PRACTICAL

ELECTRONICS

FEBRUARY 1972

20p

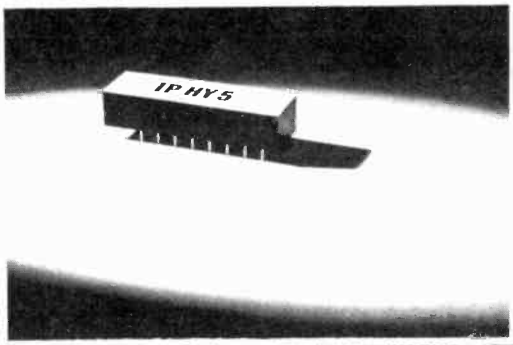
OFF...

TO A GOOD START!

with the IGNITION BOOSTER

Also: OSCILLOSCOPE BEAM SPLITTER

I.L.P. (Electronics) Ltd



A WORLDS FIRST TO JOIN THE WORLDS BEST

The HY5 is a unique and revolutionary concept in High-Fidelity pre-amplifiers. Thanks to the latest techniques, all feedback and equalization networks are, for the first time, combined into an integrated pre-amplifier circuit.

Simply by adding volume, treble, bass potentiometers and only three stabilizing capacitors, which are supplied, your HY5 is complete and ready for use.

The HY5 provides equalization for almost every conceivable input. This years developments in equalization technique enables precise correction for both output voltage and frequency response for any crystal or ceramic cartridge. Yet another feature of the HY5 is its inbuilt stabilization circuit, allowing it to be run off any unregulated power amplifier supply.

The HY5 contains a balance circuit which, when linked by a balance control to a second HY5, forms a complete stereo preamplifier.

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 HY40 and PSU45 forms a completely integrated system.

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

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

ACTIVE TONE CONTROLS
Treble ±12db.
Bass ±12db.

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

SUPPLY VOLTAGE
15–25 volt.

SUPPLY CURRENT
5mA approx.

OVERLOAD CAPABILITY
better than 28db on most sensitive input infinite on tuner and auxl.

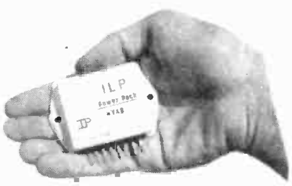
OUTPUT NOISE VOLTAGE
0.5mV.

PRICE
Mono £3·60 Stereo £7·20

HY40 IS POWER AMP PERFECTION

Lets face it — an immediate success, the HY40 is here to stay.

HY40 means Hybrid Power, power neatly locked away inside an Intregrated Circuit. Power the modern way, simply mount only five additional components on a printed circuit board (all of which are supplied with the HY40). Power not only for Hi-Fi, power for Groups, for public address, for industry, power for all.



HY40 is HI-FI POWER
ILP are POWER PROUD

In addition to the P.C. board and manual supplied with the HY40 we now include the five remaining components, at minimal cost, needed to complete the assembly of a High Performance Power Amplifier.

By merely combining two HY40s with a Stereo Preamplifier (2 x HY5) and simple Power Supply (PSU45), premium quality stereo may be obtained for a very modest outlay.

The free manual supplied with the HY40 gives clear, easy build instructions for Power Supply; volume, bass, treble and balance controls, together with inputs for Ceramic and Magnetic Pick-ups, Tape, Tuner and Auxiliary functions.

Internally the HY40 is based on conventional and proven circuit techniques developed over recent years.

OUTPUT POWER British Rating 40 WATTS PEAK, 20 watts RMS continuous.

LOAD IMPEDANCE 4–16 ohms

INPUT IMPEDANCE 22Kohms at 1Khz.

INPUT SENSITIVITY 300 mV for maximum output.

VOLTAGE GAIN 30db at 1KHz.

FREQUENCY RESPONSE 5Hz-60KHz ± 1db.

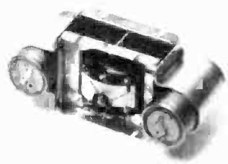
TOTAL DISTORTION less than 1% (typical 0.1%) at all output powers.

SUPPLY VOLTAGE ± 22.5 volts D.C.

SUPPLY CURRENT 0.8 amps maximum.

PRICE: including comprehensive manual, P.C. Board and FIVE EXTRA COMPONENTS:
MONO £4·40 STEREO £8·80
all post free.

POWER SUPPLY PSU45



The PSU45 is specifically designed to supply, simultaneously, your HY40 (in mono or stereo format) and one or two HY5s.

Spec.

PSU45 ± 22.5 volts, 2 amps simultaneously.

PRICE: **£4·50** including Postage and Packing

CROSSLAND HOUSE · NACKINGTON · CANTERBURY · KENT
TELEPHONE: CANTERBURY 63218

JUST BEGINNING?

Then try out **8-Watt, 10-Transistor Stereo Amplifier R.137**

ROC price £10.50

Separate tone and volume controls for each channel,inputs for turntable (ceramic cartridge),tuner and tape.Attractive black crackle finish with brushed aluminium front.Frequency response:70-20,000 Hz ±3dB.Output: 4 watts per channel @ 8 ohms.Inputs:Phono 80mV; tuner/aux 80mV.

Normal retail price : £14·70

SAVE £14

AM/FM/MPX Stereo Tuner R.132

Matching unit to the R.131 amplifier. Covers full AM and FM bands. Separate signal meter.FM frequency range:87-108 M Hz;AM frequency range 525-1605kHz.FM:Sensitivity 3µV,stereo separation 30dB @ 1kHz, image rejection 60dB.AM:Sensitivity 250µV.

Normal retail price : £50·00

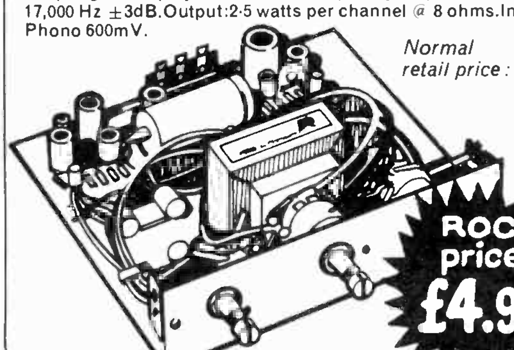
ROC PRICE £36

FIRST STEP TO STEREO!

5-Watt Transistor Stereo Amplifier Chassis R.123

Completely self-contained,fully transistorised,mains-powered (240vAC) amplifier,needing only cabinet and knobs.Ideal for adapting mono players to stereo.Frequency response:40-17,000 Hz ±3dB.Output:2·5 watts per channel @ 8 ohms.Input: Phono 600mV.

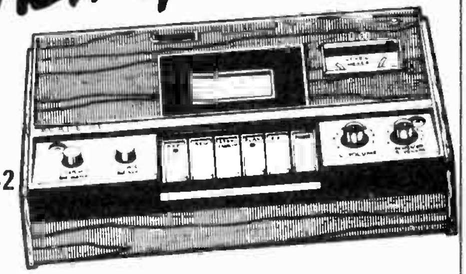
Normal retail price : £7·30



ROC price £4.95

AMAZING OFFER!

Stereo Cassette Tape Unit R.142



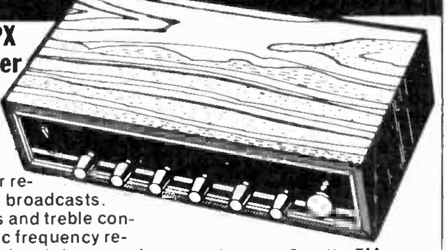
Complete stereo record and playback unit with line and microphone inputs. Fitted with tape counter,separate pause control,recording level metres for each channel,pop-up cassette ejection.Supplied complete with two pencil microphones.Wow & flutter better than 0·3%, frequency response 100-10,000 Hz.Tape speed:1⅞ IPS,4·75 CMS.Rewind time: Better than 60 sec (C.60 cassette).

Normal retail price : £65·00

ROC Price £49.50

SOUNDS SENSATIONAL

AM/FM/MPX Stereo Tuner Amplifier R.124



A top quality amplifier with facility for receiving stereo broadcasts. Separate bass and treble controls,automatic frequency response,stereo headphone socket,output power:8 watts.FM frequency range 88-108 M Hz;AM frequency range 535-1605 K Hz. Inputs for turntable (ceramic cartridge) and tape.Frequency response:50-10,000 Hz ±3dB.Output:4 watts per channel @ 8 ohms.Inputs:Phono 200mV,tape 100mV.FM:Sensitivity 20µV, stereo separation 26dB,image rejection 55dB.AM:Sensitivity 300µV.

Normal retail price : £42·00 **ROC price: £29.95**

We don't want you to

Every piece of electronic or audio-equipment we sell is built to our specifications.It comes complete with a Guarantee.And it's tested before it leaves us.

We bend over backwards in our advertising to make sure everything we say is factually accurate. But,buying mail-order,even though you're buying from us,we accept you could still end up with a piece of equipment that's not exactly what you wanted.And we think that's unfair.

TOP VALUE

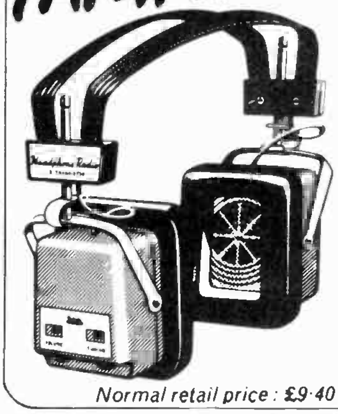
£29

40-WATT TRANSISTOR STEREO AMPLIFIER R.131

Separate bass and treble controls,separate left and right volume controls. Separate loudness control.Switches main and remote speaker outputs. Inputs for turntable (switched for magnetic or ceramic),tuner (see R.132) and tape.Outputs for tape and headphones.Frequency response 20-20,000 Hz ± 3dB.Output:20 watts per channel @ 8 ohms.Inputs:Phono magnetic 3·0mV RIAA,crystal 100mV,tape 160mV,tuner 160mV.

Normal retail price : £39·60

FANTASTIC BARGAIN



Headphone Radio R.143

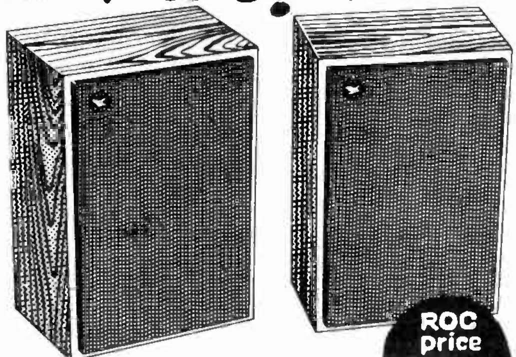
For completely private listening without the distortion of the ordinary earphone adaptor.Battery operated; PP3. Fully transistorised.Frequency range:535-1600 K Hz, Medium Wave Band. Maximum output:300mW.

ROC price £6.90

Normal retail price : £9·40

2 for the price of one!

Matched Stereo Speakers R.446



ROC price £16.40

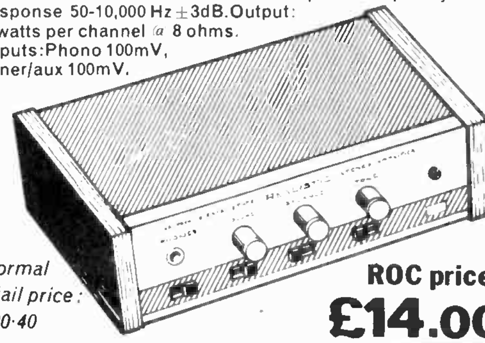
Heavily lagged teak finish cabinets each with large dual cone base unit and separate tweeter.Power handling:16 watts peak; frequency range:40-18,000 Hz,impedance: 8 ohms.Size:14 x 8¾ x 6¼.

Normal retail price : £19·60

Don't read this!

10-watt Transistor Stereo Amplifier R.136

Ganged volume,balance and tone controls.Inputs for turntable(ceramic cartridge),tuner(see R.134)or tape.Oiled walnut case with satin finish aluminium front panel.Frequency response 50-10,000 Hz ± 3dB.Output: 5 watts per channel @ 8 ohms. Inputs:Phono 100mV, tuner/aux 100mV.



Normal retail price : £20·40

ROC price: £14.00

The Perfect match!

AM/FM/MPX Stereo Tuner R.134

Matching unit to the R.136 amplifier.Covers AM and FM tuning bands with automatic stereo signal light.FM frequency range:88-108mHz; AM frequency range:535-1605kHz. FM:Sensitivity 5µV,stereo separation 25dB @ 1kHz, image rejection 50dB. AM:Sensitivity 250µV.

Normal retail price : £28·60

ROC price £22

pay for your mistakes

So we've got a proposition for you.
If you buy a piece of Roc equipment,and it's not quite what you expected,send it back within seven days,and as long as it's as good as new we'll give you your money back. O.K?

Return of post mail-order service;orders over £10 post free,(U.K. only)add 25p for p & p to orders under £10.HP terms available.

ROC ELECTRONICS LIMITED

B. Jory Esq 193 Edgware Rd., London W2 1ET. *01-723 6211.*
Callers at Shop welcome 9-6 Mon to Sat (Thurs 1pm)

THE BIG DISCOUNT HOUSE

TURNTABLES p.p. 80p

	£p
Garrard SP25 Mk. III	9·95
Garrard 2025 tc with Sonatone 9TAHCD cart.	8·50
Garrard A70 Mk. II (Transcription Deck)	9·95
Garrard SL65b	14·00
Garrard AP76	18·50
Garrard 401	26·00
Garrard SL72b	24·00
Garrard SL75b	25·00
Garrard SL95b	34·00
Garrard ZERO 100	35·00
B.R.S. McDonald Range in stock.	
Sonab 75s and 85s in stock.	
Transcriptors range in stock.	
Goldring GL85	47·50
Goldring GL85/P	57·00
Goldring LID85	5·25
Goldring GL75	28·50
Goldring GL75/P	36·50
Goldring Plinth 75	7·00
Goldring LID75	3·75
Goldring GL72	23·00
Goldring GL72/p	31·00
Goldring Plinth 72	7·00
Goldring LID72	3·75
Goldring G.99	22·00
Goldring C.99	9·00
Goldring G101/p	22·00
Philips GA202	53·00
Philips GA160	27·00
Philips GA105	15·50
Philips GA308	30·00
Thorens TD150AB	40·00
Thorens TD150A	36·00
Thorens TXII	3·90
Thorens TD150	31·50
Thorens TD125	61·00
Thorens TD125AB	92·00
Thorens TX25	7·50
Connoisseur	p.o.a.

SPECIAL OFFER

A FREE 10" LP for personal callers buying a complete system Monday to Wednesday

CARTRIDGES p.p. 15p

	£p
Goldring G.850	4·10
Goldring G.800	7·00
Goldring G.800/E	11·75
Goldring G.800/SE	17·00
Sonatone 9TAHCD	1·65
Shure M3D	4·95
Shure M44 5/7	6·75
Shure M44/E	7·95
Shure M55/E	8·75
Shure M75E type II	14·00
Shure M75EJII	13·50
Shure M756	10·50
Shure V15 II	26·50
Ortofon MF15E	18·75
Audio Technica AT66	4·10
Audio Technica AT55	3·75
ADC10E II in stock	
ADC26	47·00
ADC27	39·00
ADC550XE	14·00
Empire 100ZE	50·00
Empire 999VE/X	34·75
Empire 999TE/X	20·75
Empire 9995E/X	16·75
Empire 999E/X	12·50
Empire 999/X	10·00
Empire 909E/X	9·75
Empire 909/X	7·60
Empire 90EE/X	7·70

SPEAKER KITS priced per pair

p.p. (a) £1. (b) £1·50

	£p	
Wharfedale Unit 3	19·00	a
Wharfedale Unit 4	25·00	b
Wharfedale Unit 5	35·00	b
Richard Allan Twin Assembly	18·00	a
Richard Allan Triple Assembly	27·50	b
Richard Allan Super Triple	35·00	b
KEF	p.o.a.	
Goodmans DIN 20 Kit	19·95	a
Peerless 20–2	22·00	a
Peerless 20–3	31·00	b
Peerless 43–12	38·00	b

FULL RANGE OF SINCLAIR PRODUCTS IN STOCK

SEND A LARGE S.A.E. FOR OUR COMPLETE LISTING OF ALL HI-FI EQUIPMENT

NEW **AMSTRAD** IC 2000 AMPLIFIER OUR PRICE £31, p.p. FREE

AUDIO SUPPLIES

Dept P.E.2, 50 STAMFORD HILL, LONDON N16 Telephone: 01-806 3611

We are easy to find, 50 yds from Stoke Newington (BR) Station. 106, 67, 149, 76, 73, 249, 243, 247 Buses pass our door.

OPEN
Mon. to Wed. 9.30 am – 6 pm Fri. open until 8.00 pm
Closed Thursday. Sat. 9.30 am - 5 pm

Personal callers please note that Cheques are only accepted if backed by a relevant bank cheque card. Payment by Barclaycard accepted by arrangement.

All prices subject to change without notice as and when necessary.

VALVES

SAME DAY SERVICE NEW! TESTED! GUARANTEED!

SETS 1R5, 185, 1T4, 384, 3V4, DAF91, DF91, DK91, DL92, DL94. Set of 4 for £1·02. DAF96, DF96, DK96, DL96, 4 for £1·48.

1R5	·28	30C17	·76	EABC80	·32	EM81	·41	PCL84	·34	UBC41	·52
185	·22	30C18	·61	EAF42	·50	EM84	·32	PCL85	·38	UBF80	·34
1T4	·16	30F5	·64	EB41	·40	EM87	·34	PCL86	·38	UBF89	·32
384	·26	30FL1	·61	EB91	·10	EY51	·33	PCL88	·65	UCC84	·32
3V4	·37	30FL12	·69	EBC33	·40	EY86	·29	PCL800	·75	UCC85	·35
5U4G	·31	30FL14	·68	EBC41	·54	EZ40	·43	PENA4	·77	UCF80	·32
5V4G	·34	30L1	·29	EBC90	·22	EZ41	·43	PEN36C	·70	UCH42	·58
5Y3GT	·26	30L15	·57	EBF80	·32	EZ80	·22	PFL200	·52	UCH81	·32
5Z4G	·34	30L17	·67	EBF89	·29	EZ81	·23	PL36	·49	UCL82	·32
6/30L2	·54	30P4	·57	ECC81	·17	GZ30	·34	PL81	·44	UCL83	·55
6AL5	·11	30P12	·72	ECC82	·20	GZ32	·40	PL81A	·47	UF41	·56
6AM6	·13	30P19	·57	ECC83	·35	GZ34	·48	PL82	·31	UF89	·30
6AQ5	·22	30PL1	·60	ECC85	·34	KT41	·77	PL83	·33	UL41	·57
6AT6	·20	30PL13	·75	ECC804	·54	KT61	·55	PL84	·30	UL44	£1·00
6AU6	·20	30PL14	·65	ECF80	·27	KT66	·78	PL500	·63	UL84	·30
6BA6	·20	30PL15	·90	ECF82	·26	LN319	·63	PL504	·63	UM84	·22
6BE6	·21	35L6GT	·45	ECH35	·30	LN329	·72	PM84	·33	UY41	·42
6BJ6	·41	35W4	·25	ECH42	·59	LN339	·63	PX25	·95	UY85	·25
6BW7	·52	35Z4GT	·25	ECH81	·29	N78	·87	PY32	·55	VP4B	·77
6F14	·40	807	·45	ECH83	·40	P61	·40	PY33	·55	X78	£2·75
6F23	·68	6063	·62	ECH84	·36	PABC80	·34	PY81	·25	X79	£2·75
6F25	·58	AC/VP2	·77	ECL80	·30	PC86	·47	PY82	·25	Z77	·22
6K7G	·12	B349	·65	ECL82	·31	PC88	·47	PY83	·28	**Transistors**	
6K8G	·17	B729	·62	ECL86	·35	PC96	·42	PY88	·33	AC107	·17
6Q7G	·35	CCH35	·67	EF39	·38	PC97	·39	PY800	·34	AC127	·18
68N7GT	·30	CY31	·30	EF41	·60	PC900	·31	PY801	·34	AD140	·37
6V6G	·28	DAF91	·22	EF80	·23	PCC84	·29	R19	·30	AF115	·20
6V6GT	·28	DAF96	·36	EF85	·28	PCC85	·25	R20	·56	AF116	·20
6X4	·23	DF33	·38	EF86	·30	PCC88	·40	U25	·64	AF117	·20
6X5GT	·28	DF91	·16	EF89	·26	PCC89	·45	U26	·56	AF118	·48
10P13	·58	DF96	·36	EF91	·13	PCC189	·48	U47	·64	AF125	·17
12AT7	·17	DH77	·20	EF98	·65	PCC805	·56	U49	·56	AF127	·17
12AU6	·20	DK32	·33	EF183	·28	PCF80	·28	U50	·26	OC26	·25
12AU7	·20	DK91	·28	EF184	·31	PCF82	·31	U52	·31	OC44	·12
12AX7	·22	DK92	·38	EH90	·35	PCF86	·45	U78	·24	OC45	·12
19BG6G	·87	DK96	·38	EL33	·55	PCF800	·58	U191	·59	OC71	·12
20F2	·67	DL35	·40	EL34	·45	PCF801	·28	U193	·42	OC72	·12
20P3	·77	DL92	·26	EL41	·54	PCF802	·40	U251	·64	OC75	·12
20P4	·92	DL94	·37	EL84	·23	PCF805	·61	U301	·38	OC81	·12
25L6GT	·19	DL96	·38	EL90	·26	PCF806	·56	U329	·66	OC81D	·12
25U4GT	·57	DY86	·24	EL95	·33	PCF808	·68	U801	·80	OC82	·12
30C1	·28	DY87	·24	EL500	·62	PCL82	·32	UABC80	·32	OC82D	·12
30C15	·58	DY802	·33	EM80	·41	PCL83	·57	UAF42	·51	OC170	·23

READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD ESSEX. **Tel. 01-550 7441**

Post/packing on 1 valve 6p, on 2 or more valves 3p per valve extra. Any parcel insured against damage in transit 3p extra.

