 23p p. & ins.

HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermistor as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack **£5·50.**

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac. XN. 3. Price **£1·45** each. 10 for **£13.**

12-WAY SUB-MINIATURE MULTI-CORE CABLE

7·0076 copper cores each core. P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in thick. Price **20p** per yard.

VAT From April 1st VAT must be added to total orders.

STANDARD WAFER SWITCHES

Standard size 1¼" wafer—silver-plated 5-amp contact, standard ¼" spindle 2" long – with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10way	12way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

THYRISTOR LIGHT DIMMER

For any lamp up to 250W. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price **£2·95** plus 20p post and insurance.
Industrial model 5A with control knob but not mounted on switch plate **£3.**

HORSTMANN "TIME AND SET" SWITCH

(A 30A Switch.) Just the thing if you want to come home to a warm house without it costing you a fortune. You can delay the switch on time of your electric fires, etc., up to 14 hours from setting time or you can use the switch to give a boost on period of up to 3 hours. Equally suitable to control processing. Regular price probably around £5. Special snip price **£1·50,** p. & ins. 23p.

13 AMP TWIN GANG SOCKETS

Offered at less than wholesale price your opportunity to replace those dangerous adaptors—brown bakelite flush mounting—standard fitting. Unswitched **20p** each, separately switched **30p** each. Less 10% ten or more +20p postage if order under £5.

4 WATT AUDIO AMPLIFIER £1·45

Works off dry batteries, car battery or mains power pack. Only **£1·45.** This low price possible only because the make is over-produced. Unrepeatable once stocks are cleared. Made by the famous Mullard company and carries their full guarantee. Complete in dustproof case, amplifier may be used for Mono or Stereo, music or speech. Hundreds of applications. Frequency response 50H3-16KH3. Supplied complete with connection diagram and operating notes. Postage & Ins. 20p.
FREE All purchasers receive Mullard booklet "Do It Yourself Stereo" tells all you need to know to build your own stereo system. Write today to avoid missing this terrific offer.

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 10A 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 25p post and insurance. Don't miss this terrific bargain.

MIGHTY MIDGET

Probably the tiniest possible radio, as described in Practical Wireless, January 73. All electronic parts **£2** post paid.

DIGITAL COUNTER TIMER

Very stable and reliable crystal controlled circuit. Capable of work in excess of 15MHz. Construction simplified by use of 15 integrated circuits. Complete kit with case **£39·50** or construction data and price list **50p.**

INTEGRATED CIRCUIT BARGAIN

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 **25p** upwards with circuits and technical data of each. Complete parcel only **£1** Post paid.
DON'T MISS THIS TERRIFIC BARGAIN.

EXTRACTOR FAN

Cleans the air at the rate of 10,000 cubic ft per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., it's so quiet it can hardly be heard. Compact 5¼in casing with 5¼in fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, **£2·50** plus 30p post and ins.

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 same price. Jug heater **£1·50** plus p. & p. 14p.

MAINS TRANSISTOR POWER PACK

Designed to operate transistor sets and amplifiers. Adjustable output 6V, 9V, 12V for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP3, PP4, PP6, PP7, PP9, and others. Kit comprises: mains transformer, rectifier, smoothing and load resistor condensers and instructions. Real snip at only **£1** plus 20p postage.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless, August issue. **£2·95** plus 20p post and insurance.

WINDSCREEN WIPER CONTROL

Beat dirty roads, drizzle, fog, etc. Kit of parts to make this useful accessory with circuit details. **£2·25.**

12 VOLT 1½ AMP POWER PACK

This comprises double-wound 230/240V mains transformer with full wave rectifier and 2000 m/f/d" smoothing. Price **£2** plus post & packing.

ONE CHIP RADIO

Ferranti's latest device ZN414—gives results better than superhet. Supplied complete with technical notes and circuits. **£1·25** each. 10 for **£11.**

HI-Q TUNER COMPONENTS

For experimenting with the ZN414

Kit No. 1—Plessey Miniature Tuning Condenser with built in LW switch and 3in Ferrit slab and litz wound MW coil. **65p.**

Kit No. 2—Air spaced tuning condenser 6in ferrite rod, litz wound MW and LW coils, **85p.**

Kit No. 3—Air spaced TC with slow motion drive 8in ferrite rod, with Litz wound LW and MW coils, **£1.**

Kit No. 4—Permeability tuner with fast and slow motion drive and LW loading coils, **45p.**

6 VOLT CLOCK MOTOR

Works from 50 cycle mains through condenser, resistor or step-down transformer. This is a synchronous motor made by Smiths, so it is an extremely accurate speed controller. Very small in size (2W) and with a polythene cover. Price **30p each.** 10 for **£2·70.**

SOLDER GUN

A must for every busy man, gives almost instant heat also illuminated job. 100W **£2·25** plus post and ins. 20p. BIG JOB 250W model **£4·75** plus post and ins. 40p.

MAINS OPERATED SOLENOIDS

Model 772—small but powerful 1in pull—approx. size 1¼in × 1¼in × 1¼in **60p.**
Model 400/1 ⅜in pull. Size 2⅜in × 2in × 1⅜in **75p.**
Model TT10 1¼in pull, size 3 × 2½ × 2in **£1·80** plus 20p post and insurance.

3 STAGE PERMEABILITY TUNER

Made originally for Radiomobile car radios. This is a medium wave tuner with a frequency coverage 16kc–525kc. Aerial, RF and oscillator sections (long wave coil available) small size, only 2¾ × 2 × ½in. Can be used with our IF module and AF modules and a few inter connection components to make a complete compact receiver. Circuit supplied. Price **65p** less 10% for 10.

TERMS:—10% discount if ten of an item ordered, send postage where quoted—other terms post free if order for these over £6 otherwise add 20p.

J. BULL (ELECTRICAL) LTD.

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PRACTICAL ELECTRONICS "SCORPIO" ELECTRONIC IGNITION SYSTEM

This Capacitor-Discharge Electronic Ignition system was described in the November and December issues of Practical Electronics. It is suitable for incorporating in any 12V ignition system in cars, boats, go-karts, etc., of either pos. or neg. earth and up to six cylinders. The original coil, plugs, points and contact-breaker capacitor fitted in the vehicle are used. No extra or special components are required.

Helps to promote easier starting (even under sub-zero conditions), improved acceleration, better high-speed performance, quicker engine warm-up and improved fuel economy. Eliminates excessive contact-breaker point burning and the need to adjust point and spark-plug gaps with precision.

Construction of the unit can easily be completed in an evening and installation should take no longer than half an hour. A complete complement of components is supplied with each kit together with ready-drilled roller-tinned professional quality fibre-glass printed-circuit board, custom-wound transformer and fully-machined die-cast case. All components are available separately. Case size 7¼in × 4½in × 2in. approx.

Complete assembly and wiring manual **25p**, refundable on purchase of kit. Price: **£10·50** plus 50p P. & P.

PSYCHODELIC LIGHTING UNIT Mk. 3

This unit represents a natural progression from our phenomenally successful Mk. I and 2 Units. As before the drive voltage is derived directly from the amplifier output or across the speakers. The unit converts the audio frequency signals into a three-coloured light display; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source.

The unit is constructed on professional fibre-glass printed-circuit board material and uses latest full-wave triac circuitry. There is a master-level control, together with independent sensitivity controls for each channel. The original minimum ambient light level controls have been redesigned permitting their use as faders; allowing dimming from max. to zero at the turn of a knob. R.F.I. suppression is now incorporated as standard as well as provision for D.J. "Pulse-Flash" controls. The choice of two inputs enables operation from both high and low power amplifiers. Max. power 1·5kW per channel at 240V a.c.

Complete assembly built and tested. Size 9in × 7in × 3in. Price **£25** carr. paid.

PLEASE NOTE ALL THE ABOVE PRICES ARE SUBJECT TO V.A.T. ADJUSTMENT

DABAR ELECTRONIC PRODUCTS
98a Lichfield Street, Walsall, Staffs. WSI IUZ
TELEPHONE: WALSALL 34365 **TELEGRAMS: DABELEC Walsall Staffs.**

ERSIN Multicore 5 CORE SOLDER

for fast, easy reliable soldering

Ersin Multicore Solder contains 5 cores of non-corrosive flux, instantly cleaning heavily oxidised surfaces. No extra flux is required.