FETS N CHANNEL FETS FULLY TESTED AND MARKED

Type	BVgss (Min.)	Igss (Max.)	Vp (Max.)	IDss (Max.)	R on (Max.)	Case
GP25	20V	1nA	10V	20mA	—	TO72
GP71	20V	1nA	12V	150mA	190Ω	TO18

FETS — ANY 6 — 60p

2N3055—65p 2N3054—45p
2N3055A—min. gain 15 @ 4 amps—55p
2N3055B—min. gain 15 @ 3 amps—45p

DURHAM ELECTRONICS

FREE POST • PETERLEE • CO. DURHAM

MINIMUM FET ORDER VALUE 60p
TERMS STRICTLY CASH WITH ORDER

P.E. GEMINI

Pre-amplifier P.C.B.	£1·95
Main Amplifier P.C.B.	£1·45
Power Supply P.C.B.	60p
Pre-amplifier Semiconductors	£1·75
Main Amplifier Semiconductors	£7·25
Power Supply Semiconductors	£2·50
Packing and Postage on all orders	15p

All Semiconductors available separately.
Full range of Ferranti semiconductors available at low prices. Send S.A.E. for list.

DAVIAN ELECTRONICS
P.O. BOX 38 OLDHAM LANCS

NEW from Goodmans for constructors

Din 20 Kit

20 watt, high fidelity loudspeaker kit contains all parts necessary to complete the system, except timber and other material for the cabinet itself, with detailed, illustrated instructions.
Specification: 20 Watts DIN, 4 ohms impedance, 8 ins bass unit, dome HF radiator, crossover frequency 4,000 Hz.

Axent 100

Dome HF Radiator with integral crossover. Capable of high frequency sound reproduction with negligible distortion in systems rated up to 30 Watts DIN, this 'state of the art' drive unit has an integral crossover which cuts frequencies below 3kHz at a rate of 12dB/Octave.

Audiom 100

12 inch high fidelity bass loudspeaker.
For use as a bass unit in two-way systems, the sensitivity and high frequency roll-off of the Audiom 100 has been tailored to match the Axent 100.

Goodmans
Sound reasoning.

THORN A member of the Thorn Group

Please send Free leaflets on Constructors Equipment
Name ....
Address ....
.... PEI
Goodmans Loudspeakers Ltd.,
Downley Road, Havant, Hampshire PO9 2NL

STEREO HEADPHONES, **£1·95.** 10W TRANSISTOR AMPLIFIER, **£3·75.** HIGH IMPEDANCE HEADPHONES (2,000 ohm), **80p.** TELESCOPIC AERIALS, 47in, **45p.** RECORDING TAPE: 5in L.P. 900ft, **45p;** 5¾in L.P. 1,200ft, **60p;** 7in L.P. 1,800ft, **80p.** MICROPHONES: Lapel, **28p;** ACOS Mic. 45, **90p;** Mic. 60, **92p;** UD130 Dual Impedance 600 ohm and 50K, **£4·50.** 5K Potentiometers with Switch, **16p.** PLUGS: JACK STANDARD, **8p;** SCREENED, **13p;** 2·5 and 3·5mm, **6p;** SCREENED, **8p.** BALANCE AND TUNING METER, 500μA, **38p.** 100 MIXED RESISTORS, **45p.** Miniature INDICATOR LAMPS (5 colours), **11p;** 6 or 12V bulbs for above, **4p.** COMPATIBLE CARTRIDGES: ACOS GP91–3SC, **90p;** STEREO GP93–1, **£1·15.** NEON INDICATORS (Red, Green, Clear), **13p.** TELEPHONE AMPLIFIERS, **£2·62.** PAXOLIN PANEL, 8in × 7in, **2½p.** FIBRE GLASS Printed Circuit Board cut to size, **½p** per sq.in. CAPACITORS: 400–200–50–16mF, 300V, **30p.** Special prices for quantity. S.A.E. for full list. Add 10p for P. & P. on orders under £5.

M. DZIUBAS
158 Bradshawgate
BOLTON, Lancs.

AMAZING MINI·DRILL

Indispensable for precision drilling, grinding, polishing, etching, gouging, shaping. Precision power for the enthusiast. Shockproof. Completely portable power from 4½ volt external battery. So much more scope with MINI-DRILL. Super Kit (extra power, interchangeable chuck) £4·50 p.p. 13p.
De Luxe Professional Kit with 17 tools £7 p.p. 23p.
Money Ref. Guarantee.

MERLIN SUPPLY CO.
Dept. PE2D, Nailsea, Bristol BS19 2LP

C.T. ELECTRONICS

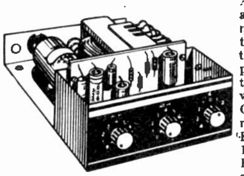
FOR REAL SERVICE WITH THE LARGEST SELECTION OF

ELECTRONIC COMPONENTS AND TEST EQUIPMENT

You must visit

C.T. ELECTRONICS
267 ACTON LANE, CHISWICK, LONDON, W.4
9.30 a.m. – 6 p.m. • MONDAY — SATURDAY

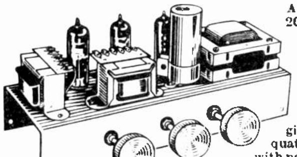
SUPERSOUND 13 HI-FI MONO AMPLIFIER



A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13W r.m.s. into 8 ohm. Frequency response 12Hz—30KHz ± 3db. Fully integrated pre-amplifier stage with separate Volume, Bass boost and Treble cut controls. Suitable for 8–15 ohm speakers. Input for ceramic or crystal cartridge. Sensitivity approx. 40mV for full output. Supplied ready built and tested, with knobs, escutcheon panel, input and output plugs. Overall size 3in high × 6in wide × 7½in deep. A.C. 200/250V.

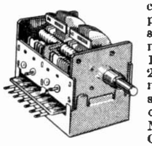
PRICE £10·50 P. & P. 25p.

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 300mV 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.

SPECIAL PURCHASE OF MANUFACTURER'S SURPLUS! All Transistor F.M. tuner head with twin A.M. Gang incorporated. Beautifully engineered with precision geared reduction drive. F.M. R.F. Transistor, oscillator/Mixer and first I.F. stage (10.7 Mc/s output) with optional AFC connection. Built on printed circuit panel and fully screened. Extremely stable over range 88-108 Mc/s. Brand new and pre-aligned. Size 2½in H. × 1¾in W. × 2¼in D. For 6V D.C. @ 2.8mA. A.M. Gang fitted with trimmers which can be connected to standard A.M. aerial and oscillator circuits if required. LIMITED NUMBER. Only **£2·25** post free. Connection details supplied.



SPECIAL PURCHASE!

BRAND NEW FM MULTIPLEX STEREO DECODER UNITS. Manufactured by PHILIPS. Size 2in × 3½in × 1in. All transistor 24V at 6mA. Supplied prealigned with full circuit diagram and connection details. **£4** each. Post free.

INPUT MATCHING TRANSFORMER. Beautifully made in heavy Mu-metal cylindrical case for minimum hum pick-up. Size 1¼in high × 1¼in dia. Ratio 150 : 1 approx. Especially suitable for matching dynamic or ribbon mikes or pick-up from low to high impedance or vice versa. **75p** each. Post Free.

BLACK ANODISED 16g. ALUMINIUM HEAT SINKS. For TO3, complete with mica's and bushes. Size 2⅞in × 3in approx. **25p** pair. P. & P. 5p.

HIGH GRADE COPPER LAMINATE BOARDS 8in × 6in × $\frac{1}{16}$in. FIVE for **50p**. P. & P. 13p.

TELESCOPIC AERIALS WITH SWIVEL JOINT. Can be angled and rotated in any direction. 6 section Lacquered Brass. Extends from 6in. to approx. 22½in. Maximum diameter ⅜in. **25p** each. P. & P. 5p.

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 **£1·75**. P. & P. 30p.

MAINS TRANSFORMER. For transistor power supplies. Pri. 200/240V. Sec. 9–0–9 at 500mA. **70p**. P. & P. 13p. Pri. 200/240V. Sec. 12–0–12 at 1 amp. **88p**. P. & P. 13p. Pri. 200/240V. Sec. 10–0–10 at 2 amp. **£1·38**. P. & P. 30p. Tapped Primary 200–220–240V. Sec. 21·5V at 500mA. **63p**. P. & P. 13p.

4 AMP BATTERY CHARGER TRANSFORMER Brand new. For 6 or 12V. 240V Primary. Secondary volts r.m.s. off load 10 and 16·5V. Overall size approx. 2¾in × 2½in × 3in. Weight 3lb. Limited number at **£1·35**. P. & P. 35p.

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.
LATEST GARRARD MODELS. S.A.E. for Latest Prices!

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. Choice of black leatherette or teak grain finish. Size 12¼in × 14¼in × 3¼in high (approx. 7½in high, including rigid smoked acrylic cover). Price **£5·50** P. & P. 60p.

LATEST ACOS GP91/18C 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 **£3·75**. P. & P. 40p. ALSO AVAILABLE mounted on board with output transformer and speaker ready to fit cabinet below. PRICE **£4·88**. 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 × 15 × 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. 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 **80p**, P. & P. 15p. 7 × 4in 3 ohm **£1·05**, 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 3 ohm with high flux ceramic magnet **£2·10** (15 ohm **£2·25**). 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. E.M.I. 13" × 8" twin cone (parastatic tweeter) 8 ohm **£2·25**. 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 **£5·50**. Guitar models: 25w **£6·50**. 35w **£8·50**. P. & P. 38p each.

E.M.I. 3½in HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohm **98p** each. P. & P. 13p.

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 11½in × 14¼in × 1$\frac{3}{16}$in 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 **£5·75** 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 (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.

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 × 1¼ × ½in. Brand new — complete with instructions. Price **88p**. P. & P. 13p.

CENTRE ZERO MINIATURE MOVING COIL METER. 100μA for balance or tuning. Approx. size 1in × 1in × ⅞in. Limited number **75p**. P. & P. 10p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

NEW IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD FOR EASY 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. Output stage for any speakers from 5 to 15 ohms. Compact design, all parts supplied including drilled metal work, high quality ready drilled printed circuit board, attractive front panel, 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 1M Ω. 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.
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 **£4·75**. P. & P. 35p.

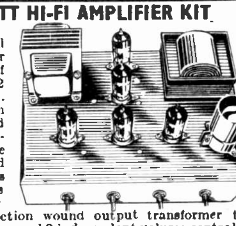
HSL "FOUR" AMPLIFIER KIT. Similar in appearance to HA34 above but employs entirely different and advanced circuitry. Complete set of parts, etc. **£3·98**. P. & P. 40p.

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. FEW ONLY.

OUR ROCK BOTTOM BARGAIN PRICE £2·75 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 complete with std. input sockets, **£9·97**. P. & P. 55p.

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.

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.
170 HIGH ST., MERTON, LONDON, S.W.19 Tel. 01-540 3985
SEND STAMPED ADDRESSED ENVELOPE WITH ALL ENQUIRIES

(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

The largest selection

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

PIV	1A TO-5 £p	3A TO-66 £p	7A TO-66 £p	10A £p	16A TO-48 £p	30A TO-48 £p
50	0·23	0·25	0·47	0·50	0·53	1·15
100	0·25	0·33	0·53	0·58	0·63	1·40
200	0·35	0·37	0·57	0·61	0·75	1·60
400	0·43	0·47	0·67	0·75	0·93	1·75
600	0·53	0·57	0·77	0·97	1·25	—
800	0·63	0·70	0·90	1·20	1·50	4·00

SIL. RECTS. TESTED

PIV	300mA £p	750mA £p	1A £p	1·5A £p	3A £p	10A £p	30A £p
50	0·04	0·05	0·05	0·07	0·14	0·21	0·47
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	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
1000	0·11	0·25	0·15	0·30	0·46	0·63	2·50
1200	—	0·33	—	0·33	0·57	0·75	—

TRIACS

VBOM	2A TO-1 £p	6A TO-66 £p	10A TO-88 £p
100	0·50	0·63	1·00
200	0·70	0·90	1·25
400	0·90	1·00	1·60

LUCAS SILICON RECTIFIERS

35 amp. 400 P.I.V. Stud type. £1·10 each.

DIACS

FOR USE WITH TRIACS BR100 D32.. 37p each

2A POTTED BRIDGE RECTIFIERS 200V 50p

UNIJUNCTION

UT46. Eqvt. 2N2646, Eqvt. TIS43. BEN3000 27p each. 25–99 25p 100 UP 20p.

NPN SILICON PLANAR

BC107/8/9, 10p each; 50–99, 9p; 100 up, 8p each; 1,000 off, 7p each. Fully tested and coded TO-18 case.

FREE

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

AF239 PNP GERM, SIEMENS VHF TRANSISTORS. RF MIXER & OSC. UP TO 900 MHZ. USE AS REPLACEMENT FOR AF139-AF186 & 100's OF OTHER USES IN VHF. OUR SPECIAL LOW PRICE:—1-24 37p each, 25–99 34p each 100 + 30p each.

SPECIAL OFFER

2N2926 (Y) (O). 10 for 50p. 25 for £1. 20,000 TO CLEAR.

CADMIUM CELLS

ORP12 43p
ORP60, ORP61 40p each

PHOTO TRANS.

OCP71 Type. 43p

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.

D13D1 Silicon Unilateral switch 50p each.

A Silicon Planar, monolithic integrated circuit having thyristor electrical characteristics, but with an anode gate and a built-in "Zener" diode between gate and cathode. Full data and application circuits available on request.

JUMBO COMPONENT PAKS

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

Plus our satisfaction or money back guarantee.

FULL RANGE OF ZENER DIODES

VOLTAGE RANGE 2-33V. 400mW (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.

BRAND NEW TEXAS GERM. TRANSISTORS

Coded and Guaranteed

Pak No.			EQVT
T1	8	2G371B	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 NIXIE DRIVER TRANSISTOR.

Sim. BSX21 & C407, 2N1893 FULLY TESTED AND CODED ND120. 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.

EX-EQUIPMENT MULLARD

AF117 transistors. Large can 4 leads type. Leads cut short but still usable, real value at 15 for 50p.

KING OF THE PAKS — SUPER PAKS

Unequalled Value and Quality

NEW BI-PAK UNTESTED SEMICONDUCTORS

Satisfaction GUARANTEED in Every Pak, or money back.

Pak No.		£p
U1	120 Glass sub-min. general purpose germanium diodes	0·50
U2	60 Mixed germanium transistors AF/RF	0·50
U3	75 Germanium gold bonded diodes sim. OA5, OA47	0·50
U4	40 Germanium transistors like OC81, AC128	0·50
U5	60 200mA sub-min. Sil. diodes	0·50
U6	30 Silicon planar transistors NPN sim. BSY95A, 2N706	0·50
U7	16 Silicon rectifiers Top-Hat 750mA up to 1,000V	0·50
U8	50 Sil. planar diodes 250mA, OA/200/202	0·50
U9	20 Mixed volts 1 watt Zener diodes	0·50
U11	30 PNP silicon planar transistors TO-5 sim. 2N1132	0·50
U13	30 PNP-NPN sil. transistors OC200 & 2S104	0·50
U14	150 Mixed silicon and germanium diodes	0·50
U15	25 NPN Silicon planar transistors TO-5 sim. 2N697	0·50
U16	10 3-Amp silicon rectifiers stud type up to 1000 PIV	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 1,000 PIV	0·50
U21	30 A.F. germanium alloy transistors 2G300 series & OC71	0·50
U23	30 Madt's like MAT series PNP transistors	0·50
U24	20 Germanium 1-Amp rectifiers GJM up to 300 PIV	0·50
U25	25 300Mc/s NPN silicon transistors 2N708, BSY27	0·50
U26	30 Fast switching silicon diodes like IN914 micro-min	0·50
U29	10 1-Amp SCR's TO-5 can up to 600 PIV CR81/25-600	1·00
U31	20 Sil. Planar NPN trans. low noise amp 2N3707	0·50
U32	25 Zener diodes 400mW D07 case mixed volts, 3–18	0·50
U33	15 Plastic case 1 amp silicon rectifiers 1N4000 series	0·50
U34	30 Sil. PNP alloy trans. TO-5 BCY26, 2S302/4	0·50
U35	25 Sil. planar trans. PNP TO-18 2N2906	0·50
U36	25 Sil. planar NPN trans. TO-5 BFY50/51/52	0·50
U37	30 Sil. alloy trans. SO-2 PNP, OC200 2S322	0·50
U38	20 Fast switching sil. trans. NPN, 400Mc/s 2N3011	0·50
U39	30 RF germ. PNP trans. 2N1303/5 TO-5	0·50
U40	10 Dual trans. 6 lead TO-5 2N2060	0·50
U41	25 RF germ. trans. TO-1 OC45 NKT72	0·50
U42	10 VHF germ. PNP trans. 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 BC115/116	0·50
U45	7 3A SCR's TO-66 up to 600 Piv.	1·00

Code Nos. mentioned above are given as a guide to the type of device in the Pak. The devices themselves are normally unmarked.

NEW QUALITY TESTED PAKS

Pak	Description	Price £p
Q1	20 Red spot trans. PNP AF	0·50
Q2	16 White spot R.F. trans. PNP	0·50
Q3	4 OC77 type trans.	0·50
Q4	6 Matched trans. OC44/45/81/81D	0·50
Q5	4 OC75 transistors	0·50
Q6	4 OC72 transistors	0·50
Q7	4 AC128 trans. PNP high gain	0·50
Q8	4 AC126 trans. PNP	0·50
Q9	7 OC81 type trans.	0·50
Q10	7 OC71 type trans.	0·50
Q11	2 AC127/128 comp. pairs PNP/NPN	0·50
Q12	3 AF116 type trans.	0·50
Q13	3 AF117 type trans.	0·50
Q14	3 OC171 H.F. type trans.	0·50
Q15	5 2N2926 sil. epoxy trans.	0·50
Q16	2 GET880 low noise germ. trans.	0·50
Q17	3 NPN 1 8T141 & 2 8T140	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 OC44 germ. trans. A.F.	0·50
Q21	3 AC127 NPN germ. trans.	0·50
Q22	20 NKT trans. A.F. R.F. coded	0·50
Q23	10 OA202 sil. diodes sub-min.	0·50
Q24	8 OA81 diodes	0·50
Q25	6 IN914 sil. diodes 75PIV 75mA	0·50
Q26	8 OA95 germ. diodes sub-min. IN69	0·50
Q27	2 10A 600PIV sil. rects. IS45R	0·50
Q28	2 Sil. power rects. BYZ13	0·50
Q29	4 Sil. trans. 2 × 2N696, 1 × 2N697, 1 × 2N698	0·50
Q30	7 Sil. switch trans. 2N706 NPN	0·50
Q31	6 Sil. switch trans. 2N708 NPN	0·50
Q32	3 PNP sil. trans. 2 × 2N1131, 1 × 2N1132	0·50
Q33	3 Sil. NPN trans. 2N1711	0·50
Q34	7 Sil. NPN trans. 2N2369, 500MHZ	0·50
Q35	3 Sil. PNP TO-5 2 × 2N2904 & 1 × 2905	0·50
Q36	7 2N3646 TO-18 plastic 300MH2 NPN	0·50
Q37	3 2N3053 NPN sil. trans.	0·50
Q38	7 PNP trans. 4×2N3703, 3×2N3702	0·50
Q39	7 NPN trans. 4×2N3704, 3×2N3705	0·50
Q40	7 NPN amp. 4×2N3707, 3×3N3708	0·50
Q41	3 Plastic NPN TO-18 2N3904	0·50
Q42	6 NPN trans. 2N5172	0·50
Q43	7 BC107 NPN trans.	0·50
Q44	7 NPN trans. 4×BC108, 3×BC109	0·50
Q45	3 BC113 NPN TO-18 trans.	0·50
Q46	3 BC115 NPN TO-5 trans.	0·50
Q47	6 NPN high gain 3×BC167, 3×BC168	0·50
Q48	4 BCY70 NPN trans. TO-18	0·50
Q49	4 NPN trans. 2×BFY51, 2×BFY52	0·50
Q50	7 BSY28 NPN switch TO-18	0·50
Q51	7 BSY95A NPN trans. 300MH2	0·50
Q52	8 BY100 type sil. rect.	1·00
Q53	25 Sil. & germ. trans. mixed all marked new	1·50

PRINTED CIRCUITS—EX-COMPUTER

Packed with semiconductors and components, 10 boards give a guaranteed 30 trans and 30 diodes. Our price 10 boards, 50p. Plus 10p P. & P 100 Boards £3, P. & P. 30p.

POWER TRANSISTOR BONANZA!

GENERAL PURPOSE GERM. PNP POWER TRANSISTORS

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. SPECIFICATION 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

AD161 *NPN* / AD162 *PNP*

OF GERM. POWER TRANSISTORS. OUR LOWEST PRICE OF 63p *PER PAIR*

SILICON High Voltage 250V NPN TO-3 case. G.P. Switching and Amplifier Applications. Brand new Coded R2400. VCBO250 / VCEO100 / IC 6A / 30W. HFE type 20/fT 5MHz.

OUR PRICE EACH	1–24	25–99	100 up
	50p	45p	40p

2N3055

115 WATT SIL POWER NPN
Price 63p each.

SILICON 50 WATTS MATCHED NPN/PNP.

BIP19 npn TO-3 plastic. BIP20 pnp Brand new. VCBO 10 / VCEO 50/ IC 10A. HFE type 100/ft 3mHZ.

OUR PRICE PER PAIR	1–24 prs.	25–99 prs.	100 prs.
	60p	55p	50p

GENERAL PURPOSE NPN SILICON SWITCHING TRANS. TO-18 SIM. TO 2N706/8, BSY27/28/95A.

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	100	For	1·75
50	For	1·00	500	For	7·50
			1000	For	13·00

OUR STOCKS of individual devices are now too numerous to mention in this Advertisement. Send S.A.E. for our listing of over 1,000 Semi-conductors. All available Ex-Stock at very competitive prices.

RTL MICROLOGIC CIRCUITS

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

Data and Circuits Booklet for I.C's Price 7p.

NEW EDITION 1971

TRANSISTOR EQUIVALENTS BOOK. A complete cross reference and equivalents book for European, American and Japanese Transistors. Exclusive to BI-PAK 90p each.

FET'S

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

PHOTO TRANS.

OCP71 Type. 43p

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

Dual-in-Line Low Profile Sockets

14 and 16 Lead Sockets for use with Dual-in-Line Integrated Circuits

Order No.	Price each 1–24	25–99	100 up
TSO 14 pin type	30p	27p	25p
TSO 16 pin type	35p	32p	30p

-the lowest prices!

74 series T.T.L. I.C's
DOWN AGAIN IN PRICE

Check our 74 Series List before you buy any I.C's. **Our prices are the lowest possible.** All devices ex-stock.
Full spec. guaranteed.

BI-PAK Order No.	Similar Types to:—Description	Price and qty. prices 1–24 £p	25–99 £p	100 up £p
BP00 = 7400	Quad 2-input NAND gate	0·15	0·14	0·12
BP01 = 7401	Quad 2-input pos. NAND gate (with open collector output)	0·15	0·14	0·12
BP02 = 7402	Quad 2-input pos. NOR gates	0·15	0·14	0·12
BP03 = 7403	Quad 2-input pos. NAND gates (with open collector output)	0·15	0·14	0·12
BP04 = 7404	Hex Inverters	0·15	0·14	0·12
BP05 = 7405	Hex Inverter (with open-collector output)	0·15	0·14	0·12
BP10 = 7410	Triple 3-input pos. NAND gates	0·15	0·14	0·12
BP13 = 7413	Dual 4-input Schmitt trigger	0·29	0·26	0·24
BP20 = 7420	Dual 4-input pos. NAND gates	0·15	0·14	0·12
BP30 = 7430	8-input pos. NAND gates	0·15	0·14	0·12
BP40 = 7440	Dual 4-input pos. NAND buffers	0·15	0·14	0·12
BP41 = 7441	BCD to decimal nixie driver	0·67	0·64	0·58
BP42 = 7442	BCD to decimal decoder (4–10 lines, 1 of 10)	0·67	0·64	0·58
BP46 = 7446	BCD-to-seven-segment decoder/driver	2·00	1·75	1·50
BP47 = 7447	BCD-seven-segment decoder/drivers (15V outputs)	0·97	0·94	0·88
BP48 = 7448	BCD-to-seven-segment decoder/driver	0·97	0·94	0·88
BP50 = 7450	Expandable dual 2-input and-or-invert	0·15	0·14	0·12
BP51 = 7451	Dual 2-wide 2-input and-or-invert gates	0·15	0·14	0·12
BP53 = 7453	Quad 2-input expandable and-or-invert	0·15	0·14	0·12
BP54 = 7454	4-wide 2-input and-or-invert gates	0·15	0·14	0·12
BP60 = 7460	Dual 4-input expander	0·15	0·14	0·12
BP70 = 7470	Single-phase J-K flip-flop	0·29	0·26	0·24
BP72 = 7472	Master slave J-K flip-flop	0·29	0·26	0·24
BP73 = 7473	Dual Master slave J-K flip-flop	0·37	0·35	0·32
BP74 = 7474	Dual D type flip-flop	0·37	0·35	0·32
BP75 = 7475	Quad latch	0·47	0·45	0·42
BP76 = 7476	Dual J-K with pre-set and clear	0·43	0·40	0·38
BP80 = 7480	Gated full adders	0·67	0·64	0·58
BP81 = 7481	16-bit read/write memory	0·97	0·94	0·88
BP82 = 7482	2-bit binary full adders	0·97	0·94	0·88
BP83 = 7483	Quad full adder	1·10	1·05	0·95
BP86 = 7486	Quad 2-input exclusive NOR gates	0·32	0·30	0·28
BP90 = 7490	BCD decade counter	0·67	0·64	0·58
BP91 = 7491	8-bit shift registers	0·87	0·84	0·78
BP92 = 7492	Divide-by-twelve counters	0·67	0·64	0·58
BP93 = 7493	4-bit binary counters	0·67	0·64	0·58
BP94 = 7494	Dual entry 4-bit shift register	0·77	0·74	0·68
BP95 = 7495	4-bit up-down shift register	0·77	0·74	0·68
BP96 = 7496	5-bit parallel in parallel out shift-register	0·77	0·74	0·68
BP100 = 74100	8-bit bistable latches	1·75	1·65	1·55
BP104 = 74104	Single J-K flip-flop equivalent 9000 series	0·97	9·94	0·88
BP105 = 74105	Single J-K flip flop equivalent 9001 series	0·97	0·94	0·88
BP107 = 74107	Dual Master slave flip-flops	0·40	0·38	0·36
BP110 = 74110	Gates master-slave flip-flops	0·55	0·53	0·50
BP111 = 74111	Dual data lock-out flip-flop	1·25	1·15	1·00
BP118 = 74118	Hex set-reset latches	1·00	0·95	0·90
BP119 = 74119	Hex set-reset latches. 24-pin	1·35	1·25	1·10
BP121 = 74121	Monostable multivibrators	0·67	0·64	0·58
BP141 = 74141	BCD-to-decimal decoder/driver	0·67	0·64	0·58
BP145 = 74145	BCD-to-decimal decoder/driver O/C	1·50	1·40	1·30
BP150 = 74150	16-bit data selector	1·80	1·70	1·60
BP151 = 74151	8-bit data selectors (with strobe)	1·00	0·95	0·90
BP153 = 74153	Dual 4-line-to-1-line data	1·20	1·10	0·95
BP154 = 74154	4- to 16-line decoder	1·80	1·70	1·60
BP155 = 74155	Dual 2- to 4-line decoder	1·40	1·30	1·20
BP156 = 74156	Dual 2- to 4-line decoder O/C	1·40	1·30	1·20
BP160 = 74160	Sync. decade counter	1·80	1·70	1·60
BP161 = 74161	Sync. 4-bit binary counter	1·80	1·70	1·60
BP190 = 74190	Sync. up-down BCD counter	3·50	3·25	3·00
BP191 = 74191	Sync. binary up-down counter (single clock line)	3·50	3·25	3·00
BP192 = 74192	Sync. up-down decade counter	2·10	1·95	1·75
BP193 = 74193	Sync. binary up-down counter (tow clock lines)	2·10	1·95	1·75
BP196 = 74196	Pre-setable 50MHz decade counter	1·80	1·70	1·60
BP197 = 74197	Pre-setable 50MHz binary counter	1·80	1·70	1·60
BP198 = 74198	8-bit parallel L-R shift register	5·50	5·00	4·00
BP199 = 74199	8-bit parallel access shift register	5·50	5·00	4·00

Devices may be mixed to qualify for quantity price. Larger quantities—prices on application (TTL 74 Series only).
Data is available for the above series of I.C's in booklet form. Price 13p.
Owing to the ever increasing range of TTL 74 Series, please check with us for supplies of any devices not listed above, as it is probably now in stock.

BRAND NEW LINEAR I.C's—FULL SPEC.

Type No.	Case	Leads	Description	Price 1–24	25–99	100 up
BP 201C—SL201C	TO-5	8	G.P. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	50p	45p
BP 702C—SL702C	TO-5	8	OP Amp Direct OP	63p	50p	45p
BP 702—72702	D.I.L.	14	G.P. OP Amp (Wide Band)	53p	45p	40p
BP 709 —72709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P—μA709C	TO-5	8	High Gain OP Amp	53p	45p	40p
BP 710-72710	D.I.L.	14	Differential comparator	53p	45p	40p
BP 711—μA711	TO-5	10	Dual comparator	58p	50p	45p
BP 741 —72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
μA 703C—μA703C	TO-5	6	R.F.-I.F. Amp	43p	35p	27p
TAA 263—	TO-72	4	A.F. Amp	70p	60p	55p
TAA 293—	TO-74	10	G.P. Amp	90p	75p	70p
TAA 350	TO-5	8	Wide loud limiting amplifier	170p	158p	150p

ANOTHER BI-PAK FIRST!

THE NEW S.G.S. EA 1000 AUDIO AMPLIFIER MODULE

*GUARANTEED NOT LESS THAN 3 WATTS RMS

Especially designed by S.G.S. incorporating their proven Linear I.C. Audio Amp. TA/621 providing unlimited applications for the enthusiast in the construction of radios, record players, Audio and Stereo units. Also ideal for intercom systems, monitoring applications and phone answering machines. OTHER USES: *portable applications where supply rails as low as 9 V are of prime importance.*

- **Sensitivity 40mV for 1 watt VOLTAGE GAIN 40dB but can be varied up to 73dB for some applications.**
- **Signal to Noise Ratio 86dB.**
- **Frequency response better than 50Hz to 25KHz for −3dB.**
- **Normal supply Voltage 9-24V.**
- **Suitable for 8-16 OHM Loads.**
- **Overall Size 2″ × 3″ × 1″.**
- **Typical Total Harmonic distortion at 1 watt less than 1%.**

* *Supply voltage (Vs) = 24 V 15ohm load.*
Module Tested and Guaranteed

Quantity	1-9	10-25
Price each	£2·63	£2·28

Larger quantities quoted on request

Full hook-up diagrams and complete technical data supplied free with each module or available separately at 10p each.

NOTE THESE PRICES!

I.C's DTL 930 SERIES LOGIC

Type No.	Function	Price 1–24	25–99	100 up
BP930	Expandable dual 4-input NAND	23p	20p	15p
BP932	Expandable dual 4-input NAND buffer	25p	23p	20p
BP933	Dual 4-input expander	25p	23p	20p
BP935	Expandable Hex Inverter	25p	23p	20p
BP936	Hex Inverter	25p	23p	20p
BP944	Dual 4-input NAND expandable buffer without pull-up	25p	23p	20p
BP945	Master-slave JK or RS	35p	32p	20p
BP946	Quad. 2-input NAND	23p	20p	15p
BP948	Master-slave JK or RS	35p	32p	29p
BP951	Monostable	90p	85p	80p
BP962	Triple 3-input NAND	23p	20p	15p
BP9093	Dual Master-slave JK with separate clock	80p	75p	70p
BP9094	Dual Master-slave JK with separate clock	80p	75p	70p
BP9097	Dual Master-slave JK with Common Clock	80p	75p	70p
BP9099	Dual Master-slave JK Common Clock	80p	75p	70p

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

DTL AND TTL INTEGRATED CIRCUITS

Manufacturers' "Fall outs"—out of spec. devices including functional units and part function but classed as out of spec. from the manufacturers' very rigid specifications. Ideal for learning about I.C's and experimental work.

Pak No.		Pak No.	
UIC930 = 12 × μA 930	50p	UIC948 = 8 × μA 948	50p
UIC932 = 12 × μA 932	50p	UIC951 = 5 × μA 951	50p
UIC933 = 12 × μA 933	50p	UIC961 = 12 × μA 961	50p
UIC935 = 12 × μA 935	50p	UIC9093 = 5 × μA 9093	50p
UIC936 = 12 × μA 936	50p	UIC9094 = 5 × μA 9094	50p
UIC944 = 12 × μA 944	50p	UIC9097 = 5 × μA 9097	50p
UIC945 = 8 × μA 945	50p	UIC9099 = 5 × μA 9099	50p
UIC946 = 12 × μA 946	50p	UIC × 925 Assorted 930 Series	£1·50

Packs cannot be split but 25 Assorted Pieces (our mix) is available as PAK UICX9.
Data Booklet available for the BP930 Series. PRICE 13p.

UIC00 = 12 × 7400N 50p	UIC46 = 5 × 7446N 50p	UIC81 = 5 × 7481N 50p
UIC01 = 12 × 7401N 50p	UIC47 = 5 × 7447N 50p	UIC82 = 5 × 7482N 50p
UIC02 = 12 × 7402N 50p	UIC48 = 5 × 7448N 50p	UIC83 = 5 × 7483N 50p
UIC03 = 12 × 7403N 50p	UIC50 = 12 × 7450N 50p	UIC86 = 5 × 7486N 50p
UIC04 = 12 × 7404N 50p	UIC51 = 12 × 7451N 50p	UIC90 = 5 × 7490N 50p
UIC05 = 12 × 7405N 50p	UIC53 = 12 × 7453N 50p	UIC91 = 5 × 7491N 50p
UIC10 = 12 × 7410N 50p	UIC54 = 12 × 7454N 50p	UIC92 = 5 × 7492N 50p
UIC13 = 8 × 7413N 50p	UIC60 = 12 × 7460N 50p	UIC93 = 5 × 7493N 50p
UIC20 = 12 × 7420N 50p	UIC70 = 8 × 7470N 50p	UIC94 = 5 × 7494N 50p
UIC40 = 12 × 7440N 50p	UIC72 = 8 × 7472N 50p	UIC95 = 5 × 7495N 50p
UIC41 = 5 × 7441AN 50p	UIC73 = 8 × 7473N 50p	UIC96 = 5 × 7496N 50p
UIC42 = 5 × 7442N 50p	UIC74 = 8 × 7474N 50p	UIC121 = 5 × 74121N 50p
UIC43 = 5 × 7443N 50p	UIC75 = 8 × 7475N 50p	UICX1 = 25 × Asst'd 74's £1·50
UIC44 = 5 × 7444N 50p	UIC76 = 8 × 7476N 50p	
UIC45 = 5 × 7445N 50p	UIC80 = 5 × 7480N 50p	

All prices quoted in new pence Giro No. 388-7006
Please send all orders direct to warehouse and despatch department

BI-PAK

P.O. BOX 6, WARE · HERTS

Postage and packing add 7p. Overseas add extra for airmail. Minimum order 50p. Cash with order please.

Guaranteed Satisfaction or Money Back

DISCOUNTS UP TO 60% ON BRANDED GOODS

ALL BRAND NEW
in manufacturer s sealed cartons
GUARANTEED 12 MONTHS

SONY · LEAK · SINCLAIR · TELETON · ARMSTRONG · THORENS · PHILIPS · K.E.F. · TEAC · ROGERS · PIONEER

SPECIAL OFFER £18

Garrard SP25 Mk. III
Goldring G800H
Teak plinth and tinted cover.
Ready wired for immediate use.
Please add £1·25 for post and packing.

TURNTABLES

Please add 75p for P. & P.

Garrard SP25 Mk. III	£10·25
Garrard 2025TC with Sonotone 9TAHC	£8·95
Garrard Zero 100-Auto (New Product)	£40·95
Garrard Zero 100-Single Play (New Product)	£37·95
Garrard SL65B	£13·50
Garrard AP76	£19·95
Garrard 401	£27·00
BSR MP60	£10·00
Pioneer PL12AC	£36·00
Thorens TD125	£62·50
Thorens 150ABII	£42·50
Goldring GL69/2	£20·00
Goldring GL69 P2	£26·95
Goldring GL75	£27·95
Goldring GL75 P	£35·95

AMPLIFIERS

Please add 50p for P. & P.

Alpha Highgate FA212	£27·50
Alpha Highgate FA300	£29·00
Alpha Highgate FA400	£33·00
Armstrong 521 (cased)	£44·95
Amstrad 8000 Mk. II	£16·95
Amstrad IC2000	£34·00
Dulci 207	£15·95
Dulci 207m	£21·00
Leak 30 Delta Range (New Prod.)	£51·00
Leak 70 Delta Range (New Prod.)	£61·00
Metrosound ST20E	£26·00
Philips R580	£18·00
Pioneer SA500	£36·00
Pioneer SA700	£65·00
Pioneer SA900	£92·00
Rogers R/brook Chassis	£35·50
Rogers R/brook Cased	£39·50
Rogers R/bourne Chassis	£44·00
Rogers R/bourne Cased	£48·50
Sansui AU101	£32·00
Sansui 55SA	£59·95
Sansui AU666	£75·00

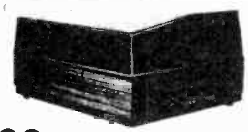
Rotel RA 301	£32·75
Rotel RA 601	£49·80
Sinclair 2000 Mk. II	£22·50
Sinclair 3000	£32·50
Sinclair PRO 60/2+Z30 PZS	£15·50
Sinclair PRO 60/2+Z30 PZ6	£17·75
Sinclair PRO 60/2+ZS0 PZ8/Trans	£22·95
Sinclair AFU	£4·70
Sinclair 605 (New Product)	£20·50
Goodmans Max. Amp.	£37·95
Teleton SAQ206B (New Prod.)	£17·95
Wharfedale	£49·75
Sinclair IC12 integrated circuit amplifier	£1·85
Eagle TSA149 7w RMS	£24·95
Eagle TSA151 15w RMS	£34·50

CARTRIDGES

Please add 10p for P. & P.

Goldring G850	£3·75
Goldring G800	£6·50
Goldring G800E	£10·50
Goldring G800SE	£15·50
Sonotone 9TAHC Diamond	£1·75
Shure M3DM	£4·50
Shure M445/7/C	£7·00
Shure M55E	£8·75
Shure M75E	£12·75
Shure V15 Type 2	£27·75
Shure M44E	£7·00
Shure M31E	£8·50
Shure M32E	£8·00
Audio Technica AT35	£12·95
Audio Technica AT66	£4·95

PLINTHS & COVERS



£3·20

Plus 35p post and packing
Finished in real teak veneer with tinted dust cover. Ready to use (fully assembled). Suitable for Garrard SP25; 202STC; 3000; AT60; 2000; 2500; 3500; 5100; 1025; SL65B; Also for BSR McDonald MP60 and others.