EASY-TO-USE DISPENSERS

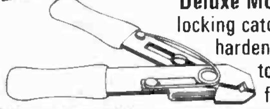
Size 5
Savbit alloy
18 swg, **18p**
(illustrated).
Size 19A
60/40 alloy
18 swg, **18p**
Size 15
60/40 alloy
22 swg, **22p**

IDEAL FOR HOME CONSTRUCTORS

Size 1 cartons in 40/60, 60/40 and Savbit alloys in 7 gauges **25p**

Size 12
for Service Engineers and Electricians.
75ft of 18 swg Savbit alloy. **75p**

NEW! BIB WIRE STRIPPER AND CUTTER



Deluxe Model 9 Automatic opening spring, locking catch, plastic-covered handles. Case hardened and precision ground. Adjusts to most wire sizes. Cuts and strips flex, splits plastic twin flex. **75p**

Prices shown are recommended retail, excluding V.A.T.
From Electrical and Hardware Shops. If unobtainable, send 10p p&p direct to:
Multicore Solders Ltd., Hemel Hempstead, Hertfordshire HP2 7EP

YATES ELECTRONICS

(FLITWICK) LTD.
ELSTOW STORAGE DEPOT
KEMPSTON HARDWICK
BEDFORD

C.W.O. PLEASE. POST AND PACKING PLEASE ADD 10p TO ORDERS UNDER £2.

Catalogue which contains data sheets for most of the components listed will be sent free on request. 10p stamp appreciated.

OPEN ALL DAY SATURDAYS

RESISTORS

½W Iskra high stability carbon film—very low noise—capless construction.
⅛W Mullard CR25 carbon film—very small body size 7·5 x 2·5mm.
½W 2% ELECTROSIL TR5

Power watts	Tolerance	Range	Values available	Price 1–99	Price 100+
⅓	5%	4·7Ω–2·2MΩ	E24	1p	0·8p
⅓	10%	3·3MΩ–10MΩ	E12	1p	0·8p
½	2%	10Ω–1MΩ	E24	3·5p	3p
⅛	10%	1Ω– 3·9Ω	E12	1p	0·8p
⅛	5%	4·7Ω–1MΩ	E12	1p	0·8p
4	10%	1Ω–10Ω	E12	6p	5·5p

Quantity price applies for any selection. Ignore fractions on total order.

DEVELOPMENT PACK

0·5 watt 5% Iskra resistors 5 off each value 4·7Ω to 1MΩ.
E12 pack 325 resistors **£2·40.** E24 pack 650 resistors **£4·70.**

POTENTIOMETERS

Carbon track 5kΩ to 2MΩ, log or linear (log ¼W, lin ½W).
Single, **12p.** Dual gang (stereo), **40p.** Single D.P. switch **24p.**

SKELETON PRESET POTENTIOMETERS

Linear: 100, 250, 500Ω and decades to 5MΩ. Horizontal or vertical P.C. mounting (0·1 matrix).
Sub-miniature 0·1W, **5p** each. Miniature 0·25W, **6p** each.

TRANSISTORS

AC107	**15p**	AF125	**20p**	BD132	**75p**	OC28	**50p**	2N3702	**13p**
AC126	**12p**	AF126	**20p**	BD133	**75p**	OC35	**50p**	2N3703	**12p**
AC127	**12p**	AF127	**20p**	BF115	**25p**	OC42	**12p**	2N3704	**13p**
AC128	**12p**	AF139	**32p**	BF173	**20p**	OC44	**12p**	2N3705	**12p**
AC131	**12p**	AF178	**32p**	BF177	**28p**	OC45	**12p**	2N3706	**11p**
AC132	**12p**	AF180	**40p**	BF178	**32p**	OC70	**12p**	2N3707	**12p**
AC176	**12p**	AF181	**40p**	BF179	**32p**	OC71	**12p**	2N3708	**10p**
AC187	**22p**	BC107	**9p**	BF180	**32p**	OC72	**12p**	2N3709	**11p**
AC188	**22p**	BC108	**9p**	BF181	**32p**	OC81	**12p**	2N3710	**11p**
AD140	**50p**	BC109	**9p**	BF194	**15p**	OC82D	**12p**	2N3711	**11p**
AD149	**45p**	BC147	**13p**	BF195	**15p**	2N2904	**20p**	2N4062	**12p**
AD161	**33p**	BC148	**13p**	BF197	**15p**	2N2926R	**9p**	40360	**35p**
AD162	**36p**	BC149	**13p**	BF200	**32p**	2N2926O	**9p**	40361	**35p**
AF114	**20p**	BC157	**14p**	BFY50	**20p**	2N2926Y	**9p**	40362	**40p**
AF115	**20p**	BC158	**14p**	BFY51	**20p**	2N2926G	**10p**	40408	**40p**
AF116	**20p**	BC159	**14p**	BFY52	**20p**			ZTX302	**15p**
AF117	**20p**	BC187	**22p**	BU105	**225p**	2N3054	**58p**	ZTX500	**15p**
AF117	**38p**	BD131	**75p**	OC26	**45p**	2N3055	**60p**	ZTX502	**20p**
AF124	**22p**								

ZENER DIODES

400mW 5% 3·3V to 30V, **12p.**

WIRE WOUND POTS, 3W, 10, 25, 50Ω and decades to 100kΩ, 35p.

DIODES

RECTIFIER

BY127	1250V	1A	**12p**
BZV10	800V	6A	**25p**
BZY13	200V	6A	**20p**
IN4001	50V	1A	**7p**
IN4004	400V	1A	**8p**
IN4007	1000V	1A	**10p**

SIGNAL

OA85	**7p**
OA90	**5p**
OA91	**5p**
OA202	**7p**
IN4148	**5p**
BA114	**8p**

BRUSHED ALUMINIUM PANELS

12in × 6in = **25p**; 12in × 2½in = **10p**; 9in × 2in = **7p**

SLIDER POTENTIOMETERS

86mm × 9mm × 16mm, length of track 59mm.
SINGLE 10K, 25K, 100K log. or lin. **40p.**
DUAL GANG, 10K + 10K etc. log. or lin. **60p.**
KNOB FOR ABOVE **12p.**
FRONT PANEL **65p.**
18 Gauge panel 12in × 4in with slots cut for use with slider pots. Grey or matt black finish complete with fixings for 4 pots.

THERMISTORS

VA1055S	**15p**
VA1066S	**15p**
VA1077	**15p**
R53	**£1·35**

COMPACT CASSETTES—IN PLASTIC LIBRARY BOX

C90	**65p**
C120	**85p**

MULLARD POLYESTER CAPACITORS C296 SERIES

400V: 0·001μF, 0·0015μF, 0·0022μF, 0·0033μF, 0·0047μF, **2½p.** 0·0068μF, 0·01μF, 0·015μF, 0·022μF, 0·033μF, **3p.** 0·047μF, 0·068μF, 0·1μF, **4p.** 0·15μF, **6p.** 0·22μF, **7½p.** 0·33μF, **11p.** 0·47μF, **13p.**
160V: 0·01μF, 0·015μF, 0·022μF, 0·033μF, 0·047μF, 0·068μF, **3p.** 0·1μF **3½p.** 0·15μF **4½p.** 0·22μF, **5p.** 0·33μF, **6p.** 0·47μF, **7½p.** 0·68μF, **11p.** 1·0μF, **13p.**

MULLARD POLYESTER CAPACITORS C280 SERIES

250V P.C. mounting: 0·01μF, 0·015μF, 0·022μF, **3p.** 0·033μF, 0·047μF, 0·068μF, **3½p.** 0·1μF, **4p.** 0·15μF, 0·22μF, **5p.** 0·33μF, **6½p.** 0·47μF, **8½p.** 0·68μF, **11p.** 1·0μF, **13p.** 1·5μF, **20p.** 2·2μF, **24p.**

MYLAR FILM CAPACITORS 100V

0·001μF, 0·002μF, 0·005μF, 0·01μF, 0·02μF, **2½p.** 0·04μF, 0·05μF, 0·068μF, 0·1μF, **3½p.**

CERAMIC DISC CAPACITORS

100pF to 10,000pF, **2p** each.

ELECTROLYTIC CAPACITORS—MULLARD 015/6/7 RANGE REPLACES C426, C457 RANGES.

(μF/v) 1·0/63, 1·5/63, 2·2/63, 3·3/63, 4·7/63, 6·8/40, 10/25, 10/63, 15/16, 15/40, 15/63, 22/10, 22/25, 22/63, 33/6·3, 33/40, 47/4, 47/10, 47/25, 47/40, 47/63, 68/6·3, 68/16, 100/4, 100/10, 100/25, 100/40, 150/6·3, 150/16, 150/25, 220/4, 220/10, 220/16, 330/4, 330/10, 470/6·3, **5p** each. 68/63, 150/40, 220/25, 330/16, 470/10, 680/6·3, 1,000/4, **9p.** 100/63, 150/63, 220/40, 470/25, 680/16, 1,000/10, 1,500/6·3, **12p.** 220/63, 470/40, 680/25, 1,000/16, 1,500/10, 2,200/6·3, **15p.** 330/63, 680/40, 1,000/25, 1,500/16, 2,200/10, 3,300/6·3, 4,700/4, **18p.**

SOLID TANTALUM BEAD CAPACITORS 12p

0·1μF	35V	2·2μF	35V	22μF	16V
0·22μF	35V	4·7μF	35V	33μF	10V
0·47μF	35V	6·8μF	25V	47μF	6·3V
1·0μF	35V	10μF	25V	100μF	3V

ELECTROLYTIC CAPACITORS Miniature P.C. mounting 5p each.

(μF/V): 10/12, 50/12, 100/12, 200/12, 5/25, 10/25, 25/25, 100/25.

VEROBOARD

	0·1	0·15
2½ × 3¾	**22p**	**16p**
2½ × 5	**24p**	**24p**
3¾ × 3¾	**24p**	**24p**
3¾ × 5	**27p**	**27p**
17 × 2½	**75p**	**57½p**
17 × 3¾	**100p**	**78p**
17 × 5 (plain)	—	**82p**
17 × 3¾ (plain)	—	**60p**
17 × 2½ (plain)	—	**42p**
2½ × 5 (plain)	—	**12p**
2½ × 3¾ (plain)	—	**11p**
Pin insertion tool	**52p**	**52p**
Spot face cutter	**42p**	**42p**
Pkt. 50 pins	**20p**	**20p**

JACK PLUGS AND SOCKETS

Standard screened	**18p**	2·5mm insulated	**8p**
Standard insulated	**12p**	3·5mm insulated	**8p**
Stereo screened	**35p**	3·5mm screened	**13p**
Standard socket	**15p**	2·5mm socket	**8p**
Stereo socket	**18p**	3·5mm socket	**8p**

D.I.N. PLUGS AND SOCKETS

2 pin, 3 pin, 5 pin 180°, 5 pin 240°, 6 pin
Plug 12p. Socket 8p.
4 way screened cable, **15p**/metre.
6 way screened cable **22p**/metre.

BATTERY ELIMINATOR £1·50

9V mains power supply. Same size as PP9 battery.

LARGE (CAN) ELECTROLYTICS

1600μF	64V	**74p**	2500μF	64V	**80p**	4500μF	16V	**50p**
2500μF	40V	**74p**	2800μF	100V	**£2·60**	4500μF	25V	**£1·68**
2500μF	50V	**58p**	3200μF	16V	**50p**	5000μF	50V	**£1·10**

HIGH VOLTAGE TUBULAR CAPACITORS—1,000 VOLT

0·01μF	**10p**	0·047μF	**13p**	0·22μF	**20p**
0·022μF	**12p**	0·1μF	**13p**	0·47μF	**22p**

POLYSTYRENE CAPACITORS 160V 2½%

10pF to 1,000pF E12 Series Values **4p each.**

SMOKE AND COMBUSTIBLE GAS DETECTOR—GDI £2

The GDI is the worlds first semiconductor that can convert a concentration of gas or smoke into an electrical signal. The sensor decreases its electrical resistance when it absorbs deoxidizing or combustible gases such as hydrogen, carbon monoxide, methane, propane, alcohol, North Sea gas, as well as carbon-dust containing air or smoke. This decrease is usually large enough to be utilized without amplification. Full details and circuits are supplied with each detector.

PRINTED BOARD MARKER 97p

Draw the planned circuit onto a copper laminate board with the P.C. Pen, allow to dry, and immerse the board in the etchant. On removal the circuit remains in high relief.

LARGE RANGE ITT/TEXAS IC's NOW IN STOCK

PRICES ARE CALCULATED ON TOTAL NUMBER ORDERED REGARDLESS OF MIX

INTRODUCTORY OFFER: 15% DISCOUNT ON THE PRICES OF IC's ON ALL ORDERS RECEIVED BEFORE THE END OF MARCH, 1973

	1–11 p	12–24 p	25–99 p	100+ p
7400	**18**	**16**	**14**	**13**
7401	**18**	**16**	**14**	**13**
7402	**18**	**16**	**14**	**13**
7403	**18**	**16**	**14**	**13**
7404	**20**	**18**	**16**	**14**
7405	**20**	**18**	**16**	**14**
7406	**50**	**45**	**40**	**35**
7407	**56**	**50**	**44**	**38**
7408	**36**	**30**	**27**	**23**
7409	**36**	**30**	**27**	**33**
7410	**18**	**16**	**14**	**13**
7411	**23**	**21**	**20**	**18**
7412	**36**	**30**	**27**	**23**
7413	**34**	**28**	**26**	**22**
7416	**45**	**43**	**39**	**34**
7420	**18**	**16**	**14**	**13**
7421	**36**	**30**	**27**	**23**
7426	**32**	**29**	**23**	**20**
7430	**20**	**18**	**16**	**14**
7432	**40**	**36**	**32**	**28**
7440	**20**	**18**	**16**	**14**
7441	**80**	**75**	**70**	**65**
7442	**80**	**75**	**70**	**65**
7443	**125**	**120**	**115**	**115**
7447	**175**	**165**	**150**	**120**
7448	**185**	**175**	**170**	**165**
7450	**18**	**16**	**14**	**13**
7451	**18**	**16**	**14**	**13**
7453	**18**	**16**	**14**	**13**
7454	**18**	**16**	**14**	**13**
7460	**18**	**16**	**14**	**13**
7470	**30**	**28**	**25**	**24**
7472	**30**	**28**	**27**	**23**
7473	**40**	**38**	**36**	**30**
7474	**40**	**36**	**32**	**28**
7475	**55**	**52**	**50**	**49**
7476	**40**	**36**	**32**	**30**
7480	**100**	**95**	**90**	**85**
7481	**125**	**115**	**110**	**105**
7482	**100**	**96**	**90**	**85**
7483	**100**	**97**	**95**	**92**
7484	**120**	**115**	**110**	**105**
7485	**250**	**245**	**240**	**230**
7486	**45**	**42**	**37**	**33**
7490	**75**	**67**	**60**	**52**
7491A	**100**	**92**	**85**	**79**
7492	**75**	**70**	**65**	**60**
7493	**75**	**68**	**60**	**52**
7494	**95**	**90**	**85**	**80**
7495	**105**	**100**	**95**	**90**
7496	**100**	**95**	**90**	**85**
74100	**250**	**240**	**235**	**230**
74118	**100**	**82**	**73**	**64**
74121	**43**	**40**	**38**	**36**
74141	**100**	**95**	**90**	**85**
74145	**150**	**140**	**135**	**130**
74150	**330**	**280**	**250**	**220**
74151	**110**	**100**	**95**	**89**
74153	**120**	**110**	**105**	**95**
74154	**200**	**180**	**170**	**160**
74155	**150**	**120**	**100**	**86**
74156	**130**	**120**	**100**	**96**
74180	**155**	**136**	**112**	**105**
74190	**195**	**190**	**185**	**180**
74191	**195**	**190**	**185**	**180**
74192	**200**	**190**	**180**	**164**
74193	**200**	**180**	**170**	**150**
74196	**200**	**190**	**180**	**170**
74197	**200**	**195**	**180**	**170**

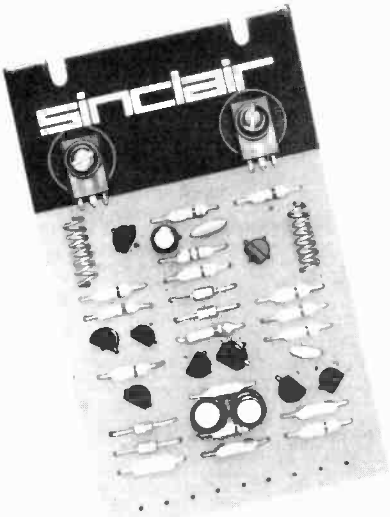
LINEAR IC's

709	14 pin DIL	**32p**
741	8 pin DIL	**34p**
741	14 pin DIL	**28p**
723	14 pin DIL	**95p**
747	14 pin DIL	**85p**
748	8 pin DIL	**35p**
DIL socket,	14 pin and 16 pin	**16p**