For AP76; AP75; SL72B; SL75; SL95B; £4 plus 35p P. & P. Also finished in walnut to match Japanese equipment—at no extra charge.

All prices correct at time of going to press

GLOBAL AUDIO DISCOUNT WAREHOUSES

Dept. (PE6) 174 Pentonville Road, London, N1. Telephone 01-278 1769
Or: 4 High View Parade, Redbridge Lane East, Woodford Avenue, Ilford, Essex. Tel: 01-550 1086.

Open Monday to Saturday 9.30 a.m. to 6 p.m. LATE NIGHT FRIDAY 7 p.m.

MAIL ORDERS: Order with confidence. Send Postal Order, Cheque, Money Order, Bank Draft, Giro or Cash by Registered Mail. **CALLERS:** Please note that cheques can only be accepted together with cheque cards (not Barclay Card).

2 minutes from KING S CROSS, EUSTON & ST PANCRAS on main road leading to the East and West Country

SIEMENS TTL EX STOCK!!

SIEMENS QUALITY PLUS BARGAIN PRICES PLUS LST SERVICE
A full design range of high quality TTL available from LST your Officially Appointed Siemens Distributors

Part No.	Description	Equal to	1-24	25-99	100 up
7400	Quadruple 2-input NAND gate	FLH 101	20p	16p	14p
7401	Quadruple 2-input NAND gate with open collector output	201	20p	16p	14p
7402	Quadruple 2-input NOR gate	191	20p	16p	14p
7403	Quadruple 2-input NAND gate with open collector output	291	20p	16p	14p
7404	Hex inverter	211	25p	21p	18p
7405	Hex inverter with open collector output	271	25p	21p	18p
7408	Quad 2-input positive AND gate Totem pole output	381	25p	21p	18p
7409	Quad 2-input positive AND gate open collector	391	25p	21p	18p
7410	Triple 3-input NAND gate	111	20p	16p	14p
7413	Schmitt Trigger	351	35p	29p	25p
7420	Dual 4-input NAND gate	121	20p	16p	14p
7430	8-input NAND gate	131	20p	16p	14p
7440	Dual 4-input NAND buffer	141	24p	20p	17p
7442	BCD to decimal decoder TTL output	281	£1·16	94p	31p
7443	Excess 3 to decimal decoder	361	£1·45	£1·20	£1·08
7444	Excess 3 gray to decimal decoder	371	£1·45	£1·20	£1·08
7450	Expandable dual 2-wide 2-input AND-OR-INVERT gate	151	20p	16p	14p
7451	Dual 2-wide 2-input AND-OR-INVERT gate	161	20p	16p	14p
7453	Expandable 4-wide 2-input AND-OR-INVERT gate	171	20p	16p	14p
7454	4-wide 2-input AND-OR-INVERT gate	181	20p	16p	14p
7460	Dual 4-input expander	FLY 101	20p	16p	14p
7470	J-K flip-flop	FLJ 101	45p	37p	32p
7472	J-K master-slave flip-flop	111	32p	27p	23p
7473	Dual J-K master-slave flip-flop	121	45p	40p	35p
7474	Dual D-type edge triggered flip-flop	141	46p	38p	33p
7475	Quad bistable latch	151	45p	40p	37p
7476	Dual J-K master-slave flip-flop with preset and clear	131	45p	40p	36p
7480	Gated full adder	FLH 221	67p	56p	48p
7482	2-bit binary full-adder	231	87p	73p	62p
7483	Four-bit binary full adder	241	£1·32	£1·16	£1·00
7486	Quadruple 2-input exclusive-OR element	341	33p	27p	23p
7490	Decade counter	FLJ 161	80p	67p	57p
7491A	8-bit shift register	221	£1·28	£1·07	92p
7492	Divide-by-12 counter	171	85p	71p	61p
7493	4-bit binary counter	181	80p	67p	57p
7494	4-bit shift register	231	£1·13	94p	81p
7495	4-bit shift register	191	87p	72p	62p
7496	5-bit shift register	261	£1·48	£1·22	£1·05
74100	Dual quadruple bistable latch	301	£1·64	£1·37	£1·17
74107	Dual J-K master-slave flip-flop with preset and clear	271	52p	43p	36p
74121	Monostable multivibrator	FLK 101	48p	40p	34p
74141	BCD to decimal decoder and nixie driver	FLL 101	£1·22	£1·02	87p
74190	Synchronous up down 4-bit decade counter with one line mode control	201	£1·80	£1·48	£1·27
74191	Synchronous up down 4-bit binary counter with one line mode control	211	£1·80	£1·48	£1·27
74192	Synchronous up down 4-bit decade counter	241	£1·74	£1·45	£1·25
74193	As above—binary counter	251	£1·74	£1·45	£1·25

TYPES MAY BE MIXED TO QUALIFY FOR PRICE BREAKS
DATA BOOKLET 20p

CONTRACT ORDER PRICES AND BULK QUANTITY PRICES QUOTED ON REQUEST

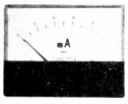
See opposite page for addresses

SEW PANEL METERS

USED EXTENSIVELY BY INDUSTRY, GOVERNMENT DEPARTMENTS, EDUCATIONAL AUTHORITIES, ETC.
● LOW COST ● QUICK DELIVERY ● OVER 200 RANGES IN STOCK ● OTHER RANGES TO ORDER

NEW "SEW" DESIGNS!

CLEAR PLASTIC METERS

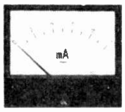


TYPE SW. 100
100 x 80 mm

50µA	£3·60	500µA	£3·35
50-0-50µA	£3·45	1mA	£3·10
100µA	£3·20	20V d.c.	£3·10
100-0-100µA	£3·45	50V d.c.	£3·10
		300V d.c.	£3·10
		1A d.c.	£3·10
		5A d.c.	£3·10
		300V a.c.	£3·10
		VU Meter	£3·75

BAKELITE PANEL METERS

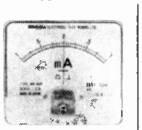
TYPE S-80
80 mm square fronts



50µA	£3·20	1A d.c.	£2·60
50-0-50µA	£3·10	5A d.c.	£2·60
100µA	£2·75	300V a.c.	£2·60
100-0-100µA	£3·10	VU Meter	£3·37
500µA	£3·00		
1mA	£2·60		
20V d.c.	£2·60		
50V d.c.	£2·60		
300V d.c.	£2·60		

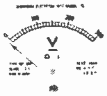
"SEW" CLEAR PLASTIC METERS

Type MR.85P. 4¼in · 4¼in fronts.



50µA	£3·60	50mA	£2·80
50-0-50µA	£3·10	100mA	£2·80
100µA	£3·10	500mA	£2·80
100-0-100µA	£3·00	1A	£2·80
200µA	£3·00	5A	£2·80
500µA	£2·90	15A	£2·80
500-0-500µA	£2·80	30A	£2·90
1mA	£2·80	20V d.c.	£2·80
1-0-1mA	£2·80	50V d.c.	£2·80
5mA	£2·80	150V d.c.	£2·80
10mA	£2·80	300V d.c.	£2·80
		15V a.c.	£2·80
		300V a.c.	£2·80
		S Meter 1mA	£2·87
		VU Meter	£3·60
		1A a.c.*	£2·80
		5A a.c.*	£2·80
		10A a.c.*	£2·80
		20A a.c.*	£2·80
		30A a.c.*	£2·80

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



50µA	£2·10	150mA	£1·60
50-0-50µA	£1·90	200mA	£1·60
100µA	£1·90	300mA	£1·60
100-0-100µA	£1·75	500mA	£1·60
200µA	£1·75	750mA	£1·60
500µA	£1·65	1A	£1·60
500-0-500µA	£1·60	2A	£1·60
1mA	£1·60	5A	£1·60
1-0-1mA	£1·60	10A	£1·60
2mA	£1·60	3V d.c.	£1·60
5mA	£1·60	10V d.c.	£1·60
10mA	£1·60	15V d.c.	£1·60
20mA	£1·60	20V d.c.	£1·60
50mA	£1·60	100V d.c.	£1·60
100mA	£1·60	150V d.c.	£1·60
		300V d.c.	£1·60
		500V d.c.	£1·60
		750V d.c.	£1·60
		15V a.c.	£1·70
		50V a.c.	£1·70
		150V a.c.	£1·70
		300V a.c.	£1·70
		500V a.c.	£1·70
		S Meter 1mA	£1·70
		VU meter	£2·10

Type MR.52P. 2¼in square fronts.

50µA	£3·10	20V d.c.	£2·00
50-0-50µA	£2·60	50V d.c.	£2·00
100µA	£2·60	300V d.c.	£2·00
100-0-100µA	£2·50	15V a.c.	£2·10
500µA	£2·30	300V a.c.	£2·10
1mA	£2·00	S Meter	
5mA	£2·00	1mA	£2·10
10mA	£2·00	VU Meter	£3·20
50mA	£2·00	1A a.c.*	£2·00
100mA	£2·00	5A a.c.*	£2·00
500mA	£2·00	10A a.c.*	£2·00
1A	£2·00	20A a.c.*	£2·00
5A	£2·00	30A a.c.*	£2·00
10V d.c.	£2·00		

Type MR.45P. 2in square fronts.

50µA	£2·25	10V d.c.	£1·50
50-0-50µA	£2·10	20V d.c.	£1·50
100µA	£2·10	50V d.c.	£1·50
100-0-100µA	£1·87	300V d.c.	£1·50
200µA	£1·87	15V a.c.	£1·80
500µA	£1·75	300V a.c.	£1·80
500-0-500µA	£1·70	S Meter	
1mA	£1·70	1mA	£1·85
5mA	£1·70	VU Meter	£2·25
10mA	£1·70	1A a.c.*	£1·70
50mA	£1·70	5A a.c.*	£1·70
100mA	£1·70	10A a.c.*	£1·70
500mA	£1·70	20A a.c.*	£1·70
1A	£1·70	30A a.c.*	£1·70
5A	£1·70		

Type MR.65P. 3½in · 3½in fronts.

50µA	£3·37	20V d.c.	£2·20
50-0-50µA	£2·75	50V d.c.	£2·20
100µA	£2·75	150V d.c.	£2·20
100-0-100µA	£2·65	300V d.c.	£2·20
200µA	£2·65	15V a.c.	£2·30
500µA	£2·40	50V a.c.	£2·30
500-0-500µA	£2·20	150V a.c.	£2·30
1mA	£2·20	300V a.c.	£2·30
5mA	£2·20	500V a.c.	£2·30
10mA	£2·20	S Meter	
50mA	£2·20	1mA	£2·37
100mA	£2·20	VU meter	£3·37
500mA	£2·20	50mA a.c.*	£2·20
1A	£2·20	100mA a.c.*	£2·20
5A	£2·20	200mA a.c.*	£2·20
10A	£2·20	500mA a.c.*	£2·20
15A	£2·20	1A a.c.*	£2·20
20A	£2·20	5A a.c.*	£2·20
30A	£2·30	10A a.c.*	£2·20
50A	£2·50	20A a.c.*	£2·20
5V d.c.	£2·20	30A a.c.*	£2·20
10V d.c.	£2·20		

"SEW" BAKELITE PANEL METERS

Type MR.65 3½in square fronts.

25µA	£3·50	500mA	£1·90
50µA	£2·37	1A	£1·90
50-0-50µA	£2·35	5A	£1·90
100µA	£2·35	15A	£1·90
100-0-100µA	£2·25	30A	£1·90
500µA	£2·20	50A	£1·90
1mA	£1·90	5V d.c.	£1·90
1-0-1mA	£1·90	10V d.c.	£1·90
5mA	£1·90	20V d.c.	£1·90
10mA	£1·90	50V d.c.	£1·90
50mA	£1·90	150V d.c.	£1·90
100mA	£1·90	300V d.c.	£1·90
		30V a.c.*	£1·95
		50V a.c.*	£1·95
		150V a.c.*	£1·95
		300V a.c.*	£1·95
		500mA a.c.*	£1·95
		1A a.c.*	£1·95
		5A a.c.*	£1·95
		10A a.c.*	£1·95
		20A a.c.*	£1·95
		30A a.c.*	£1·95
		50A a.c.*	£1·95
		VU meter	£3·10

*** MOVING IRON — ALL OTHERS MOVING COIL**
Please add postage

"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. 3" mirror scale. The meter movement is easily accessible to demonstrate internal working. Available in the following ranges:

50µA	£5·00	20V d.c.	£4·40
100µA	£4·65	50V d.c.	£4·40
1mA	£4·40	300V d.c.	£4·40
50-0-50µA	£4·65	Dual range	
1-0-1mA	£4·40	500mA/5A d.c.	£4·65
1A d.c.	£4·40	5V/50V d.c.	£4·65
5A d.c.	£4·40		
10V d.c.	£4·40		

EDGEWISE METERS

PE.70 3 17/32in × 1 15/32in × 2¼in deep.

50µA	£3·10	500µA	£2·75
50-0-50µA	£3·00	1mA	£3·45
100µA	£3·00	300V a.c.	£3·45
100-0-100µA	£2·90	VU meter	£3·40
200µA	£2·90		

MULTIMETERS for EVERY purpose!

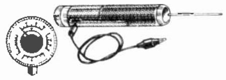
MODEL LT.101 1000 O.P.V. 0/10/50/250/1000 V. D.C. 0/10/50/250/1000 V. A.C. 0/1/100 M.A. 0/150 K ohms. **£1·97.** P. & P. 15p.

TMK MODEL MD.120. Mirror scale. 20kΩ/volt d.c., 10kΩ/volt a.c. 30/60/300/600/3,000V d.c. 6/120/1,200V a.c. Current 0–60µA/0–12/0–300mA. 0–60kΩ/0–6MΩ −20 to +63dB. **£4·62½.** P. & P. 15p.

MODEL 500. 30,000 O.P.V. with overload protection, mirror scale 0/·5/2·5/10/25/100/250/500/1,000 V d.c. 0/2·5/10/25/100/250/500/1,000 V. a.c. 0/50 µA/5/50/500 mA. 12 amp. d.c. 0/60K/6 Meg./60 MegΩ. **£8·87½.** Post paid.

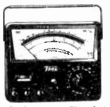
TMK LAB TESTER. 100,000 O.P.V. 6½in scale buzzer short circuit check. Sensitivity: 100,000 OPV d.c. 5/Volt a.c. D.c. volts: 0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 3, 10, 50, 250, 500, 1,000V. D.c. current: 10, 100µA, 10, 100, 500mA, 2·5, 10A. Resistance: 1K, 10K, 100K, 10 meg, 100 meg. Decibels: −10 to +49dB. Plastic case with carrying handle, size 7½in × 6¾in × 3¼in. **£18·90.** P. & P. 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 0–20kΩ. ONLY **£1·97.** P. & P. 13p.

TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER



Battery operated, 11 meg input. 26 ranges. Large 4¾in mirror scale. Size 5⅞in × 4⅜in × 2⅜in. D.c. volts 0·3–1,200V. A.c. volts 3–300V R.M.S. 8·0–800V P-P. D.c. current 0·12–12MA. Resistance up to 2,000M ohm. Decibels −20 to +51dB. Complete with leads/instructions. **£17·50.** P. & P. 20p.

T.E.40 HIGH SENSITIVITY A.C. VOLTMETER

10 meg. input 10 ranges: ·01 / ·003 / ·1 / ·3 / 1 / 3 / 10 / 30 / 100 / 300V. R.M.S. 4c/s.-1·2Mc/s. Decibels −40 to +50dB. Supplied brand new complete with leads and instructions. Operation 230V a.c. **£17·50.** Carr. 25p.

TE22 SINE SQUARE WAVE AUDIO GENERATORS

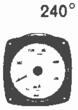
Sine: 20c/s to 200 kc/s on 4 bands. Square: 20c/s to 30 kc/s. Output impedance 5,000 ohms. 200/250V a.c. Supplied brand new and guaranteed with instruction manual and leads. **£16·50.** Carr. 37½p.

TE-20RF SIGNAL GENERATOR

Accurate wide range signal generator covering 120 kc/s-260 Mc/s on 6 bands.

Directly calibrated variable R.F. attenuator. Operation 200/240V a.c. Brand new with instructions. **£15.** P. & P. 37½p. S.A.E. for details.

240° WIDE ANGLE 1mA METERS



MW1-6 60mm square **£3·97½.** MW1-8 80mm square **£4·97½.** P. & P. extra.

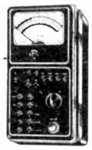
MODEL TE-300. 30,000 O.P.V. Mirror scale, overload protection 0/0·6/3/15/60/300/1,200V d.c. 0/6/30/120/600/1,200V a.c. 0/30µA / 6mA / 60mA / 300mA/600mA. 0/8K/80K/800K/8 meg. −20 to +63dB. **£5·97½.** P. & P. 15p.

MODEL PL436. 20kΩ/Volt d.c. 8kΩ/Volt 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 meg Ω. −20 to + 46dB. **£6·97½.** P. & P. 12½p.

MODEL 5025. 57 ranges, giant 5¼in meter, polarity reverse switch. Sensitivity: 50K/Volt d.c. 5K/Volt a.c. D.c. Volts: 0·125, 0·25, 1·25, 5, 10, 25, 50, 125, 250, 500, 1,000V. A.c. Volts: 1·5, 3, 5, 10, 25, 50, 125, 250, 500, 1,000V. D.c. current: 25, 50µA, 2·5, 5, 25, 50, 250, 500mA, 5, 10A. Resistance: 2K, 10K, 100K, 1 meg, 10 meg. Decibels: −20 to +85dB. **£12·50.** P. & P. 17½p.

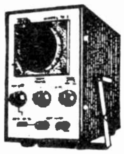
TMK MODEL TW-20CB. Features Resettable Overload Button. Sensitivity: 20KΩ/Volt d.c. 5KΩ/Volt a.c. D.c. volts: 0–0·5, 2·5, 10, 50, 250, 1,000V. A.c. volts: 0–2·5, 10, 50, 250, 1,000V. D.c. currents: 0–0·05, 0·5, 5, 50, 500mA. Resistance: 0–5K, 50K, 0–500K, 5 meg. Decibels: −20 to +52dB. **£11·50.** P. & P. 17½p.

RUSSIAN 22 RANGE MULTIMETER



Model U437 10,000 o.p.v. A first class versatile instrument manufactured in U.S.S.R. to the highest standards. Ranges: 2·5 / 10 / 50 / 250 / 500 / 1000V d.c., 2·5 / 10 / 50 / 250 / 500 / 1000V a.c. D.c. current 100 mA / 1 / 10 / 100mA/1A. Resistance 300 ohms / 3 / 30 / 300kΩ / 3MΩ. Complete with batteries, test leads, instructions and sturdy steel carrying case. **OUR PRICE £5·97.** P. & P. 25p.

TO-2 PORTABLE OSCILLOSCOPE



A general purpose low cost economy oscilloscope for everyday use. Y amp. Bandwidth 2 CPS-1 MHZ. Input imp. 2 megΩ 25 P.F. Illuminated scale. 2in. tube. 115 × 180 × 230mm. Weight 8lb. 220/240V a.c. Supplied brand new with handbook. **£22·50.** Carr. 50p.