Sinclair Project 60

Now–the Z.50 Mk.2

with built-in automatic transient overload protection



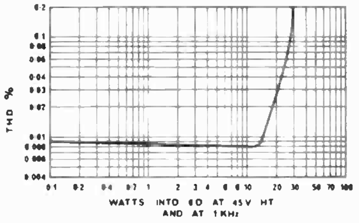
When originally introduced, the Sinclair Z.50 proved how it was possible to design and produce a popularly priced modular power amplifier having characteristics to challenge the world's costliest amplifiers. Many thousands of Z.50's are now giving excellent service day in, day out. But we have also learned that constructors do not always use their Z.50's ideally. That is why we have introduced modifications whereby risk of damage through mis-use, is greatly reduced and performance further enhanced. The Z.50 Mk.2 has improved thermal stability, more accurately regulated D.C. limiting to ensure more symetrical output voltage swing and clipping and still less distortion at lower power. Z.50 Mk.2 is compatible with all other Project 60 modules, and may be incorporated to advantage in existing systems. Eleven silicon epitaxial planar transistors are now used, two more than in the original Z.50; circuitry has been re-designed, making this versatile high performance amplifier better than ever.

with free manual

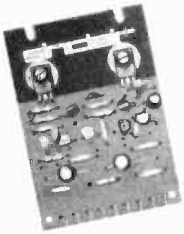
£5.48

Brilliant new technical specifications

Input impedance 100 KΩ
Input (for 30w into 8Ω) 400mV
Signal to noise ratio, referred to full o/p at 30v HT 80dB or better
Distortion 0.02% up to 20W at 8Ω. See curve
Frequency response 10Hz to more than 200 KHz ±1dB
Max. supply voltage 45v (4Ω to 8Ω speakers) (50v 15Ω speakers only)
Min. supply voltage 9v
Load impedance – minimum 4Ω at 45v HT
Load impedance – maximum safe on open circuit



Z.30 the power amplifier for quality and economy



with free manual

£4.48

The Z.30 provides excellent facilities for the constructor requiring a high fidelity audio system of less power than that available from Z.50's. Using a power supply of 35 volts, Z.30 will deliver 15 watts RMS into 8 ohms, or 20 watts RMS into 3 ohms using 30 volts. Total harmonic distortion is a fantastically low 0.02% at 15 watts into 8 ohms with signal to noise ratio better than 70 dB unweighted. Input sensitivity 250mV into 100K ohms. Size 80 x 57 x 13 mm (3⅛ x 2¼ x ½) Z.30. Z.50 and Z.50 MK.2 modules are compatible and interchangeable.

Guarantee

If, within 3 months of purchasing any product direct from Sinclair Radionics Ltd., you are dissatisfied with it, your money will be refunded at once. Many Sinclair appointed Stockists also offer this same guarantee in co-operation with Sinclair Radionics Ltd.

Each Project 60 module is tested before leaving our factory and is guaranteed to work perfectly. Should any defect arise in normal use, we will service it at once and without any charge to you, if it is returned within two years from the date of purchase. Outside this period of guarantee a small charge (typically £1.00) will be made. No charge is made for postage by surface mail. Air Mail is charged at cost.

sinclair

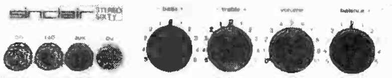
Typical Project 60 applications

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

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

the world's most advanced high fidelity modules

Stereo 60 Pre-amp/control unit



Designed specifically for use on Project 60 systems, the Stereo 60 is equally suitable for use with any high quality power amplifier. Since silicon epitaxial planar transistors are used throughout, a really high signal-to-noise ratio and excellent tracking between channels is achieved. Input selection is by means of press buttons, with accurate equalisation on all input channels. The Stereo 60 is particularly easy to mount.

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

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

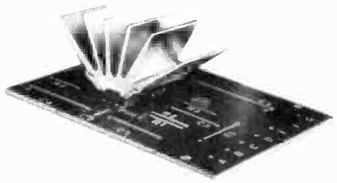
Project 60 Stereo F.M. Tuner

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

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

Built and tested. Post free. **£25**

Super IC.12 Integrated circuit high fidelity amplifier



Having introduced Integrated Circuits to hi-fi constructors with the IC.10, the first time an IC had ever been made available for such purposes, we have followed it with an even more efficient version, the Super IC.12, a most exciting advance over our original unit. This needs very few external resistors and capacitors to make an astonishingly good high fidelity amplifier for use with pick-up, F.M. radio or small P.A. set up, etc. The free 40 page manual supplied, details many other applications which this remarkable IC make possible. It is the equivalent of a 22 transistor circuit contained within a 16 lead DIL package, and the finned heat sink is sufficient for all requirements. The Super IC.12 is compatible with Project 60 modules which would be used with the Z.50 and Z.30 amplifiers. Complete with free manual and printed circuit board.

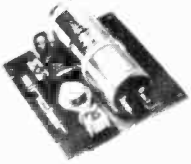
SPECIFICATIONS

Output power: 6 watts RMS continuous (12 watts peak). 6–8Ω. **Frequency Response:** 5Hz to 100KHz ±1dB. **Total Harmonic Distortion:** Less than 1%. (Typical 0·1%) at all output powers and frequencies in the audio band (28V). **Load Impedance:** 3 to 15 ohms. **Input Impedance:** 250 Kohms nominal. **Power Gain:** 90dB (1,000,000,000 times) after feedback. **Supply Voltage:** 6 to 28V. **Quiescent current:** 8mA at 28V. **Size:** 22 x 45 x 28mm including pins and heat sink.

Manual available separately 15p post free.

With FREE printed circuit board and 40 page manual.
£2.98 Post free

Power Supply Units The new PZ.8 Mk.3



The most reliable power supply unit ever made available to constructors. Brilliant circuitry makes failure from over load and even direct shorting of the output impossible. This is due to an ingenious re-entrant current limiting principle which, as far as we know has never before been available in any comparable unit outside the most expensive laboratory equipment. Ripple and residual noise have been reduced to the point of almost total elimination. This is, of course, the perfect unit for Project 60 assemblies, particularly where the new Z.50 MK.2 amplifiers are used. Nominal working voltage – 45.

PZ.8 Mk.3—£7.98
(Mains transformer, if required) £5.98
PZ.5 30v. unstabilised
(not suitable for Project 60 tuner) £4.98
PZ.6 35v. stabilised
(not suitable for IC. 12) £7.98

Project 605

the easy way to buy and build Project 60 without soldering

Project 605 in one pack contains: one PZ.5, two Z.30's, one Stereo 60 and one Masterlink, which has input sockets and output components grouped on a single module and all necessary leads cut to length and fitted with clips to plug straight on to the modules thus eliminating all soldering.

Complete with comprehensive manual, post free **£29.95**
All you need for a superb 30 watt high fidelity stereo amplifier

Order form

Please send
I enclose cash/cheque/money order
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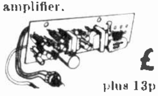
LOW VOLTAGE AMPLIFIER

5 transistor amplifier complete with volume control, is suitable for 9V d.c. and a.c. supplies. Will give about 1W at 8 ohm output.
With high IMP input this amplifier will work as a record player, baby alarm, etc., amplifier.



£1·75 plus 13p P. & P.

TRI-VOLT BATTERY ELIMINATOR

Enables you to work your Transistor Radio, Amplifier or Cassette, etc., from the a.c. mains through this compact Eliminator. Just by moving a plug you can select the voltage you require. 6, 7½ or 9 volt. This means all your transistor power pack applications can be handled by this one unit. Approx. size 2¾in · 2¼in 3¼in. Our Price **£2·75** plus 10p P. & P. Same model suitably wired for the Philips Cassette **£3** plus 10p P. & P.

DIGITAL CLOCK KIT

24-hr. Nixie dig. clock kit. We supply: a complete set of components; a complete set of easy to follow instructions; printed circuits made to make construction as simple as possible; a cabinet and front panel to give a professional finish. All for the price of the components. **£22·50** + 50p P. & P. Please send S.A.E. if you require more information.

EA1000 3 WATT AUDIO AMPLIFIER

An Audio Amplifier designed around the TAA621 Linear I.C.:—

Supply Voltage .. .	9-24V
Speaker Imp. . .	8-16 ohm
Frequency	50Hz-25kHz
Overall Size	2in × 3in × ¾in

Ideal Amplifier for radios, record players, stereo units, etc.
Full technical data and diagrams with each module. All guaranteed and a bargain at **£2·63** + 5p P. & P.

V.A.T.

From 1st April, 1973, will you please include on your Total (Goods plus Postage and Packing) Value Added Tax at the Standard Stated Rate.

MINI LOUDSPEAKERS

2¼in 8 ohm .	**50p**
2¼in 80 ohm . ..	**50p**
2¼in 40 ohm .. .	**50p**

Please include 5p P. & P. on each L.S.

MAINS TRANSFORMER

Fused Primary 240V. Secondary 220V @ 50mA. 6·3V @ 1A. This transformer is made to a very high standard and is a small size: 2in × 2½in × 2¼in. **63p** plus 15p P. & P.