HONEYWELL DIGITAL VOLTMETER VT.100

Can be panel or bench mounted. Basic meter measures 1 volt 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. No. 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: 5¼in. × 2 13/16in. × 8 3/16in AVAILABLE BRAND NEW AND FULLY GUARANTEED AT APPROX. HALF PRICE. **£49·97½** Carr. 50p

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

Also see next two pages

SEMI-CONDUCTORS/VALVES
ALL DEVICES BRAND NEW AND FULLY GUARANTEED

Transistors

Type	Price
2G301	20p
2G302	20p
2G303	20p
2G306	30p
2G308	30p
2G309	30p
2G371	15p
2G374	20p
2G381	22p
2N388A	49p
2N404	20p
2N696	15p
2N697	15p
2N698	25p
2N699	30p
2N706	10p
2N706A	12p
2N708	12p
2N709	45p
2N718	25p
2N718A	30p
2N726	25p
2N727	25p
2N914	17p
2N916	17p
2N918	30p
2N929	22p
2N930	20p
2N937	52p
2N1090	22p
2N1091	22p
2N1131	25p
2N1132	25p
2N1302	17p
2N1303	17p
2N1304	22p
2N1305	22p
2N1306	25p
2N1307	25p
2N1308	25p
2N1309	25p
2N1507	17p
2N1613	20p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27p
2N1639	27p
2N1701	162p
2N1711	24p
2N1889	32p
2N1893	37p
2N2147	72p
2N2160	57p
2N2193	40p
2N2193A	42p
2N2194	27p
2N2194A	30p
2N2217	25p
2N2218	20p
2N2219	20p
2N2220	25p
2N2221	25p
2N2222	20p
2N2222A	25p
2N2297	30p
2N2368	15p
2N2369	15p
2N2369A	15p
2N2410	42p
2N2483	27p
2N2484	32p
2N2539	22p
2N2540	22p
2N2613	35p
2N2614	30p
2N2646	47p
2N2711	25p
2N2712	25p
2N2713	27p
2N2714	30p
2N2904	20p
2N2904A	25p
2N2905	25p
2N2905A	20p
2N2906	20p
2N2906A	25p
2N2907	23p
2N2923	15p
2N2924	15p
2N2925	15p
2N2926G	12p
2N2926O	12p
2N2926Y	12p
2N3011	20p
2N3014	25p
2N3053	20p
2N3054	49p
2N3055	72p
2N3133	25p
2N3134	30p
2N3135	25p
2N3136	25p
2N3390	25p
2N3391	20p
2N3391A	30p
2N3392	17p
2N3393	15p
2N3394	15p
2N3402	22p
2N3403	22p
2N3404	82p
2N3405	45p
2N3414	22p

Type	Price
2N3415	22p
2N3416	27p
2N3417	37p
2N3439	130p
2N3440	97p
2N3564	17p
2N3565	15p
2N3566	22p
2N3568	25p
2N3569	25p
2N3570	125p
2N3572	97p
2N3605	27p
2N3606	27p
2N3607	22p
2N3638	18p
2N3638A	20p
2N3641	18p
2N3642	18p
2N3643	20p
2N3644	25p
2N3645	25p
2N3691	15p
2N3692	18p
2N3693	15p
2N3694	18p
2N3702	10p
2N3703	10p
2N3704	12p
2N3705	10p
2N3706	10p
2N3707	12p
2N3708	10p
2N3709	10p
2N3710	10p
2N3711	10p
2N3713	187p
2N3714	200p
2N3715	220p
2N3716	285p
2N3773	240p
2N3791	275p
2N3819	34p
2N3820	55p
2N3823	50p
2N3854	27p
2N3854A	27p
2N3855	27p
2N3855A	30p
2N3856	30p
2N3856A	35p
2N3858	25p
2N3858A	30p
2N3859	27p
2N3859A	32p
2N3860	30p
2N3866	150p
2N3877	40p
2N3877A	40p
2N3900	37p
2N3900A	40p
2N3901	97p
2N3903	20p
2N3904	25p
2N3905	30p
2N3906	25p
2N4058	12p
2N4059	10p
2N4060	12p
2N4061	12p
2N4062	12p
2N4244	47p
2N4248	15p
2N4249	15p
2N4250	18p
2N4254	42p
2N4255	42p
2M4284	17p
2N4285	17p
2N4286	17p
2N4287	17p
2N4288	15p
2N4289	12p
2N4290	12p
2N4291	15p
2N4292	15p
2N4294	17p
2N4303	47p
2N4964	15p
2N4965	18p
2N5027	52p
2N5028	57p
2N5029	47p
2N5030	42p
2N5172	12p
2N5174	52p
2N5175	52p
2N5176	45p
2N5232A	30p
2N5245	45p
2N5246	42p
2N5249	67p
2N5265	325p
2N5305	37p
2N5306	40p
2N5307	37p
2N5308	37p
2N5309	62p
2N5310	42p
2N5354	27p
2N5355	27p
2N5356	32p
2N5365	47p
2N5366	32p
2N5367	57p
2N5457	30p

Type	Price
2N5458	35p
2N5459	40p
2S102	25p
2S103	25p
2S104	25p
2S301	50p
2S302	50p
2S303	60p
2S304	75p
2S501	32p
2S502	35p
2S503	27p
3N83	40p
3N128	70p
3N140	77p
3N141	72p
3N142	55p
3N143	67p
3N152	87p
40050	55p
40250	50p
40251	32p
40309	32p
40310	45p
40311	35p
40312	47p
40314	37p
40315	37p
40316	47p
40317	37p
40319	55p
40320	47p
40323	32p
40324	47p
40326	37p
40329	30p
40344	27p
40347	57p
40348	52p
40360	40p
40361	40p
40362	50p
40370	32p
40406	57p
40407	40p
40408	52p
40409	55p
40410	62p
40412	50p
40467A	57p
40468A	35p
40528	72p
40600	57p
40603	50p
AC107	30p
AC126	20p
AC127	24p
AC128	20p
AC151	18p
AC152	22p
AC154	22p
AC176	20p
AC187	25p
AC188	25p
ACY17	27p
ACY18	24p
ACY19	24p
ACY20	20p
ACY21	20p
ACY22	10p
ACY28	17p
ACY39	47p
ACY40	14p
ACY41	15p
ACY44	25p
AD140	47p
AD149	47p
AD150	62p
AD161	35p
AD162	35p
AF109	45p
AF114	25p
AF115	25p
AF116	25p
AF117	20p
AF118	44p
AF121	30p
AF124	22p
AF125	19p
AF126	16p
AF127	16p
AF139	28p
AF178	42p
AF179	45p
AF180	50p
AF181	40p
AF186	39p
AF239	30p
AF279	47p
AF280	47p
AFZ11	32p
ASY26	25p
ASY27	30p
ASY28	24p
ASY29	27p
ASY50	25p
ASY51	32p
ASY54	25p
ASY67	45p
ASY86	32p
ASZ21	51p
AUY10	150p
BC107	10p
BC108	10p
BC109	10p
BC113	10p

Type	Price
BC114	15p
BC115	15p
BC116	15p
BC118	15p
BC119	30p
BC121	20p
BC122	20p
BC125	15p
BC126	25p
BC134	12p
BC135	12p
BC136	15p
BC137	15p
BC138	20p
BC140	35p
BC141	35p
BC147	10p
BC148	10p
BC149	12p
BC152	17p
BC153	20p
BC154	20p
BC157	15p
BC158	11p
BC159	12p
BC160	35p
BC167	11p
BC168B	12p
BC168C	15p
BC169B	14p
BC169C	15p
BC170	12p
BC171	15p
BC172	15p
BC175	22p
BC177	20p
BC178	20p
BC179	20p
BC182	12p
BC182L	10p
BC183	9p
BC183L	9p
BC184	11p
BC184L	11p
BC186	25p
BC187	27p
BC212L	12p
BC213L	12p
BC214L	15p
BCY10	27p
BCY30	35p
BCY31	40p
BCY32	60p
BCY33	30p
BCY34	35p
BCY38	30p
BCY39	60p
BCY40	50p
BCY41	15p
BCY42	15p
BCY43	15p
BCY54	32p
BCY58	22p
BCY59	22p
BCY60	97p
BCY70	15p
BCY71	20p
BCY72	15p
BCY78	30p
BCY79	30p
BCZ10	27p
BCZ11	40p
BD112	50p
BD116	112p
BD121	65p
BD123	80p
BD124	75p
BD131	75p
BD132	80p
BDY10	125p
BDY20	105p
BDY61	125p
BDY62	100p
BF115	25p
BF117	47p
BF152	28p
BF154	20p
BF158	15p
BF159	35p
BF163	35p
BF167	25p
BF170	33p
BF173	30p
BF177	30p
BF178	25p
BF179	30p
BF180	35p
BF181	35p
BF182	30p
BF184	20p
BF185	20p
BF194	15p
BF195	15p
BF196	15p
BF197	15p
BF198	15p
BF200	35p
BF224	14p
BF225	19p
BF237	22p
BF238	22p
BF244	32p
BFW61	47p
BFW87	25p
BFW88	23p
BFW89	20p

Type	Price
BFW90	22p
BFW91	20p
BFX12	22p
BFX13	22p
BFX29	25p
BFX30	25p
BFX37	30p
BFX44	37p
BFX68	67p
BFX84	25p
BFX85	30p
BFX86	25p
BFX87	25p
BFX88	20p
BFX89	62p
BFX93A	70p
BFY11	42p
BFY18	25p
BFY19	25p
BFY21	42p
BFY24	45p
BFY29	40p
BFY30	40p
BFY41	50p
BFY43	62p
BFY50	20p
BFY51	20p
BFY52	20p
BFY53	15p
BFY56A	57p
BFY76	42p
BFY77	57p
BFY90	65p
BSX19	17p
BSX20	15p
BSX21	20p
BSX26	45p
BSX27	47p
BSX28	32p
BSX60	82p
BSX61	62p
BSX76	15p
BSX77	20p
BSX78	25p
BSY24	15p
BSY25	15p
BSY26	17p
BSY27	15p
BSY28	17p
BSY29	17p
BSY32	25p
BSY36	25p
BSY37	25p
BSY38	20p
BSY39	22p
BSY43	50p
BSY51	32p
BSY52	32p
BSY53	37p
BSY54	40p
BSY56	90p
BSY79	45p
BSY90	57p
BSY95A	12p
C424	15p
C450	15p
GET102	35p
GET113	25p
GET114	20p
GET118	20p
GET120	25p
GET873	12p
GET880	45p
GET887	15p
GET889	22p
GET890	22p
GET896	22p
GET897	22p
GET898	22p
MAT100	25p
MAT101	25p
MAT120	25p
MAT121	25p
MJ400	107p
MJ420	80p
MJ421	80p
MJ430	102p
MJ440	95p
MJ480	97p
MJ481	125p
MJ490	100p
MJ491	137p
MJE340	50p
MJE370	80p
MJE371	80p
MJE520	75p
MJE521	70p
MPF102	42p
MPF103	35p
MPF104	37p
MPF105	37p
MPS3638	32p
NKT124	42p
NKT125	27p
NKT126	27p
NKT128	27p
NKT135	27p
NKT137	32p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	20p
NKT215	22p
NKT216	35p
NKT217	40p

Type	Price
NKT219	30p
NKT223	27p
NKT224	22p
NKT225	22p
NKT229	30p
NKT237	35p
NKT238	25p
NKT240	27p
NKT241	27p
NKT242	20p
NKT243	62p
NKT244	17p
NKT245	20p
NKT261	20p
NKT262	30p
NKT264	20p
NKT271	20p
NKT262	20p
NKT274	20p
NKT275	20p
NKT278	25p
NKT281	27p
NKT401	87p
NKT402	90p
MKT403	75p
NKT404	55p
NKT405	75p
NKT406	62p
NKT451	62p
NKT452	62p
NKT453	47p
NKT713	20p
NKT717	42p
NKT734	27p
NKT736	35p
NKT773	25p
NKT781	30p
OC16	50p
OC19	37p
OC20	85p
OC22	50p
OC23	60p
OC24	60p
OC25	40p
OC26	25p
OC28	60p
OC29	60p
OC35	50p
OC36	60p
OC41	22p
OC42	40p
OC44	15p
OC45	12p
OC46	15p
OC70	15p
OC71	12p
OC72	12p
OC73	30p
OC74	30p
OC75	25p
OC76	25p
OC77	40p
OC78	20p
OC81	20p
OC81D	20p
OC82	25p
OC82D	15p
OC83	25p
OC84	25p
OC139	25p
OC140	40p
OC170	25p
OC171	30p
OC200	40p
OC201	75p
OC202	80p
OC203	40p
OC204	40p
OC205	75p
OC206	95p
OC207	75p
OCP71	42p
ORP12	50p
ORP60	40p
ORP61	42p
P346A	22p
ST140	15p
ST141	20p
TIS34	62p
TIS43	40p
TIS44	12p
TIS45	12p
TIS46	12p
TIS47	12p
TIS48	12p
TIS49	12p
TIS50	12p
TIS51	10p
TIS52	11p
TIS53	22p
XB112	12p
XC141	35p
ZTX107	15p
ZTX108	12p
ZTX109	15p
ZTX300	12p
ZTX301	15p
ZTX302	20p
ZTX303	20p
ZTX304	25p
ZTX500	15p
ZTX501	15p
ZTX502	20p
ZTX503	17p
ZTX504	40p
ZTX531	25p

Integrated Circuits

Type	Price
CA3000	180p
CA3005	117p
CA3007	262p
CA3011	75p
CA3012	88p
CA3013	105p
CA3014	124p
CA3018	84p
CA3018A	110p
CA3019	84p
CA3020	126p
CA3020A	160p
CA3021	156p
CA3022	130p
CA3023	126p
CA3026	100p
CA3028A	74p
CA3028B	105p
CA3029	87p
CA3029A	165p
CA3030	137p
CA3035	122p
CA3036	72p
CA3039	82p
CA3041	109p
CA3042	109p
CA3043	137p
CA3044	120p
CA3045	122p
CA3046	81p
CA3047	137p
CA3048	204p
CA3049	160p
CA3050	185p
CA3051	134p
CA3052	165p
CA3053	46p
CA3054	109p
CA3055	240p
CA3059	165p
CA3064	120p
FCH101	85p
FCH111	105p
FCH121	105p
FCH131	50p
FCH141	105p
FCH151	105p
FCH161	50p
FCH171	105p
FCH181	105p
FCH191	105p
FCH201	130p
FCH211	130p
FCH221	130p
FCH231	150p
FCJ101	160p
FCJ111	150p
FCJ121	275p
FCJ131	275p
FCJ141	525p
FCJ201	100p
FCJ211	275p
FCK101	430p
FCL101	230p
FCY101	102p

Type	Price
FJH101	25p
FJH111	70p
FJH121	25p
FJH131	25p
FJH141	25p
FJH151	25p
FJH161	70p
FJH171	25p
FJH181	25p
FJH221	25p
FJH231	25p
FJH241	25p
FJH251	25p
FJJ101	50p
FJJ111	50p
FJJ121	60p
FJJ131	60p
FJJ141	125p
FJJ181	75p
FJJ191	65p
FJJ211	125p
FJJ251	125p
FJL101	125p
FJY101	25p
IC10	250p
IC12	250p
L900	40p
L914	40p
L923	40p
MC724P	60p
MC780P	247p
MC788P	146p
MC790P	124p
MC792P	66p
MC799P	66p
MC1303L	100p
MC1304P	225p
MC1305P	386p
MC838P	549p
MC1435P	345p
MC1552G	461p
MC1709CG	94p
MFC4000P	75p
PA222	260p
PA230	140p
PA234	92p
PA237	210p
PA246	160p
PA424	235p
PA264	190p
PA265	200p
SN7400	20p
SN7401	20p
SN7402	20p
SN7403	20p
SN7404	20p
SN7405	20p
SN7406	80p
SN7408	20p
SN7409	20p
SN7410	20p
SN7411	23p
SN7413	30p
SN7420	20p

Type	Price
SN7430	20p
SN7440	20p
SN7441AN	75p
SN7442	75p
SN7446	100p
SN7447	135p
SN7448	125p
SN7450	20p
SN7451	20p
SN7453	20p
SN7454	20p
SN7460	20p
SN7472	30p
SN7473	40p
SN7474	40p
SN7475	45p
SN7476	45p
SN7483	87p
SN7486	33p
SN7490	87p
SN7492	87p
SN7493	87p
SN7495	87p
SN7496	87p
SN74107	52p
SN74153	140p
SN74154	220p
SN74160	180p
SN74161	260p
SN74164	220p
SN74165	225p
SN74192	175p
SN74193	175p
TAA241	162p
TAA242	425p
TAA243	150p
TAA263	75p
TAA293	97p
TAA300	175p
TAA310	125p
TAA320	72p
TAA350	175p
TAA435	147p
TAA521	132p
TAA522	360p
TAA530	495p
TAA811	445p
TAB101	97p
TAD100	150p
TAD110	150p
SL403D	150p
SL702C	147p
UA702A	280p
UA702C	77p
UA703C	137p
UA709C	125p
UA710C	125p
UA716	187p
UA723C	162p
UA730C	160p
UA741C	87p

BRIDGE RECTIFIERS PLASTIC ENCAPSULATED

600 PIV 1A	50p	50 PIV 4A	60p
50 PIV 2A	55p	100 PIV 4A	70p
100 PIV 2A	60p	200 PIV 4A	70p
200 PIV 2A	65p	400 PIV 4A	75p
400 PIV 2A	75p	50 PIV 6A	62p
		100 PIV 6A	75p
		200 PIV 6A	75p
		400 PIV 6A	100p

SILICON RECTIFIERS MINIATURE WIRE ENDED PLASTIC

	IN SERIES 1 AMP	PL SERIES 1·5 AMP	CL SERIES 3 AMP
4001 50PIV	7p	8p	19p
4002 100PIV	7p	9p	20p
4003 200PIV	8p	10p	22p
4004 400PIV	8p	10p	25p
4005 600PIV	10p	12p	26p
4006 800PIV	12p	15p	27p
4007 1000PIV	15p	16p	30p

50 + less 15% 100 + less 20%

SILICON RECTIFIERS STUD MOUNTING

	6A	10A	17·5A	35A
100PIV	—	45p	50p	£1 22
200PIV	25p	50p	55p	£1·42
400PIV	30p	55p	62p	£1·77
600PIV	32p	60p	72p	£2·12
800PIV	35p	75p	87p	£2·47
1000PIV	40p	85p	£1·05	£2·77

50 + less 15% 100 + less 20%

ZENER DIODES

400MW	1·5 WATT	10 WATT
3·3-33 V	2·4—100	3 9—100V
10p each	25p each	40p each

25 + less 15% 100 + less 20%

TRANSISTOR DISCOUNTS:- 12 + 10%; 25 + 15%; 100 + 20% any one type. Postage on all Semi Conductors 7p extra.

S A E FOR FULL LISTS

VALVES

Type	Price
OA2	38p
OB2	45p
OZ4	30p
1L4	20p
1R5	40p
1S5	30p
1T4	25p
1U4	30p
1U5	60p
2D21	35p
3Q4	50p
3S4	35p
3V4	48p
5R4	75p
5U4	35p
5V4	45p
5Y3	40p
5Z4G	40p
6/30L2	80p
6AC7	40p
6AG7	40p
6AK5	35p
6AK6	60p
6AL5	20p
6AM6	30p
6AQ5	38p
6AS6	40p
6AT6	35p
6AU6	25p
6AV6	30p
6BA6	25p
6BE6	30p
6BH6	75p
6BJ6	50p
6BQ7A	40p
6BR7	90p
6BR8	70p
6BW6	85p
6BW7	80p
6BZ6	40p
6C4	33p
6CD6	125p
6CL6	50p
6CW4	65p
6F1	62p
6F6G	35p
6F13	45p
6F14	70p
6F15	65p
6F18	50p
6F23	85p
6H6	17p
6J4	50p
6J5	25p
6J5GT	30p
6J6	20p
6J7	45p
6K8G	40p
6L6GT	45p
6LD20	50p
6Q7	40p
6SA7	40p
6SG7	40p
6SJ7	40p
6SK7	40p
6SL7	35p
6SN7	35p
6SQ7	40p
6U4	65p
6V6G	25p
6V6GT	32p
6X4	35p
6X5G	30p
6X5GT	40p
10C2	50p
10F1	75p
10P13	60p
10P14	£1·10
12AT6	30p
12AT7	30p
12AU7	30p
12AX7	30p
12AV6	40p
12BA6	40p
12BE6	40p
12BH7	45p
19AQ5	35p
20D1	50p
20F2	65p
20L1	£1·10
20P1	50p
20P3	60p
20P4	£1·10
20P5	£1·20
25L6	50p

Type	Price
25Z4	30p
25Z5	42p
25Z6	65p
30C15	80p
30C17	90p
30C18	80p
30F5	85p
30FL1	75p
30FL12	120p
30FL14	95p
30L15	85p
30L17	80p
30P12	80p
30P19	85p
30PL1	75p
30PL13	93p
30PL14	90p
35L6	50p
35W4	35p
35Z4	35p
35Z5	50p
50B5	50p
50C5	50p
80	55p
85A2	50p
807	50p
1625	50p
5763	70p
6146	160p
AZ31	55p
CY31	35p
DAF91	30p
DAF96	45p
DF91	22p
DF96	45p
DK91	40p
DK92	55p
DK96	50p
DL92	35p
DL94	48p
DL96	45p
DM70	40p
DY86	32p
DY87	33p
E88CC	100p
E180F	100p
EABC80	35p
EAF42	35p
EB91	20p
EBC41	55p
EBC81	30p
EBF80	40p
EBF83	40p
EBF89	32p
EBL21	60p
EC86	60p
EC88	60p
ECC40	65p
ECC84	30p
ECC85	40p
ECC88	40p
ECF80	85p
ECF82	35p
ECF86	65p
ECH21	57p
ECH35	100p
ECH42	75p
ECH81	30p
ECH83	45p
ECL80	45p
ECL82	35p
ECL83	70p
ECL86	40p
EF37A	120p
EF39	50p
EF40	50p
EF41	65p
EF42	70p
EF80	25p
EF85	35p
EF86	30p
EF89	28p
EF91	15p
EF92	35p
EF183	35p
EF184	35p
EH90	40p
EL34	50p
EL33	£1·25
EL41	60p
EL42	65p
EL81	55p
EL84	25p
EL85	43p
EL91	35p

Type	Price
EL95	35p
EM80	45p
EM81	60p
EM84	35p
EM85	£1·00
EM87	70p
EY51	40p
EY86	40p
EY87	42p
EZ40	55p
EZ41	50p
EZ80	27p
EZ81	29p
GZ32	48p
GZ34	60p
KT66	£2·05
KT88	£2·00
MU14	75p
PABC80	40p
PC86	60p
PC88	60p
PC97	45p
PC900	43p
PCC84	40p
PCC85	40p
PCC88	55p
PCC89	50p
PCC189	55p
PCF80	30p
PCF82	34p
PCF84	60p
PCF86	60p
PCF800	80p
PCF801	50p
PCF802	50p
PCF805	80p
PCF806	70p
PCF808	75p
PCL82	35p
PCL83	65p
PCL84	45p
PCL85	40p
PCL86	45p
PFL200	65p
PL36	55p
PL81	50p
PL82	45p
PL83	45p
PL84	40p
PL500	75p
PL504	80p
PY32	55p
PY33	63p
PY80	40p
PY81	30p
PY82	35p
PY83	38p
PY88	40p
PY800	40p
PY801	50p
U25	80p
U26	80p
U50	40p
U52	35p
U191	75p
U281	40p
U282	40p
U301	40p
U801	£1·80
UABC80	40p
UAF42	55p
UBC41	50p
UBC81	40p
UBF80	40p
UBF89	35p
UCC84	49p
UCC85	40p
UCF80	55p
UCH21	60p
UCH42	70p
UCH81	40p
UCL82	35p
UCL83	60p
UF41	60p
UF80	35p
UF85	40p
UF89	40p
UL41	65p
UL84	40p
UY41	48p
UY85	40p
VR105/30	38p
VR150/30	35p

Add 12p in £ for postage

DIODES & RECTIFIERS

Type	Price	Type	Price	Type	Price
1N34A	10p	BA154	12p	GJ7M	37p
1N914	7p	BAX13	12p	OA5	25p
1N916	10p	BAX16	7p	OA6	12p
AA119	7p	BAY31	7p	OA10	25p
AA129	10p	BAY38	15p	OA9	10p
AAZ13	10p	BY100	15p	OA47	10p
AAZ15	10p	BY103	22p	OA70	10p
BA100	15p	BY122	37p	OA73	10p
BA102	30p	BY124	15p	OA79	10p
BA110	25p	BY126	12p	OA81	8p
BA111	27p	BY127	15p	OA85	7p
BA112	70p	BY164	57p	OA90	8p
BA115	7p	BY210	35p	OA91	7p
BA141	32p	BYZ11	30p	OA95	7p
BA142	32p	BYZ12	30p	OA200	7p
BA144	12p	BYZ13	25p	OA202	10p
BA145	20p	BYZ16	40p	OA210	17p

← See previous page • G.W. SMITH & Co. (RADIO) LTD. • See opposite page →

3 WAYS

HOME RADIO (Components) Ltd.
Dept. PE, 234-240 London Road,
Mitcham CR4 3HD. 01-648 8422

# of obtaining components *quickly & easily*

1 CALL AT No. 240 London Rd., Mitcham

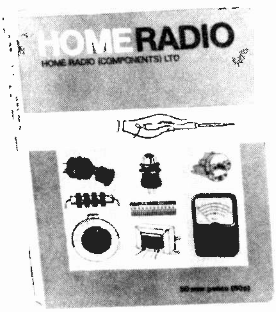
If you live within easy reach of Mitcham or are in the area at any time do call on us. We are almost opposite Mitcham Baths. We open 9 a.m. every weekday. On Wednesdays we close 1 p.m. and all other days, including Saturdays, 5.30 p.m. On Saturdays we have extra staff to deal with queries. We carry a vast stock of components, and 999 times out of a 1,000 we can immediately lay our hands on the particular item required.

2 JOIN OUR CREDIT ACCOUNT SERVICE

We began our Credit Account Service about 18 months ago and it has proved extremely popular. Little wonder! Our customers find it a very simple and convenient way of purchasing all their radio and electronic needs. We supply pre-paid envelopes and order forms and no matter how many orders you send us you make only one payment per month. There are several other advantages with our Credit Account Service. Please write or phone for details.

3 and ORDER BY MAIL OR TELEPHONE

Although we are kept busy selling "over the counter" we supply even more by Mail Order. You can telephone any time of day or night, Sundays included. If you ring out of office hours a recording machine takes your message for us to deal with as soon as we open shop again. Our number is 01–648 8422. If you wish to order by post our address is in the panel at the top of the page. We deal with all orders promptly.



WHICHEVER WAY YOU CHOOSE you need the Home Radio Catalogue

In its 315 pages are listed over 8,000 components, over 1,500 of them illustrated. Each copy contains 10 vouchers, each worth 5p when used as instructed. Free Supplements are supplied regularly to keep you up-to-date. The Catalogue costs 50p over the counter, or 70p including postage and packing.

Post this Coupon with Cheque or P.O. for 70p

Please write your Name and Address in block capitals

Name..

Address..

....

HOME RADIO (Components) LTD.
Dept. PE, 234-240 London Road, Mitcham CR4 3HD

The price of 70p applies only to catalogues purchased by customers in the U.K. and to BFPO addresses.

VOL. 8 No. 2
February 1972

PRACTICAL ELECTRONICS

Editor F. E. BENNETT **Assistant Editor** M. A. COLWELL **Editorial** D. BARRINGTON G. GODBOLD S. R. LEWIS B.Sc. (Eng.)
Art Editor J. D. POUNTNEY **Technical Illustrators** J. A. HADLEY R. J. GOODMAN
Advertisement Manager D. W. B. TILLEARD

UPDATING THE MOTORWAYS

SURELY it ought by now to be accepted that motorways are special areas, throughout which surveillance and control must be continuously exercised, just as in the air lanes above our busy airports and on the railways.

There is a limit to how much of this motorway supervision can be performed by police patrols. In any case in terms of widespread coverage and reliability the human can rarely equal electronic systems. This we know from experience in other areas. Modern tools and techniques appropriate to the high density, fast moving traffic are available. Why don't we use them!

An imaginative programme for bringing our motorways into the electronic era ought to be launched without delay. We suggest a comprehensive scientifically planned system could be evolved on the following lines.

Firstly, weather radars should be installed to monitor atmospheric conditions along the whole length of the motorways. These radars would detect any natural precipitation such as rain, snow, hail or fog; also, any large dense patches of man-made smoke or industrial haze. Significant warning lights would be activated, some distance on either side of the affected region, by the radar equipment.

In these days of sophisticated radio systems, it is not good enough to rely entirely upon roadside signs or lights as a medium for informing or instructing motorists. The next stage therefore should be the setting-up of a motorway radio broadcast service, receivable throughout the length of the motorway by any vehicle equipped with a special receiver. Inductive loop systems seem to offer some practical advantages here, and would simplify the necessary regionalising of the system.

Thirdly, every motorist should eventually be equipped with an electronic aid to provide warning of the presence of other vehicles or obstacles either in front or to the rear, when visibility is severely reduced. Happily it seems this particular need could well be satisfied in a year or so. Recent developments in microwave semiconductors make one confident that a simple c.w. Doppler type radar suitable for this application will emerge shortly.

All these things are technically possible—tomorrow if not today. But there is no guarantee that they, or any other commendable systems, will materialise. Government research establishments have been investigating safety problems for years, so we are told. Why no results? Officialdom must be pressurised by public opinion into some swift and decisive action. And what of the cost? Does any air traveller argue about the contribution he is compelled to make towards the maintenance of complex and expensive electronic installations that ensure his safety in flight?

F.E.B.

THIS MONTH

CONSTRUCTIONAL PROJECTS

SPECIAL SERIES

GENERAL FEATURES

NEWS AND COMMENT

Our March issue will be published on Friday, February 11.

Subscription Rates including postage for one year, to any part of the world, £2·65 (£2 13s. 0d).
Practical Electronics, Fleetway House, Farringdon St., London, E.C.4. Phone: *Editorial* 01-634 4452; *Advertisements* 01-634 4202

WHY WORRY ABOUT
COLD, DAMP MORNINGS?

BOOST YOUR CAR IGNITION
VOLTAGE WITH THIS ADD-ON
IGNITION BOOSTER
AND ENSURE YOUR CAR GETS . . .

OFF TO A GOOD START

By A.J.DUNN

THE question of battery replacement usually comes to a head on a freezing, damp, winter's morning when the car fails to start often due to an effect known as "coil robbing" when the starter motor and internal impedance of the battery combine to drastically lower the ignition coil's voltage.

Many motorists are reluctant to discard a battery since, apart from cold weather starting, the battery in question is usually suitable for many months less arduous service. The author has tried many schemes to avoid premature battery replacement, including separate batteries for ignition, but the booster to be described is equally effective and certainly a lot more convenient.

ENERGY REQUIREMENTS

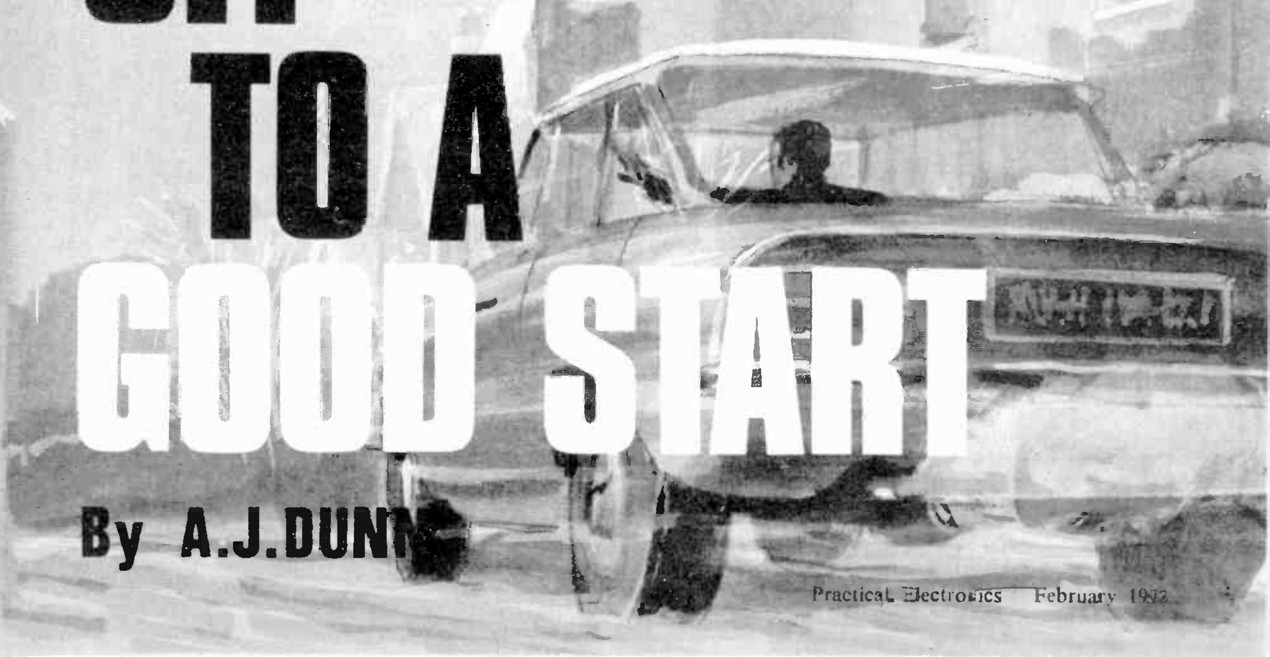
The heavy current drawn by the starter motor under normal conditions causes the battery terminal voltage to fall to about 8V with a 12V system. While this voltage is adequate for starting with a normal running mixture any reduction below this figure with a low air/petrol ratio will require more ignition energy as can be seen from Fig. 1.

A number of factors combine against easy starting in cold and damp conditions the principle ones being:

1. Low temperatures increase the internal resistance of the battery and reduce its charge capacity.
2. Low temperatures increase the oil viscosity and increase the engine resistance torque as shown in Fig. 2.
3. Poor fuel dispersion producing an over rich mixture.
4. Damp causing tracking and other high tension losses.

The combined results are that, with a poor battery starter cranking speed is very low, and the ignition high tension developed is usually too low to fire a rich mixture.

The cure is either a powerful new battery or a means of increasing the available ignition supply voltage. In this article, the technique consists of using an inverter circuit, the output being connected in series with the ignition coil and contact breaker circuit.



The additional load presented by the device is of the order of 5A at 6V when running which is negligible in comparison with starter motor demands. In practice the inverter unit is permanently connected.

The net loss when not active is 0·9V on a supply that rises above 13·6V hence it may be fitted and forgotten.

TWO VERSIONS

Two forms of coil booster units are described, the difference being that one is intended for "starting only" use (Unit A) and is intermittently rated; the "general purpose" booster (Unit B) is similar in construction but with the addition of another two components. This unit has the advantage that it can provide ignition boost when starting and when running, but it must be pointed out that this latter provision depends on how well the engine is tuned and maintained.

The units can be wired to both negative and positive earth electrical systems. This is achieved by total isolation of the circuit components from case, or chassis, so that simple lead interchange is possible.

CIRCUIT ACTION

The booster circuits for both versions are given in Figs. 3a and b. In Unit B, transistors TR2 and TR4 (Fig. 3a) with the ferrite core transformer T1 make up a push-pull inverter, the alternating output of which is rectified by the diodes D1, D2 to charge the energy storage capacitor C1.

The driver transistors are OC28 germanium types, chosen for high efficiency at low collector voltages, with their bases protected from excessive reverse bias by TR1 and TR3 wired as diodes. The bias control resistor R1 determines the starting performance on a heavy load.

When the inverter is oscillating the capacitor C1 is charged under no load conditions and supplies energy to the ignition coil when the contact breaker makes until the load is removed (contacts open) or until C1 has discharged to the point when TR5, which is connected as a diode, is turned on.

This transistor, in its diode role is normally reverse biased relative to the capacitor. If it is made to conduct the inverter stalls as both diodes D1 and D2 are turned on continuously so short circuiting the output. This occurs when the voltage across TR5 equals the turn-on voltage of the silicon diodes. From Fig. 4 it can be seen that this occurs beyond the average non-running ignition current of 3·5A to ensure easy starts under heavy load.

Under high speed running conditions capacitor C1 prevents stalling so that a continuous output is provided for the coil.

The start only version of Fig. 3b is similar in operation, however in this the capacitor is omitted.

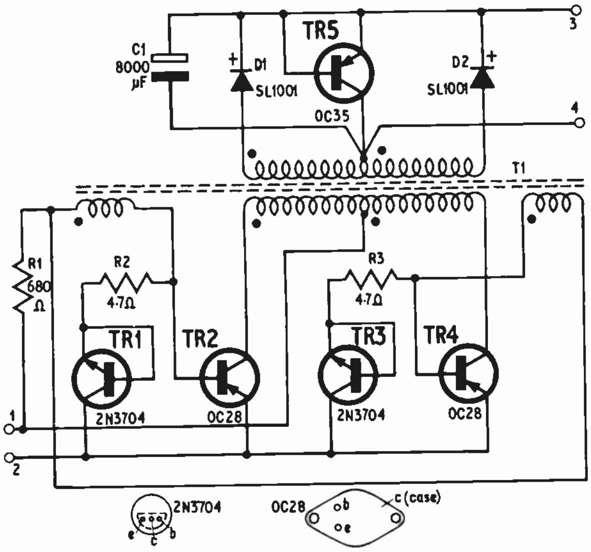


Fig. 3a. Circuit diagram of Unit B (general purpose)

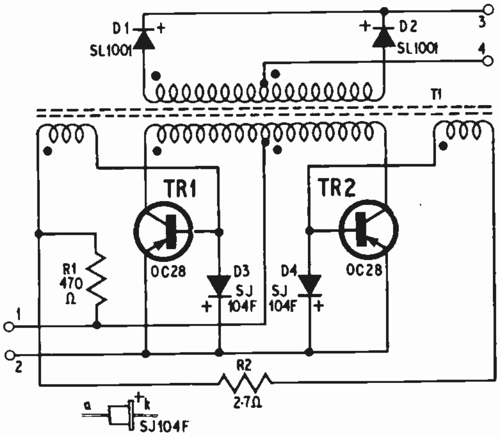


Fig. 3b. Circuit diagram of Unit A

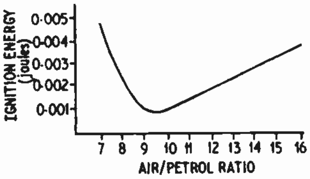


Fig. 1. Graph showing ignition energy requirements for different mixture ratios

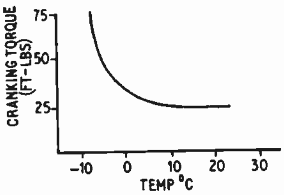


Fig. 2. Graph showing how low temperatures increase the cranking torque requirement

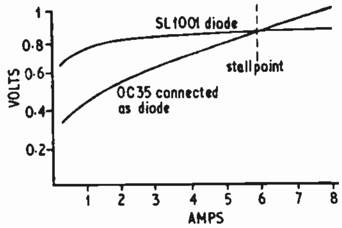
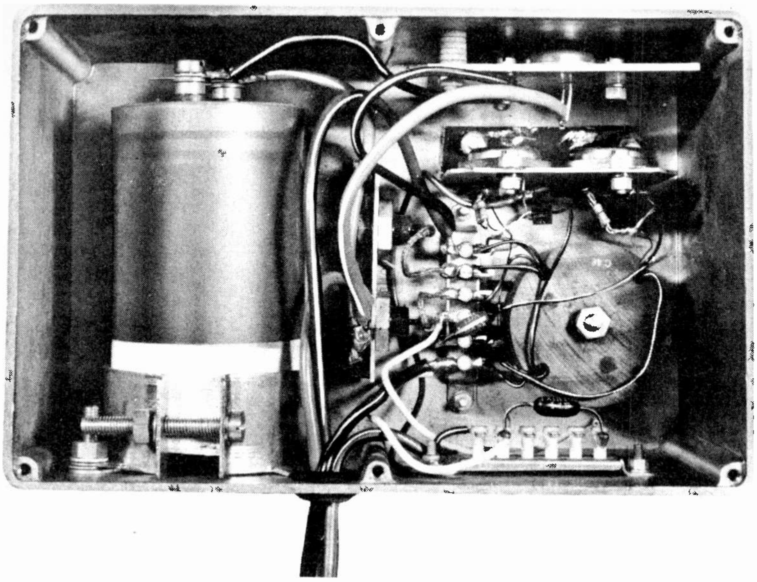


Fig. 4. Graph showing how the OC35 connected as a diode governs the stall point of the inverter oscillator of Unit B



Unit B assembled and wired

Components . . .

UNIT B (General purpose)

Resistors
R1 680–1,000 Ω 2·5W (see text)
R2, R3 4·7 Ω 1W (2 off)
R4 390 Ω 1W
Capacitor
C1 8,000μF elect. 25V
Transistors
TR1, TR3 2N3704 (2 off)
TR2, TR4 OC35 (2 off)
Diodes
D1, D2 SL1001 or SL1003 (2 off)
Transformer
T1 Mullard pot core type LA1201 with DT2206 former (see text)
Switches
S1 2A on/off toggle (Negative earth only)
S2 2A press switch (Negative earth only)
S3 2A single pole change-over (Positive earth only)
Miscellaneous
Insulated terminal strip, diecast box 7¼in × 4½in × 3in, mica washers p.v.c. tape

HIGH SPEED ADJUSTMENT

The current rating of car ignition make and break contacts is of the order of 4A and this is regarded as a practical limit for the output circuit; the difficulty is to achieve this with an 8V supply avoiding the danger of excessive currents and transistor destruction at supply voltage above 12V.