S. G. BROWN "DIPLOMAT" MONO/STEREO HEADSET. Finest quality British made Lightweight Headphones. Incorporate ceramic piezo electric transducers. *Specification:*—Frequency 20–17,500 CPS. Impedance Predominantly capacitive, at ·001MFD per earpiece can be regarded as 150K at 1kcs. Weight—3·5oz. (98 grams). Please include 10p per set P.P. A Bargain at **£1·50** each set.

TRI-VOLT CAR SUPPLY

Enables you to work your Transistor Radio, Amplifier or Cassette, etc. from the 12 volt car supply. Positive or negative earth. Approx. size = 2in. × 3¼in. × 1½in. This converter supplies 6, 7½ or 9 volts and is transistor regulated. A real money saving device for **£2·50** plus 10p P. & P.

MINIATURE RELAY

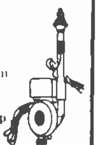
6 volt 70 ohm.
Single Pole Changeover **40p** plus 5p P. & P.
Approx. size = 1¼in. × 1in. × ¾in.

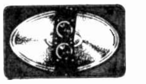
ADD LUXURY TO YOUR CAR

WITH A MOTOR DRIVEN CAR AERIAL

Spec.: 5 Section
Extended Length 100cm
Length under Fender 40cm
Cable Length 120cm

Supplied complete with Fixing Bracket and Control Switch. **£5·75** plus 25p P. & P.





EMI LOUDSPEAKER 450

10W 13in · 8in ± two 2·2½in tweeters and cross-over. All wired and ready for use. This ever-popular 450 in 3–8–15 ohm imp.
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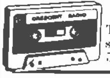
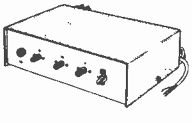
CRESCENT CASSETTES



Top quality cassettes at unbeatable prices (complete with standard storage case): C60 **28p**, C90 **38p**, C120 **48p** plus 5p P. & P.

PSYCHEDELIC LIGHT CONTROL UNIT



Three Channel: Bass Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 500W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed) **£18·50** plus 38p P. & P.

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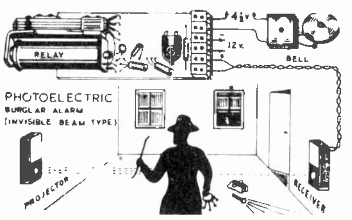

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BZY88C8V2	13p
BZY88C9V1	13p
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BZY88C11V	13p
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2N698	30p
2N706	10p
2N706A	12p
2N708	16p
2N911	50p
2N914	20p
2N918	42p
2N929	25p
2N930	28p
2N1131	24p
2N1132	24p
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2N1306	30p
2N1307	30p
2N1308	34p
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74191	£1·80
74192	£1·74
74193	£1·74
74196	£1·50
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40311	42p
40312	62p
40320	42p
40360	56p
40361	45p
40362	45p
40406	52p
40407	40p
40408	54p
40409	62p
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Mfd.	Working Voltage	Price	Mfd.	Working Voltage	Price
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1·0	100v	5p	100	25v	6p
2·2	25v	7p	100	40v	7p
2·2	63v	5p	100	63v	10p
4·7	40v	5p	220	25v	8p
10	25v	5p	220	40v	9p
10	63v	6p	470	25v	12p
22	25v	6p	1000	25v	16p
22	40v	6p	2200	25v	30p
47	25v	6p	4700	16v	33p
47	40v	6p			

CAPACITORS—METALLISED POLYESTER

Stock values: MFD	Price each
0·01, 0·015, 0·022, 0·033	3p
0·047, 0·068, 0·10	4p
0·150, 0·220	5p
0·33	7p
0·47	8p
0·68	11p
1·0	14p
1·5	20p
2·2	24p

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Axial leads, Clear encapsulation, 5% Tolerance. 160 volt working.

Stock values	Price each
100pF, 150pF, 220pF, 330pF, 470pF, 560pF, 680pF, 820pF, 1000pF, 1500pF, 2200pF, 3300pF, 4700pF, 5600pF, 6800pF.	3p

Order as: "Polystyrenes" + Capacitance.

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10DN **34p** (Plain All undrilled)
10DDR 43p (Plain All drilled 2 x To3)

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DRD 7 14 Pin DIL **15p** DRD 8 16 Pin DIL **17p**

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Cheese head screw bolts. Nuts with integral washer. Moulded in high density nylon. Ideal for mounting "live" assemblies, power transistors, etc.

Each pack consists of four nuts and four screw bolts.

Pack No.	Thread	Length	Quantity	Pack Price
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A range of miniature high stability resistors with very low noise characteristics and long life. Tolerances, ranges and wattages as indicated. (Wattage ratings are at max. limiting voltage).

Type No.	Wattage	Tol.	Range	Series	Price
UPM050	0·5	5%	10E-1M	E12	1p each
UPM050	0·5	10%	1M -4·7M	E12	1p each
UPM075	0·75	5%	10E-1M	E12	1p each
UPM075	0·75	10%	1M -4·7M	E12	1p each
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ALSO AVAILABLE WITH 115/120V SEC. WINDING

Ref.	VA	Weight		Size cm.		P & P
No.	(Watts)	lb	oz		£	p
07	20	1	11	7·0 × 6·0 × 6·5	1·61	30
100	60	3	8	8·9 × 8·0 × 7·7	2·39	36
61	100	5	12	10·2 × 8·9 × 8·3	2·62	52
30	200	9	8	12·0 × 10·3 × 10·0	4·39	52
62	250	12	4	9·5 × 12·7 × 11·4	5·80	67
55	350	15	0	14·0 × 10·8 × 12·4	7·77	82
63	500	27	0	17·1 × 11·4 × 15·9	11·20	*
92	1000	40	0	17·8 × 17·1 × 21·6	20·63	*
128	2000	63	0	24·1 × 21·6 × 15·2	34·10	*

AUTO SERIES (NOT ISOLATED)

Ref.	VA	Weight		Size cm.	Auto Taps		P & P
No.	(Watts)	lb	oz			£	p
113	20		11	7·3 × 4·3 × 4·4	0-115-210-240	0·85	22
64	75	1	14	7·0 × 6·4 × 6·0	0-115-210-240	1·66	30
4	150	3	0	8·9 × 6·4 × 7·6	0-115-200-220-240	2·00	36
66	300	6	0	10·2 × 10·2 × 9·5	,, ,,	3·89	52
67	500	12	8	14·0 × 10·2 × 11·4	,, ,,	5·78	67
84	1000	16	0	11·4 × 14·0 × 14·0	,, ,,	10·49	82
93	1500	28	9	13·5 × 14·9 × 16·5	,, ,,	15·20	*
95	2000	40	0	17·8 × 16·5 × 21·6	,, ,,	19·84	*
73	3000	45	8	17·4 × 18·1 × 21·3	,, ,,	26·99	*

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PRIMARY 200-250 VOLTS 12 AND/OR 24 VOLT RANGE

Ref.	Amps.		Weight		Size cm.	Secondary Windings		P & P
No.	12V	24V	lb	oz			£	p
111	0·5	0·25		12	7·6 × 5·7 × 4·4	0-12V at 0·25A × 2	0·85	22
213	1·0	0·5	1	0	8·3 × 5·1 × 5·1	0-12V at 0·5A × 2	1·01	22
71	2	1	1	0	7·0 × 6·4 × 5·7	0-12V at 1A × 2	1·33	22
18	4	2	2	4	8·3 × 7·0 × 7·0	0-12V at 2A × 2	1·86	36
70	6	3	3	12	10·2 × 7·6 × 8·6	0-12V at 3A × 2	2·24	42
108	8	4	5	4	10·0 × 8·3 × 8·2	0-12V at 4A × 2	2·48	52
72	10	5	6	3	7·9 × 10·8 × 10·2	0-12V at 5A × 2	2·94	52
17	16	8	7	8	12·1 × 9·5 × 10·2	0-12V at 8A × 2	4·54	52
115	20	10	11	13	12·1 × 11·4 × 10·2	0-12V at 10A × 2	5·78	67
187	30	15	16	12	13·3 × 12·1 × 12·1	0-12V at 15A × 2	10·67	82
226	60	30	34	0	17·0 × 14·5 × 12·5	0-12V at 30A × 2	19·61	*