If the high speed unit is used, the power input is restricted by increasing R2 and R3 (Fig. 3a) to reduce the stalled loss at slow speeds and adjusting R1. For these resistance valves, 20 ohms and 820 ohms respectively are suggested.

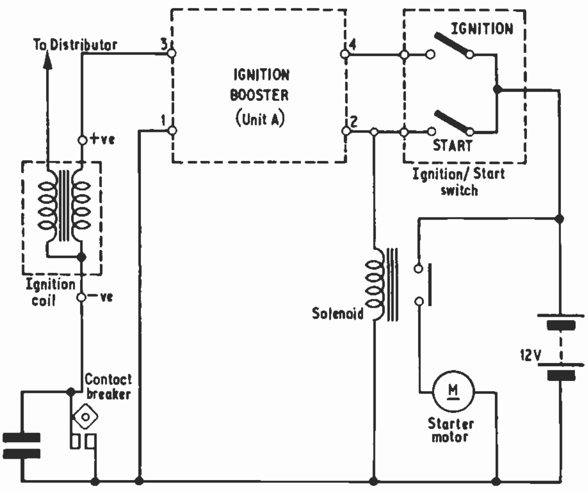
NEGATIVE EARTH

The in-circuit negative earth connections for Unit A are given in Fig. 5a. The input circuit has lead 1 (Fig. 3b) connected to chassis negative and lead 2 to the starter motor relay connector.

The output leads 3 and 4 are so arranged to provide a boost voltage which is, in effect, in series with the battery when the start switch is made.

Unit B has lead 1 connected to chassis negative and lead 2 brought out to the ignition switch lead via S1 and R4 (Fig. 5b).

Once again the output leads are in series with the ignition coil. With S2 and S1 closed, full output is developed when starting (8V input). With S2 released, R4 will now limit the output since the input is now 14V. This is the condition for ignition boost when running and S1 can be used for switching it in and out.



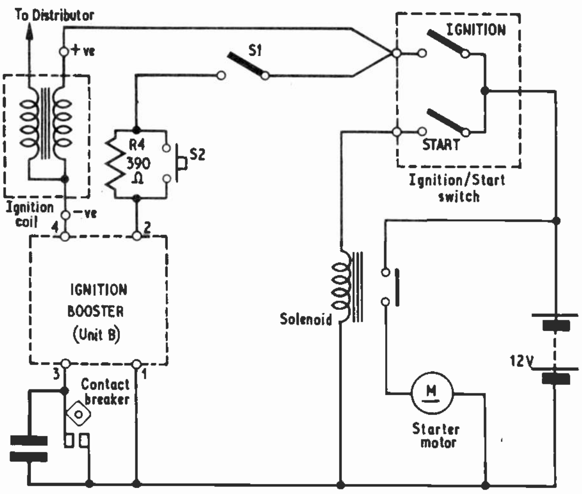


Fig. 5a. Showing the ignition circuit connections for Unit A. Fig. 5b. In-circuit connections for Unit B. These are for negative earth systems only

POSITIVE EARTH

Car wiring connections for Unit A to positive earth electrical systems are given in Fig. 6a. For the input circuit lead 1 (Fig. 3a) is connected to the starter motor solenoid terminal and lead 2 to chassis positive.

The output circuit is connected in series with the ignition coil to boost the voltage when the start switch is closed.

For Unit B, input lead 1 is connected to the solenoid terminal via S3 for starting (Fig. 6b). Ignition boost at high speed is achieved by switching over S3. The resistor R4 limits the output since the input is now 14V.

SPARK ENERGY

The spark energy required for a normal ignition is taken as approximately 0·005 joules and up to ten times this figure may be available in modern engines, however, the spark voltage is often the determining factor in starting. For example a particularly rich mixture may be ignited at 7kV by one third of the spark energy available at 5kV.

The performance of a standard coil ignition is shown in Fig. 7. Here the marked fall at higher energy speeds being partly due to the decreasing time available for the coil current to develop. This can be explained by considering that the average 12V ignition coil has an inductance of 10mH and a resistance of about 3·5 ohms. The non-running current is therefore 3·5A. This current increases initially with speed and dynamo output but later falls.

The coil inductive time constant (L/R) can be calculated as 2·8ms and is the time necessary to develop 60 per cent of the possible inductive energy.

A four cylinder engine running at 5,000 r.p.m. requires 166 sparks per second which means a spark cycle of 1/166s. With a contact breaker having a make and break period of $\frac{2}{3}$ and $\frac{1}{3}$ respectively, the time available for current development is $\frac{2}{3} \times 1/166$s which is 4ms.

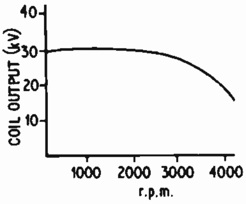


Fig. 7. Graph showing how coil output falls at high revs

Incorrectly set or worn points will reduce this figure to around 3ms which approaches the time constant of the coil so that only 60 per cent of the energy is available.

The mechanics of the breaker system are such that often the cam follower is thrown clear of each lift and the current development is further reduced.

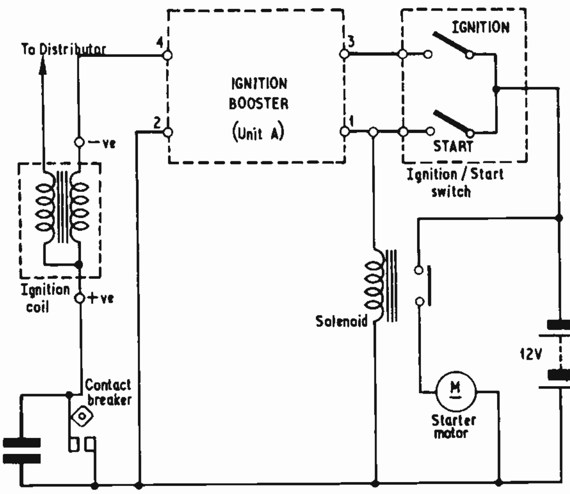
INCREASING VOLTAGE

There are two components of the high tension spark, the inductive oscillation and the charge energy stored by the capacity of the plug leads etc. For good firing at high speeds it is desirable that the relationship between these is maintained. Unfortunately, in practice it is not, and often undetectable misfiring occurs.

Inaccuracy in combustion timing also leads to power losses at speeds below the maximum considered.

By using the inverter circuit it is possible to raise the effective ignition supply voltage progressively from, say, 2,000r.p.m. upwards; the factor by which the voltage is increased being the equivalent to the loss factors introduced as described.

In the design, consideration must be given to the efficiency of the ignition coil (say 60 per cent), the efficiency of the inverter (say 60 per cent). Overall an inverter capable of a 2W output is adequate and the design provides for a compromise between this and a 25W (short term rating) car starting requirement.



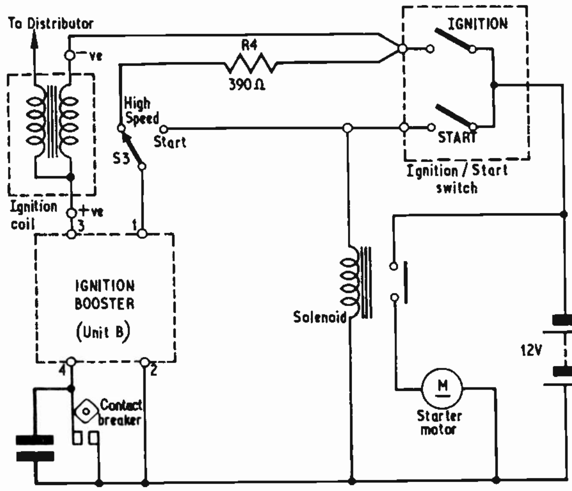


Fig. 6a. Showing the ignition circuit connections for Unit A Fig. 6b. In-circuit connections for Unit B. These are for positive earth systems only

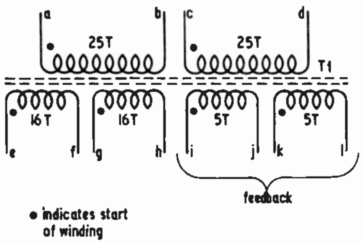


Fig. 8. Winding details for inverter transformer

COIL WINDING

The coil winding details for the inverter transformers of Figs. 3a and b are identical and are given in Fig. 8. The pot core assembly is a 45mm Mullard Vinkor type LA1201 with a DT2206 coil former.

First two separate layers of 25 turns of 20s.w.g. enamelled wire are evenly wound on the former. Take care not to cross adjacent turns or scratch the insulation during this process. The layer should be thinly insulated with p.v.c. tape.

With the output windings completed they should be covered with about four layers of insulating tape.

Next wind on two separate layers of 16 turns each of 20s.w.g. enamelled wire once again using tape for insulation. Finally the two feedback windings of five turns each of 28s.w.g. enamelled wire are added and insulated.

All wire ends should be colour coded with sleeves so as to facilitate later connections.

An adjuster for the core is not necessary this being replaced by a 1½in. 2B.A. bolt for fixing to the unit housing when this is completed.

COMPONENTS

The inverter transistors for both versions of the booster were specially chosen because of their voltage ratings. Diodes D1 and D2 are silicon SL1001 types and have a current rating of 10A.

Silicon type 2N3704 transistors are used in Fig. 3a as diodes primarily for cheapness. In Fig. 3b SJ104F diodes are used in this position although 2N3704 transistors can be substituted.

The value of the capacitor used is made as large as possible consistent with two requirements which are:

1. The inherent resistance of the capacitor and ignition coil circuit should be approximately that of critical damping which is $R \simeq 2\sqrt{\frac{L}{C}}$ where $R = 3{\cdot}5$ ohms and $L = 10$mH, which are the resistance and inductance of the coil unit. Rearranging this for the value of capacitors this works out to approximately 3,000 microfarads.

2. The time constant of the capacitor used and the effective resistance of the charging circuit should be less than five times the mid-range discharge time. At 3,000r.p.m. this is approximately 4ms and a 3 ohm output is feasible so that once again a capacitor value can be calculated. Here, $CR = 5 \times 4$ms hence $C \simeq 7{,}000$ microfarads. Since capacitors in this range at 20–25V working are expensive it is recommended that high speed tests are carried out using any temporary combination of capacitors above 3,000 microfarads before a purchase is made.

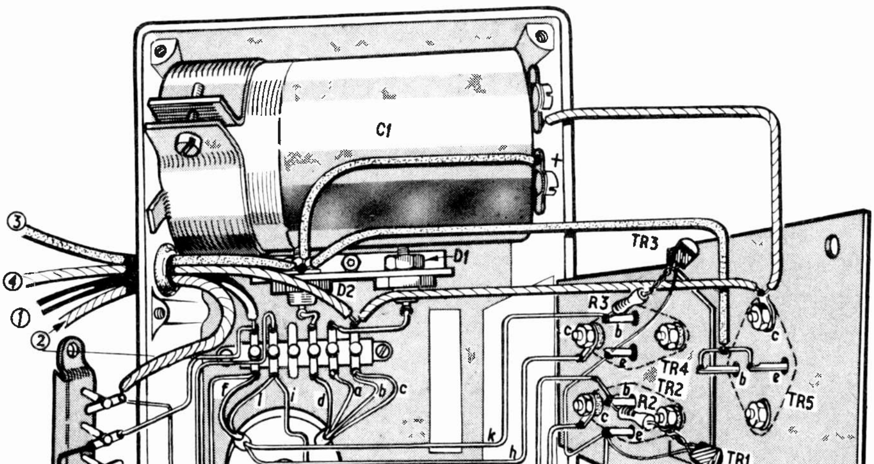


Fig. 9. Interwiring and component layout of Unit B. All components are electrically insulated from chassis

Components...

UNIT (A Start only)

Resistors
R1 470–680 Ω 2·5W (see text)
R2 2·7 Ω 5W (see text)

Transistors
TR1, TR2 OC28 or OC29 (2 off)

Diodes
D1, D2 SL1001 or SL1003 (2 off)
D3, D4 SJ104F (2 off)

Transformer
T1 Mullard pot core type LA1201 with DT2206 former (see text)

Miscellaneous
Insulated terminal strip, 18 s.w.g. aluminium plate 4in × 4½in, heatsinks (see text), mica washers

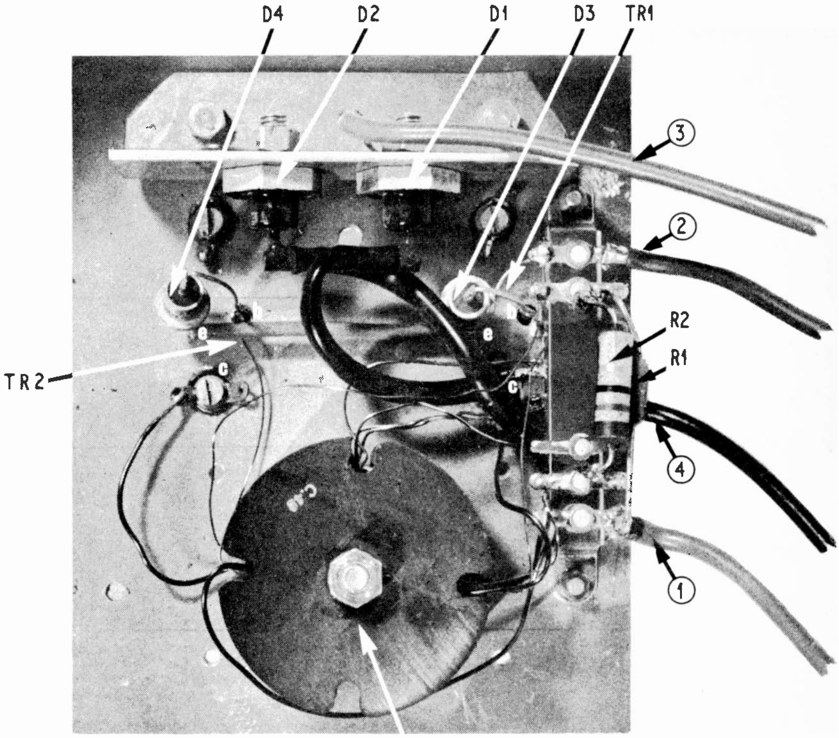


Fig. 10. Wiring and component layout for Unit A. All components are electrically insulated from chassis

ASSEMBLY OF UNITS

Assembly and wiring details for both versions of the booster are given in Figs. 9 and 10. Components for the general purpose unit are shown contained in a 7¼in × 4½in × 3in diecast box. This is necessary for the unit is mounted in the vicinity of the ignition coil, since it will exclude oil and moisture. An alternative open assembled version of the "start-only" unit can be mounted on a plate behind the dashboard.

For starting purposes only small heatsinks are necessary but for Unit B six square inch heatsinks should be used if possible.

On the output side of both units the diodes D1, D2 and the transistor TR5 of Fig. 3a, should be insulated for 1kV to earth and this may easily be done with p.t.f.e. insulators or nylon nuts and screws with plastic spacers. The large capacitor C1 should have one or two layers of insulating tape under the mounting clamp.

With the chosen unit assembled and the wiring checked, connect the input leads 1 and 2 (Figs. 3a or b) to the 6V taps of a car battery taking note of polarity. An audible note will indicate that the device is functioning and the unloaded input current may be monitored using a 10A meter

Connect a headlamp bulb as load across 3 and 4 and note the change in note and increased input current. If possible measure the input and output voltages on load. If the results are not satisfactory check for wrong phasing in the transformer connections.

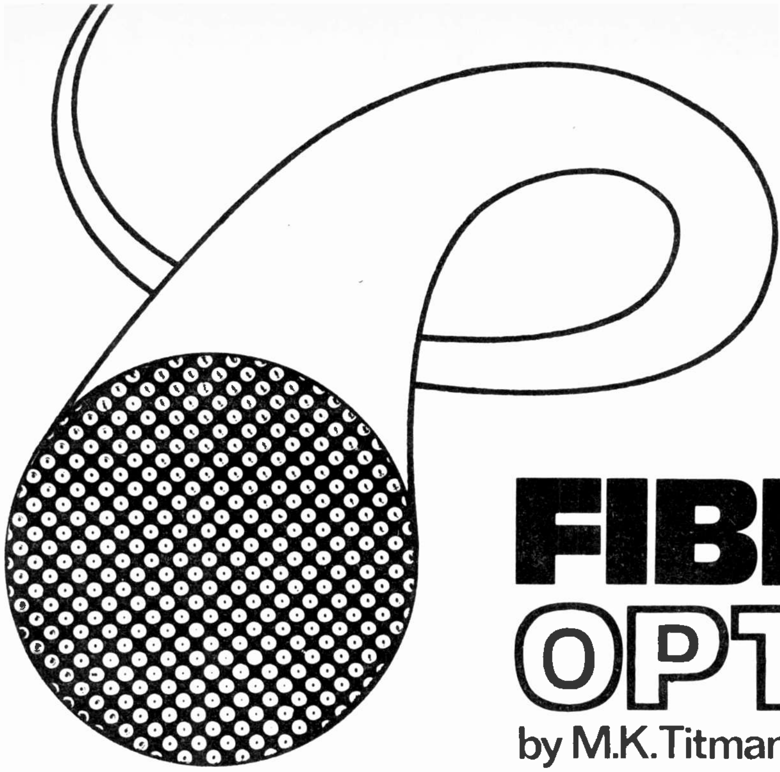
The charged capacitor C1 should only be discharged through a resistance greater than 3 ohms, a lamp is suitable, otherwise damage may result.

The following test results using a variable input supply were obtained using the circuit of Fig. 3a with a resistive load connected at the output and the bias resistor R1 varied as shown.

Table 1:

Input Volts	Input Amps	Output Volts	Output Amps	Load Ohms	Efficiency Per cent	R1 Ohms
8·25	0·5	15	—	o/c	—	350
6·25	3·5	7·5	2·1	3·6	71	350
7·75	1	—	—	s/c	—	350
5·7	4	5·5	2·6	o/c	—	90
6	3·5	7·5	2·5	3	89	90
6·5	2·5	—	—	s/c	—	90
5·1	4·6	5·5	2·9	1·9	68	44

If the general purpose unit is constructed the best test for improved performance is to switch the unit in and out under motorway conditions at say, 60 m.p.h., and observe if a slight impulse is felt, similar to automatic overdrive. If no impulse is felt, little improvement is available and this is probably due to poor car maintenance. ★



FIBRE OPTICS

by M.K. Titman B.Sc.(Eng), C.Eng.

FIBRE optics is the science of transmitting light along flexible translucent fibre cables. The fibres are usually transparent glass or plastics in very thin circular section, and sheathed by a second similar material having a different refractive index. Provided the refractive indices are carefully selected, almost total internal reflection takes place at the boundary between the two surfaces. Consequently the light is constrained to travel along the fibre because of successive reflections along the sheath. This mode of transmission is illustrated in Fig. 1.

LIGHT GUIDE

The simplest form of construction is a single strand cable known as the light guide, but often a multistrand assembly is used, as shown in Fig. 2. Here the individual cores are drawn down to a small diameter to allow cable flexibility. This random arrangement of fibres into a cable is known as a light guide, since it can only transmit light in an incoherent mode, not as optical images.

For the transmission of visual images the fibres are laid out in parallel arrays as illustrated in Fig. 3. Here the spacing of each fibre remains consistent and thus enables the image to be transmitted. These image bundles, as they are known, are produced in short lengths only and are expensive when compared with the cost of longer light guides.

Although many suitable applications spring to mind, fibre optic cables have still to be accepted by most potential users as a versatile means of communication. This is due mainly to problems of impurities in the fibre manufacture, which can give rise to severe attenuation. One other factor is the usual time lag between development and production, but there are some promising trials being carried out to overcome these barriers.

Potentially, the application of fibre optic techniques to certain industrial processes, where hazardous conditions prevail, promises to open up a completely new science related to both electronics and optical physics, and applicable to all branches of engineering.