30 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps		P & P
No.		lb	oz			£	p
112	0·5	1	4	8·3 × 3·7 × 4·9	0-12-15-20-24-30V	1·01	22
79	1·0	2	0	7·0 × 6·4 × 6·0	,, ,,	1·35	36
3	2·0	3	2	8·9 × 7·0 × 7·6	,, ,,	2·01	36
20	3·0	4	6	10·2 × 8·9 × 8·6	,, ,,	2·48	42
21	4·0	6	0	10·2 × 10·0 × 8·6	,, ,,	2·94	52
51	5·0	6	8	12·1 × 10·0 × 8·6	,, ,,	3·66	52
117	6·0	7	8	12·1 × 10·0 × 10·2	,, ,,	4·36	52
88	8·0	10	0	14·0 × 11·7 × 10·0	,, ,,	5·64	67
89	10·0	12	2	14·0 × 10·2 × 11·4	,, ,,	7·14	67

50 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps		P & P
No.		lb	oz			£	p
102	0·5	1	11	7·0 × 7·0 × 5·7	0-19-25-33-40-50V	1·33	30
103	1·0	2	10	8·3 × 7·3 × 7·0	,, ,,	1·94	36
104	2·0	5	0	10·2 × 8·9 × 8·6	,, ,,	2·69	42
105	3·0	6	0	10·2 × 10·2 × 8·3	,, ,,	3·65	52
106	4·0	9	4	12·1 × 11·4 × 10·2	,, ,,	4·83	52
107	6·0	12	4	12·1 × 11·1 × 13·3	,, ,,	7·14	67
118	8·0	18	9	13·3 × 13·3 × 12·1	,, ,,	9·32	97
119	10·0	19	12	16·5 × 11·4 × 15·9	,, ,,	11·68	97

60 VOLT RANGE

Ref.	Amps.	Weight		Size cm.	Secondary Taps		P & P
No.		lb	oz			£	p
124	0·5	2	4	8·3 × 9·5 × 6·7	0-24-30-40-48-60V	1·35	36
126	1·0	3	0	8·9 × 7·6 × 7·6	,, ,,	1·88	36
127	2·0	5	6	10·2 × 8·9 × 8·6	,, ,,	2·94	42
125	3·0	8	8	11·9 × 9·5 × 10·0	,, ,,	4·48	52
123	4·0	10	6	11·4 × 9·5 × 11·4	,, ,,	5·78	67
120	6·0	16	12	13·3 × 12·1 × 12·1	,, ,,	8·37	82
122	10·0	23	2	16·5 × 12·7 × 16·5	,, ,,	13·85	*

LEAD ACID BATTERY CHARGER TYPES

Ref.	Amps.	Weight		Size cm.			P & P
No.		lb	oz			£	p
45	1·5	1	9	7·0 × 6·0 × 6·0	Please note, these units do not include rectifiers	1·34	30
5	4·0	3	11	10·2 × 7·0 × 8·3		2·03	42
86	6·0	5	12	10·2 × 8·9 × 8·3		3·07	52
146	8·0	6	4	8·9 × 10·2 × 10·2		3·49	52
50	12·5	11	14	13·3 × 10·8 × 12·1		5·20	67

All ratings are continuous. Standard construction: open with solder tags and wax impregnation. Enclosed styles to order.

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100 + **6·5p**	100 + **45p**	100 + **50p**
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MULLARD POLYESTER CAPACITORS C296 SERIES
160V: (μF) 0·01, 0·015, 0·022, **2p**; 0·047, 0·068, **3p**; 0·15, 0·22, **4p**; 0·33, **5p**; 0·47, **6p**; 0·68, 1·0, **10p.**
400V: (μF) 0·001, 0·0015, 0·0022, 0·0033, 0·01, **2p**; 0·015, 0·033, **3p**; 0·068, **4p.**

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MULLARD C437: (μF/V) 64/64, **9p**; 160/25, **9p**; 160/40, **11p**; 640/6·4, **9p**; 1600/6·4, **14p.**

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50V: (pF) 22, 27, 33, 39, 47, 56, 68, 82, 100, 120, 150, 180, 220, 270, 330, 390, 470, 560, 680, 820, 1K, 1K5, 2K2, 3K3, 4K7, 6K8. (μF) 0·01, 0·015, 0·022, 0·033, **2p.** 0·047, 30V, **3p.** 0·1, 1,100V, **5p.**
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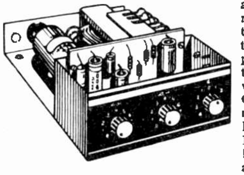

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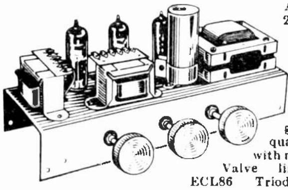
PRICE £10·50 P. & P. 25p.

DE LUXE STEREO AMPLIFIER



A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. **Price £8·92.** P. & P. 45p.

NEW! POWER SUPPLY UNIT

200/240V A.C. input. Four switched fully smoothed D.C. outputs giving 6V and 7½V and 9V and 12V at 1 amp continuous (1½ amp intermittent).
Fitted insulated output terminals and pilot lamp indicator. Hammer finish metal case, overall size 6" · 3½" · 2½". Suitable for Transistor Radios, Tape Recorders, Amplifiers, etc., etc. Ready built and tested.

PRICE £4·50 P. & P. 35p.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2½in × 3in approx. **25p** pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS. 8" × 6", 5 for **50p**. P. & P. 13p.

BRAND NEW MULTI-RATIO MAINS TRANSFORMERS. Giving 13 alternatives. Primary: 0-210-240V. Secondary combinations: 0-5-10-15-20-25-30-35-40-60V half wave at 1 amp or 10-0-10, 20-0-20, 30-0-30V, at 2 amps full wave. Size 3inL 3½inW × 3inD. Price **£1·85.** P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies.
Pri. 200/240V. Sec. 9–0–9 at 500mA. **85p.** P. & P. 13p.
Pri. 200/240V. Sec. 12–0–12 at 1 amp. **95p.** P. & P. 13p.
Pri. 200/240V. Sec. 10–0–10 at 2 amp. **£1·45.** P. & P. 30p.

GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9–18V. Battery or from H.T. line 200/300V. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1¾ × 1½ × ¾in. Brand new — complete with instructions. Price **88p.** P. & P. 13p.

HANDBOOK OF TRANSISTOR EQUIVALENTS and SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A., European and Japanese transistors. ONLY **40p.** Post 5p.

V.A.T.
Prices in this advertisement (incl. P. & P.) will be subject to V.A.T. as from 1st April, 1973.

4-SPEED RECORD PLAYER BARGAINS

Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/C129 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97.** Carr. 50p. With stereo cartridge **£7·97.** Carr. 50p.
Garrard SP25 Mk. III with heavy precision machined die cast turntable. **£10·95.** Carr. 50p.

SPECIAL BARGAIN OFFER!

PRECISION ENGINEERED PLINTHS

Beautifully constructed in heavy gauge "Colorcoat" plastic coated steel. Resonance free. Designed to take Garrard 1025, 2000, 2025TC, 2500, 3000, 3500, 5100, SP25 II and III, SL65B, AT60, etc., or B.S.R. C109, C129, A21, etc. Black leatherette finish. Size 12¾in × 14¾in × 3¼in high (approx. 7¼in high, including rigid smoked acrylic cover). P. & P. 35p. **NOW ONLY £4·50**

LATEST ACOS GP91/1SC Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50.** P. & P. 8p.

SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus. Diamond Stereo LP and Sapphire 78. ONLY **£2·50.** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3.** P. & P. 10p.

LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **£1·63.** P. & P. 10p.

LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. **£1·50.** P. & P. 10p.

QUALITY RECORD PLAYER AMPLIFIER MK II

A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w. × 3 d. × 6 h. Ready built and tested. PRICE **£3·95.** P. & P. 40p. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit cabinet below. PRICE **£5·25.** P. & P. 50p.

DE LUXE QUALITY PORTABLE R/P CABINET MK II Uncut motor board size 14½ × 12in., clearance 2in. below, 5½in. above. Will take above amplifier and any B.S.R. or GARRARD changer or Single Player (except AT60 and SP25). Size 18 × 5 × 8in. PRICE **£4·75.** P. & P. 50p.

SPECIAL OFFER!!

HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½in high × 10½in wide × 5½" deep. Fitted with E.M.I. Ceramic Magnet 13in × 8in bass unit, two H.F. tweeter units and crossover. Max. power handling 10W. Available 3, 8 or 15 ohm impedance.

Our Price £8·40 Carr. 65p.

CABINET AVAILABLE SEPARATELY **£4·50.** Carr. 60p.

Also available in 8 ohm with EMI 13in × 8in. bass speaker with parasitic tweeter. **£6·50.** Carr. 65p.

LOUDSPEAKER BARGAINS

5in 3 ohm **£1·05,** P. & P. 15p. 7 × 4in 3 ohm **£1·15,** P. & P. 20p. 10 × 6in 3 or 15 ohm **£1·90,** P. & P. 30p. E.M.I. 8 × 5in 3 ohm with high flux magnet **£1·62,** P. & P. 20p. E.M.I. 13½ × 8in with high flux ceramic magnet with parasitic tweeter 3, 8, or 15 ohm **£3·20.** P. & P. 30p. E.M.I. 13 × 8in, 3 or 8 or 15 ohm with two inbuilt tweeters and crossover network **£4·20.** P. & P. 30p.

BRAND NEW. 12in 15w H/D Speakers, 3 or 15 ohm. Current production by well-known British maker. Now with Hiflux ceramic ferrobar magnet assembly **£6·75.** Guitar models: 25w **£6·75.** 35w **£8·50.** P. & P. 38p each.

SPECIAL OFFER!

LIMITED NUMBER OF BRAND NEW ELAC 10" TWIN CONE LOUDSPEAKERS. With large ceramic magnet and plasticised cone surround, 8 ohm impedance.

£2·75. P. & P. 25p.

12in "RA" TWIN CONE LOUDSPEAKER

10 watts peak handling, 3, 8 or 15 ohm, **£2·20.** P. & P. 30p.

35 ohm SPEAKERS 3". ONLY **63p.** P. & P. 13p.

"POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER Size 11¾in × 14 11/16in × 1 7/16in deep. Weight 19oz. Power handling 20W r.m.s. (40W peak). Impedance 8 ohm only. Response 40Hz–20kHz. Can be mounted on ceilings, walls, doors, under tables, etc., and used with or without baffle. Send S.A.E. for full details. Only **£5·95** each. P. & P. 25p.

VYNAIR & REXINE SPEAKERS & CABINET FABRICS app. 54 in. wide. Usually £1·75 yd., our price **75p** yd. length. P. & P. 15p per yd. (min. 1 yd.). S.A.E. for samples.

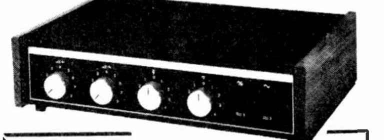
HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam earmuffs. Wired and fitted with standard stereo ¼in jack plug. Frequency response 30–15,000Hz. Matching impedance 8–16 ohms. Easily converted for mono. PRICE **£2·95.** P. & P. 15p.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **£1·05.** P. & P. 8p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA for balance or tuning. Approx. size 1in × 1in × ¾in. Limited number **75p.** P. & P 10p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



NEW FURTHER IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED FIBRE GLASS PRINTED CIRCUIT BOARD WITH COMPONENT IDENTIFICATION CLEARLY MARKED FOR EVEN EASIER CONSTRUCTION

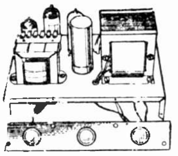
A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two Volume Controls. Suitable for use with Ceramic or Crystal cartridges. (Very simple to modify to suit magnetic cartridge—instructions included). Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled fibre glass printed circuit board, smart brushed anodised aluminium front panel with matching knobs, wire, solder, nuts, bolts—no extras to buy. Simple step by step instructions enable any constructor to build an amplifier to be proud of. Brief specification: Power output 14W r.m.s. per channel into 5 ohms. Frequency response ± 3dB 12–30,000Hz. Sensitivity better than 80mV into 1MΩ. Full power bandwidth ± 3dB 12–15,000Hz. Bass boost approx. to ± 12dB. Treble cut approx. to —16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1·0 amp. Overall size—12" wide × 8" deep × 2½" high.

Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.

PRICES	AMPLIFIER KIT,	**£10·50**	P. & P. 15p.
	(Magnetic input components 30p extra)		
	POWER PACK KIT,	**£3**	P. & P. 30p.
	CABINET,	**£3**	P. & P 30p.

(Post Free if all units purchased at same time). Full after sales service. Also available ready built and tested, **£20·50.** Post Free.

Note: The above amplifier is suitable for feeding two mono sources into inputs (e.g. mike, radio, twin record decks, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discotheque use, etc.



3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7½in w. × 4in. d. × 4¾in. h. Incorporates ECC83, EL84, EZ80 valves. Heavy duty, double wound mains transformer and output transformer matched for 3 ohm speaker. Separate volume control and now with improved wide range tone controls giving bass and treble lift and cut. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. Complete with knobs, valves, etc., wired and tested for only **£4·95.** P. & P. 35p.

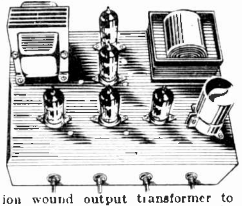
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£4·10.** P. & P. 40p.

HARVERSON'S SUPER MONO AMPLIFIER

A super quality gram amplifier using a double wound fully isolated mains transformer, rectifier and ECL82 triode pentode valve as audio amplifier and power output stage. Impedance 3 ohms. Output approx. 3·5 watts. Volume and tone controls. Chassis size only 7in. wide × 3in. deep × 6in. high overall. AC mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer.

OUR ROCK BOTTOM BARGAIN PRICE **£2·95** P. & P. 35p

10/14 WATT HI-FI AMPLIFIER KIT



A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Super reproduction of both music and speech, with negligible hum. Separate inputs for mike and gram allow records and announcements to follow each other Fully shrouded section wound output transformer to match 3–15Ω speaker and 2 independent volume controls, and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84s, ECC83, EF86 and EZ80 rectifier. Simple instruction booklet **13p** (Free with parts). **All parts sold separately.** ONLY **£7·97.** P. & P. 55p. Also available ready built and tested **£10·97.** P. & P. 60p.

Open 9-5.30 Monday to Saturday
Early closing Wed. 1 p.m.
A few minutes from South Wimbledon Tube Station

HARVERSON SURPLUS CO. LTD.

Dept. PE, 170 High St., Merton, London, S.W.19 Tel. 01-540 3985

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BRAND NEW GUARANTEED

SEMICONDUCTORS & COMPONENTS

WE SUPPLY NEARLY ALL THE COMPONENTS FOR PROJECTS IN THIS MAGAZINE

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2N274	0·75
2N335	0·75
2N351	0·95
2N376	1·00
2N384	0·93
2N388A	0·40
2N404	0·23
2N456	0·75
2N456A	0·75
2N457A	0·80
2N491	3·25
2N584	0·26
2N591	0·34
2N696	0·16
2N697	0·15
2N698	0·25
2N699	0·29
2N706	0·10
2N706A	0·12
2N708	0·15
2N709	0·40
2N711	0·50
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2N1131	0·25
2N1132	0·25
2N1184	1·57
2N1302	0·16
2N1303	0·16
2N1304	0·20
2N1305	0·25
2N1306	0·22
2N1307	0·22
2N1308	0·25
2N1309	0·25
2N1483	0·90
2N1507	0·24
2N1613	0·19
2N1631	0·38
2N1637	0·36
2N1638	0·32
2N1671	1·25
2N1701	1·46
2N1702	2·61
2N1711	0·23
2N1893	0·37
2N2102	0·30
2N2147	0·70
2N2148	0·60
2N2192	0·40
2N2192A	0·40
2N2193	0·40
2N2193A	0·42
2N2194	0·27
2N2194A	0·30
2N2195	0·37
2N2195A	0·18
2N2218A	0·18
2N2219	0·20
2N2219A	0·20
2N2220	0·20
2N2221	0·20
2N2221A	0·22
2N2222	0·20
2N2222A	0·32
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2N2925	0·12
2N2926	
Green	0·10
Yellow	0·10
Orange	0·10
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2N3055	0·60
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2N3391	0·20
2N3391A	0·22
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2N3403	0·19
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3N140	0·92
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3N142	0·58
3N143	0·75
3N152	0·92
3N153	0·81
3N154	0·84
3N159	1·17
3N200	2·49
LM741CN (d.i.l)	0·70
L741C (TO5)	0·40
40050	0·55
40251	0·81
40309	0·30
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AC127	0·25
AC128	0·25
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AC142K	0·25
AC151V	0·14
AC152V	0·17
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AD140	0·50
AD141	0·55
AD142	0·50
AD143	0·45
AC149V	0·66
AD149V	1·26
AD150	0·63
ADZ11	1·50
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AF106	0·27
AF109R	0·40
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AF172	0·25
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AF200	0·35
AF239	0·41
AF240	0·72
AF279	0·54
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AFY42	0·75
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AL102	0·75
AL103	0·70
ASY26	0·30
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BC309	0·10
BC309A	0·10
BC309B	0·10
BC313	0·30
BC327	0·24
BC328	0·22
BC337	0·19
BC338	0·19
BCY30	0·35
BCY31	0·40
BCY32	0·60
BCY33	0·25
BCY34	0·35
BCY38	0·40
BCY39	0·05
BCY40	0·50
BCY42	0·15
BCY43	0·15
BCY58	0·21
BCY59	0·21
BCY66	0·66
BCY67	0·94
BCY70	0·17
BCY71	0·20
BCY72	0·13
BCY87	3·47
BCY88	2·40
BCY89	0·80
BCZ10	0·35
BCZ11	0·50
BD115	0·75
BD116	0·75
BD121	0·75
BD123	0·82
BD124	0·60
BD130	0·57
BD131	0·40
BD132	0·50
BD135	0·43
BD136	0·49
BD137	0·55
BD138	0·63
BD139	0·71
BD140	0·23
BDY10	1·25
BDY11	1·50
BDY17	1·50
BDY18	1·75
BDY19	1·97
BDY20	0·80
BDY38	0·55
BDY60	0·65
BDY61	0·57
BDY62	0·52
BF115	0·23
BF117	0·43
BF119	0·58
BF121	0·25
BF123	0·27
BF125	0·25
BF127	0·27
BF152	0·20
BF153	0·29
BF154	0·16
BF158	0·23
BF159	0·27
BF160	0·23
BF161	0·41
BF163	0·20
BF166	0·31
BF167	0·21
BF173	0·22
BF177	0·29
BF178	0·35
BF179	0·43
BF180	0·35
BF181	0·34
BF182	0·40
BF183	0·40
BF184	0·17
BF185	0·25
BF194	0·14
BF195	0·16
BF196	0·15
BF197	0·15
BF198	0·18
BF199	0·18
BF200	0·40
BF224J	0·14
BF225J	0·19
BF237	0·22
BF238	0·22
BF244	0·16
BF245	0·33
BF246	0·43
BF247	0·49
BF254	0·16
BF255	0·17
BF257	0·47
BF258	0·53
BF259	0·55
BF261	0·23
BF264	1·45
BF270	0·21
BF271	0·21
BF272	0·49
BF273	0·15
BF274	0·17
BF457	0·53
BF458	0·65
BF459	0·65
BFS21	1·75
BFS21A	2·30
BFS28	0·74
BFS61	0·27
BFS98	0·30
BFW10	0·61
BFW11	0·61
BFX13	0·23
BFX29	0·30
BFX30	0·25
BFX37	0·33
BFX44	0·33
BFX63	2·48
BFX68	0·30
BFX84	0·24
BFX85	0·30
BFX86	0·25
BFX87	0·27
BFX88	0·25
BFX89	0·45
BFY10	0·35
BFY11	0·45
BFY17	0·90
BFY18	0·35
BFY19	0·35
BFY20	0·50
BFY29	0·40
BFY37	0·20
BFY41	0·43
BFY43	0·65
BFY50	0·19
BFY51	0·18
BFY52	0·16
BFY53	0·15
BFY56	0·34
BFY64	0·41
BFY75	0·40
BFY76	0·22
BFY77	0·24
BFY78	0·36
BFY90	0·55
BRY39	0·29
BSX19	0·13
BSX20	0·12
BSX21	0·20
BSX26	0·34
BSX27	0·34
BSX28	0·25
BSX29	0·47
BSX30	0·68
BSX59	0·78
BSX60	0·54
BSX61	0·42
BSX76	0·15
BSX77	0·20
BSX78	0·25
BSW70	0·28
BSY24	0·20
BSY25	0·15
BSY26	0·20
BSY27	0·15
BSY28	0·15
BSY38	0·15
BSY39	0·15
BSY51	0·25
BSY52	0·25
BSY53	0·25
BSY54	0·30
BSY56	0·79
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C425	0·36
C426	0·25
C428	0·25
C444	0·26
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GET111	0·45
GET113	0·25
GET114	0·20
GET115	0·50
GET119	0·35
GET120	0·40
GET535	0·20
GET536	0·20
GET538	0·20
GET873	0·15
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SN7402	0·20	0·18	SN7432	0·42	0·40	SN7474	0·40	0·34
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SN7404	0·22	0·18	SN7438	0·52	0·45	SN7476	0·44	0·39
SN7405	0·22	0·18	SN7440	0·20	0·18	SN7480	0·75	0·70
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1S113	15p	BA100	15p	BY103	22p	OA70	7p
1S120	12p	BA102	25p	BY122	47½p	OA73	10p
1S121	14p	BA110	25p	BY124	15p	OA79	7p
1S130	8p	BA114	15p	BY126	15p	OA81	8p
1S131	10p	BA115	7p	BY127	17p	OA82	10p
1S132	12p	BA141	17p	BY164	57p	OA90	7p
1S920	7p	BA142	17p	BYX10	22p	OA91	7p
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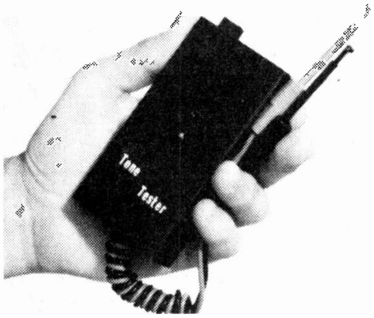

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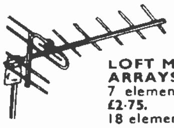

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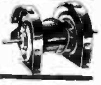

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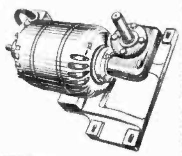

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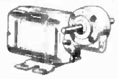

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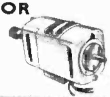

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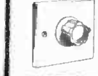

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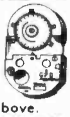

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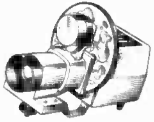

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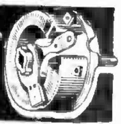

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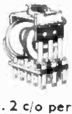

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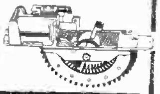

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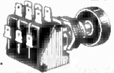

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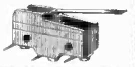

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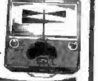

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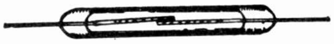

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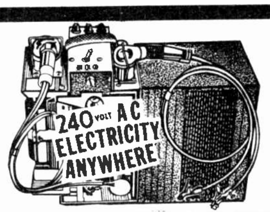

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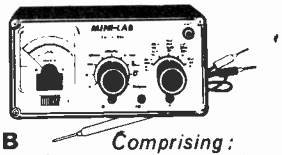

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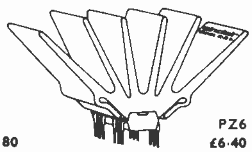

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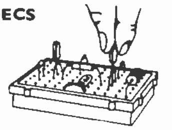

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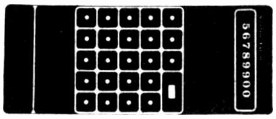

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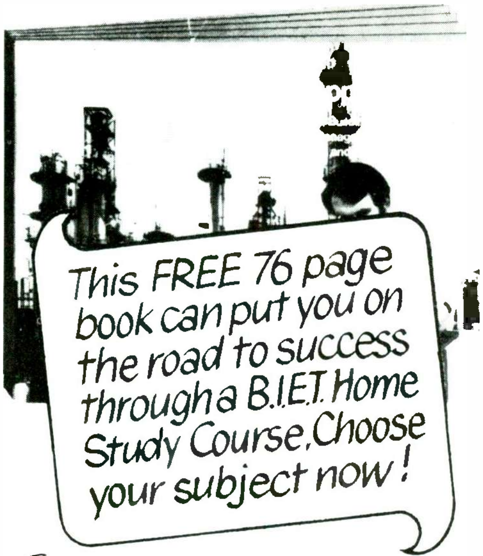

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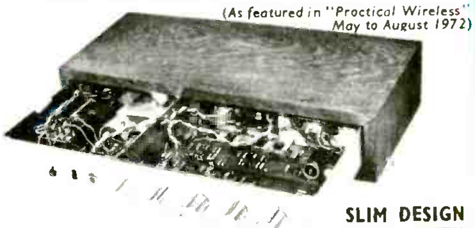

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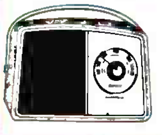

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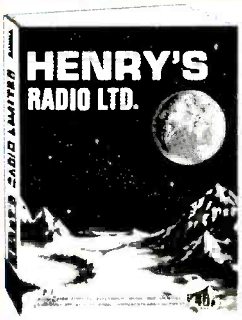

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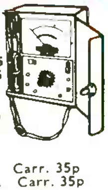

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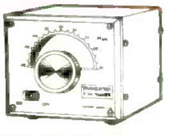

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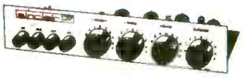

Z30 £3·57 Z50 £4·37

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