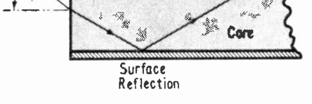


Fig. 1. Fibre optic light transmission

Fig. 2. Fibre strands forming a light guide

Fig. 3. Image bundle

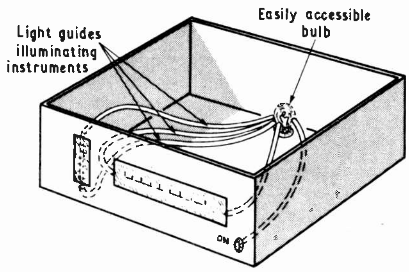


Fig. 4. Multipoint illumination with light guides

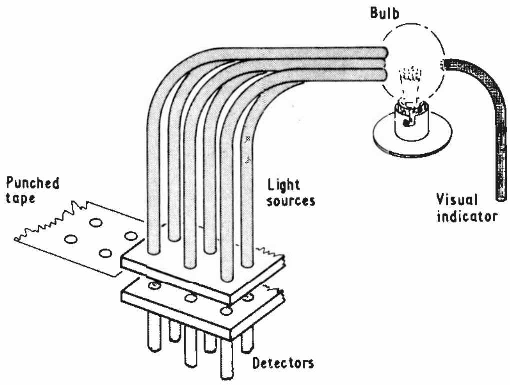


Fig. 5. Multi-position read and detect assembly

SAFE LIGHT SOURCE

Fibre optics provides a safe medium for the transfer of light to dangerously inaccesible positions, such as near rotating mechanisms, cutting edges, or even inflammable substances. It is particularly advantageous for locations such as petrol and oil tanks.

Since no electrical power is transmitted along the guide, the fibre optic system cannot induce explosions. One example of such an application would be the inspection of the carburettor, or petrol pump in a vehicle, perhaps utilising light guided from the headlamps, or monitoring the petrol level in a tank.

The inherent reliability of light guides offers distinct advantages where light has to be provided in complex equipment or machinery. In such cases a single light source can be used with light guides transmitting light to the required areas. Such a use is illustrated in Fig. 4 where a number of separate instruments are illuminated from the single lamp.

This system will allow easy access to facilitate bulb changing and is suitable for meter illumination on vehicle and other instrument panels.

A similar application is their use as point sources in light arrays such as punched card or tape readers. Here the advantage is a single lamp source which can be readily monitored, coupled with the compression of point light sources in a small area, Fig. 5.

LIGHT DETECTION

Light guides are very suitable for light detection and can be used to convey light from detector heads such as that illustrated in Fig. 4. The light can be taken to a location for visual observation or to semiconductor detectors such as are used in paper tape readers. One such likely application in vehicles is a visual check on the instrument panel of the state of all the vehicle lights.

A related application is their use as both source and detector in hazardous regions for edge or position detection. This application is illustrated in Fig. 6, and since the light transmitted is directly proportional to that viewed a proportional detection system is possible. Both the direct and reflective edge detection systems are shown.

FLAME DETECTION

Light guides are suitable for use as flame detectors since they are reliable, robust and non-inflammable.

In many applications a special form of guide known as the Y guide is used. Here the guide is divided to give two light inputs for a single output as shown in Fig. 7. They can of course be used in reverse to give dual point illumination from a single source.

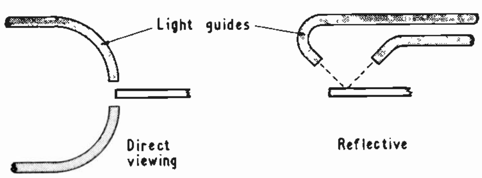


Fig. 6. Remote position detection

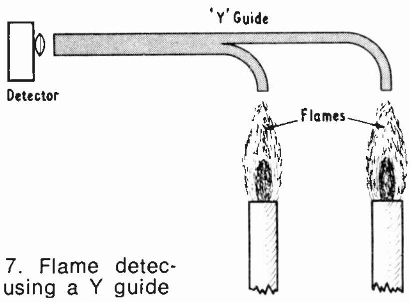


Fig. 7. Flame detection using a Y guide

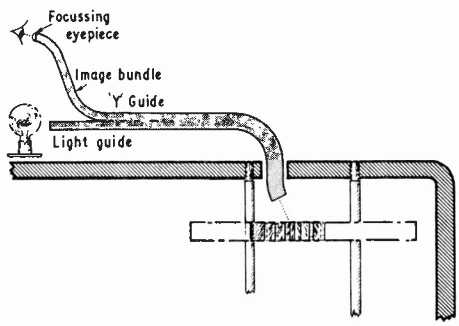


Fig. 8. Using a Y guide to view and illuminate hidden parts

IMAGE TRANSMISSION

Image transmission can only be accomplished by using the special image bundles. Since these are flexible they find use in specialist applications where the increased cost and relatively poor resolution are outweighed. Typical uses are for observation of wear and movement in machinery and equipment, or living anatomical structures.

Fairly often a Y guide is formed with a light guide to illuminate the object, as shown in Fig. 8.

PRESENT LIMITATIONS

At present, light guides have many technical limitations which prevent their widespread adoption as light transmitters. Perhaps the most serious is the rapid attenuation of light strength to about 30 per cent in a distance of six to ten feet. This is acceptable for many applications but precludes their use at present for long distance communications.

Similarly image bundles are limited to a maximum length of six feet by the manufacturing process, which ensures correct alignment.

A second, though less serious limitation, is the spectral response which is not uniform over the visible spectrum and falls off significantly at either side; this is particularly marked in the ultra-violet region.

PRACTICAL CONSIDERATIONS

A number of practical considerations should be observed when using fibre optics. Since they are manufactured from plastic or glass fibre, certain cleaning solvents could damage the fibre. Apart from these solvents the fibres are impervious to most everyday liquids and are not damaged by contact with water, oil or similar solutions. This is a decided advantage in applications where they are exposed to such conditions that would otherwise harm electrical installations.

On installation the fibres can be attached by normal cable clamps and should be well supported. Grommets should be used to protect the cable from sharp edges. Severe bends should be avoided where possible; a good rule is to make the radius of such bends at least more than three times the cable diameter.

To achieve maximum light transfer the cable ends should be highly polished and directly sighted onto the light source. The fibre generally has an acceptance angle of at least 30 degrees but a direct line of light entry is preferable.

While these limitations are serious for some applications, often they do not detract from the very many advantages. Therefore we can expect to see continued effort devoted to the improvement of both light guides and image bundles. These advances will undoubtedly result in price reductions as well as significant technical advances.

Having discussed the widespread uses to which light guides can be put, let us consider a practical installation. Since the penalty for light failure in motor vehicles is at least a fine, this would seem a useful area in which to use fibre optic techniques.

Naturally many will argue that current or voltage detectors are sufficient. However, since they monitor inputs rather than outputs they are not as reliable an indicator as the light guide, which looks directly at the light output.

PLANNING

In applying fibre optic transmission to monitoring car lamps, one should plan where the display is to be located. Ideally all four side lights should be displayed on the dashboard, but this involves the expense of long runs of light guide. An alternative is to mount the front light indicator on the dashboard and display the rear lights on a second indicator raised up on the rear window shelf. The rear display should be through a coloured lens, otherwise they will look like the lights of a following car in the mirror.

The light guide runs can now be planned. Avoid sharp bends; the curvature for all bends should be greater than two inches radius to avoid damage. Allow for grommets at all bulkheads and cable supports with clamps along the underside of the car. Self-tapping screws are adequate for most positions.

With the plan established the precise length of light guide can be measured using stiff wire or cable temporarily. Allow two or three inches at each end

Arrangement of 3 light guides. The Crofon 64 filament guide in plastics and two "mares" tails in glass. Notice the polished ends
The short piece of Perspex rod shown is not a suitable material for optical transmission

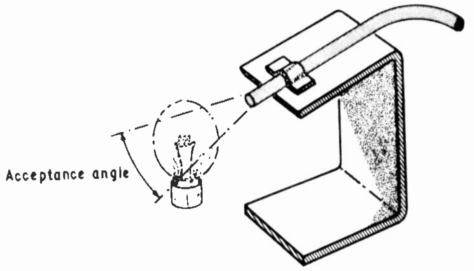


Fig. 9. Bracket for mounting light guide near car lamp

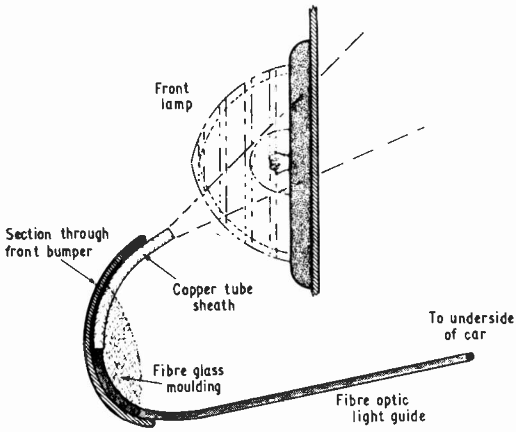


Fig. 10. Direct view mounting of light guide behind front bumper

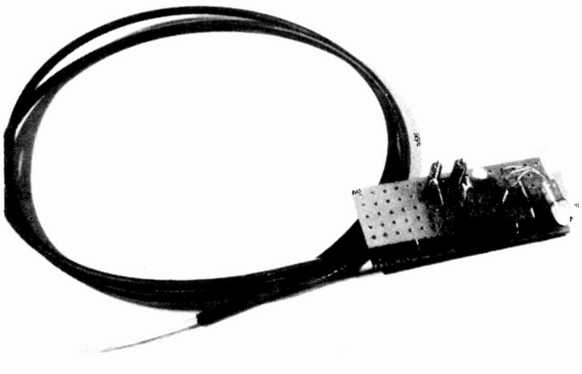
for end finishing, and ensure that bends and positioning is correct. You cannot easily add extra guide if an error occurs.

REAR LAMP FITTINGS

As with most car components the lamp mountings vary considerably. Most rear lamp housings are located in the boot, with either a simply mounted bulb behind the lens, or a moulded housing clamped to the bodywork.

For the mounted bulb common to older cars, a simple bracket can be made which supports the light guide and directs it at the bulb filament as shown in Fig. 9. The bracket is mounted from the bulb fixing frame and provides protection and alignment for the light guide. The slot cut across the bend allows an adequate radius of curvature and support for the guide.

Where the rear lamp assembly is a moulded fitting, a similar bracket can be made and a hole drilled in line with the filament to allow a clear view.



Thin plastics light guide used to transmit light from a remote area to a photo sensitive circuit

In both cases it may be possible to align both rear and brake bulbs in which case correct operation of the brake lights will also be observed on the light guide output.

FRONT LAMP FITTINGS

Most front lamps are exposed to the weather and located on the external bodywork of the car. This presents the designer with the problem of how to mount the light guide without damaging the enclosed fitting. Furthermore, any assembly must not interfere with bulb replacement or removal of the lamp housing.

Two methods are available to us which fulfil all these conditions. Firstly we can gain entry to the rear of the lamp assembly via the cable entry holes in the rubber cover. This ensures that the weatherproofing remains intact particularly if tape is used to facilitate water runoff.

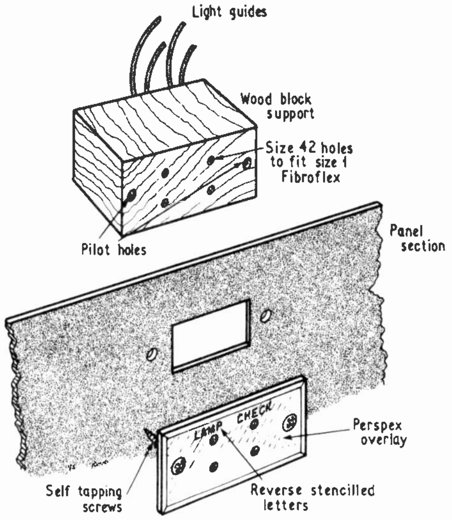
Inside the cover a beehive shaped fibreglass moulding can be formed on the side of the holder and drilled through to take the ferrule ended fibre optic lead. Alternatively the light guide can be permanently moulded into position using a stiff glass fibre resin.

Care must be taken to angle the hole so that a direct view of the filament is obtained without interfering with the lamp fittings. The guide should not project more than $\frac{1}{8}$ inch into the enclosure.

The second method of viewing the front lamp is to bring the guide through to the front lens and view it directly. This has the advantage that it does not require any modifications to the lamp holder.

Many cars position the bumper close to the front sidelight and often this can be used to mount the guide. Such a method is shown in Fig. 10 with the fibreglass moulding shown in section. In order to provide the necessary strength, the guide is held in a copper tube to give rigidity coupled with an ability to bend.

Where an adjacent fitting cannot be used to cover the light guide, all that remains is to drill close to the lamp and bend the guide through. This is generally unsatisfactory but sufficient for some applications.



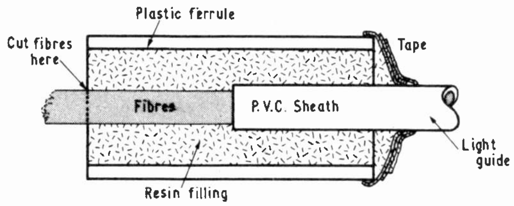


Fig. 11 (left). Instrument panel layout for fibre optic light guides

Fig. 12 (above). Securing and protecting the end of the light guide

INSTRUMENT FACIA

The visual appearance of any system is important because the merits of the entire equipment may be judged by them. Care must be taken to blend the visible escutcheon with the other instrumentation on the dashboard.

To this end it is always preferable to use an existing display and incorporate the new refinements. Thus it may be possible to add an additional indicator lamp with the light guides fed directly through to the lenscap, or to fit the simple escutcheon described below into an existing meter. Such possibilities should be investigated before recourse to the unit described below.

Where we wish to provide a separate mounting, such as the rear window shelf, then the construction shown in Fig. 11 will provide an acceptable finish. The basis is a block of hardwood drilled to accept the individual light guides. A perspex plate is cut and drilled to overlay this block.

The perspex must be accurately cut and the edges bevelled and polished. The plate is then offered up to the block and indentations made in the four lamp positions. The lettering is stencilled on the reverse face and sprayed over with paint to match or contrast the panel. The indentations are cleared and polished by using a rag soaked in metal polish over the point of the drill.

The dashboard panel can be drilled to accept the new instrument and the escutcheon screwed on to the wood block through the panel. The light guides can now be fitted into their respective holes and the light transmission checked.

INSTALLATION

With everything planned and prepared the actual installation should prove simple. All that remains is to finish off the ends of the guide to allow maximum acceptance of light. As the inner cores of the guide are not fixed to the out p.v.c. sheath the best finish is achieved by moulding the core and sheath into a plastic or metal ferrule. Such an assembly is illustrated in Fig. 12.

The edge of the plastic ferrule is sealed to the sheath by tape as shown. With the core exposed an epoxy resin such as Araldite is poured into the mould and allowed to set. The end is carefully cut with a sharp razor, and if necessary polished. The result is a reinforced end fitting with excellent light properties. When using an opaque resin the inner fibres should extend well beyond the ferrule to be sure of maximum light transmission.

A final visual inspection is preferable to ensure that bends are protected and all fixings secure. The position of each guide can be checked by covering the guide input, or disconnecting the lamps in turn.

SUPPLIERS

Crofon Type 1610 64 filament sheathed plastics guide 0·13in. diameter, 35p per foot (as shown in photograph) Single fibre Type 0010· unsheathed £1.50 per 25 metre reel.
Henry's Radio Ltd, 309 Edgware Road, London W.2.
64 filament plastics guide, 0·13in diameter, approx 42½p per foot (305mm) (minimum length supplied 2ft)
Proops Brothers Ltd., The Hyde Industrial Estate, Edgware Road, Hendon, London NW9 6JS.
Fibroflex, size 1, multistrand, 1·1mm, approx 25p per foot (305mm) (minimum length supplied 8ft)
The Emprise Company, 59 St Christopher Road, Colchester, Essex, CO4 4NF. ★

POINTS ARISING

LIE DETECTOR *(January 72)*

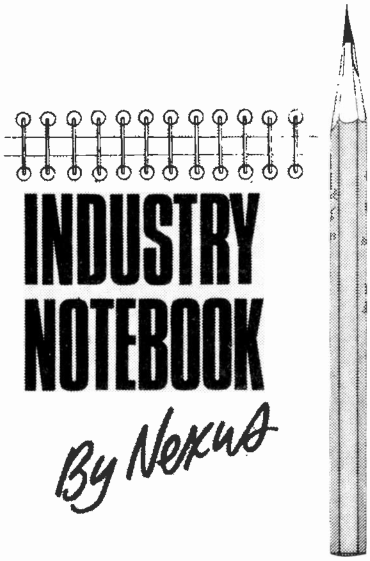
Page 34, Fig. 2. Capacitor C4 should be connected between pin 2 of IC2 and the common ground line in place of the short-circuit shown. Only R11 and R13 are connected to pin 3 of IC2.

I.C. DIGITAL DICE *(December 71)*

Page 1004, under heading THEORY, 14th line should read: "A third output decides 4, 5, or 6 and lights the two remaining diagonally opposite lamps LP4 and LP5 . . . ."

DRIVE IN EUROPE

With even the die-hards now grudgingly admitting that Britain will be joining the European Common Market, there has been a flurry of activity and discussion on what the impact is likely to be on the electronics industry. And it's not all good news.



At a management conference in London, Ian Senior of the Economist Intelligence Unit, himself a pro-marketeer, suggested that U.K. companies would find the market not only tough but even detrimental to the industry as a whole. German domination, he said, is such that Germany already has a sales performance better than the U.K. in EFTA countries where the U.K. has substantial tariff advantages. How will the U.K. fare when all the tariff barriers are down? Well, the present Common Market countries' products will be more competitive in the British market and Britain will have to perform a lot better.

AEROSPACE CONTRIBUTION

At another London conference, this time on Aerospace, Peter Hearne, joint general manager of Elliott Flight Automation, pointed out that Britain has been too lenient in the past in not insisting on major shares of the electronics systems contracts for aircraft being built under co-operative schemes in Europe. What has happened, he said, was that design leadership of systems has gone to European partners ill-equipped to undertake such work with the consequence that they have depended too much on licensed U.S. designs. The Americans have got in, as it were, by the back door.

He stated that Europe, as a whole, with 270 million people was well able to undertake the whole of the research, development, and production for an indigenous aerospace industry and this is what we should aim at. The cost of a modern aircraft is split one third for the airframe, one third for the engines and one third for systems and equipment. The systems market was therefore very large in its own right and a purely European capability already existed but had not, so far, been properly exploited.

The conference delegates learnt that the U.K. market alone was 50 per cent of the total European market and therefore it was to the advantage of French and German aerospace companies for Britain to join the Common Market.

TRADING UPTURN

While the great debate still goes on, a number of companies are pressing on with their own plans. Exacta Circuits, the Scottish based printed circuit company, has just appointed native French and German sales engineers to operate in these two important market areas. Exacta Circuits has only one per cent of the European market which is estimated to be worth at least £12 million a year. Their target is to capture five per cent of the European high quality p.c.b. market by the end of 1973.

An upturn of electronics business in the U.K. towards the end of this year with the rest of Europe following on a year later, is forecast by the General Manager of ITT Components Group Europe. But, he warns, don't expect the fantastic growth rates we have been used to in the past. Even Germany, he says, will find it hard to maintain even a four per cent growth. Which reminds me of that old tag, "There are no bad times ahead—it's just that the easy times are over!"

TTL PRICE WAR

Motorola, in a brave attempt to knock some sense into the price structure of TTL integrated circuits, raised prices 10 per cent hoping that others would follow their example. Alas, main competitors Texas Instruments, Fairchild and National Semiconductors wouldn't play.

TI even went so far as forecasting even more price cuts. Says TI, every time TTL production doubles the price falls 30 per cent. Over the past year the fall was 40 per cent. But, for 1972, the price fall will not be so great. Moreover, says TI, the industry can expect big price cuts in the more exotic devices once they start getting produced on a similar huge scale to TTL.

The semiconductor price war may be bad for semiconductor manufacturers but it's good news for equipment manufacturers. Semicomps, the component distributors, say that the availability of low cost semiconductors is the finest shot in the arm for U.K. electronic manufacturers since the semiconductor was first invented. One item in their catalogue, which sold in volume quantities for 80p per piece three years ago, is offered at today's bargain price of 8p.

BOOM FOR LEDs?

New boom area in semiconductors is light emitting diodes. Eighteen months ago a small company called Litronix started up in business in the U.S.A. Sales are already running at over £1 million a year.

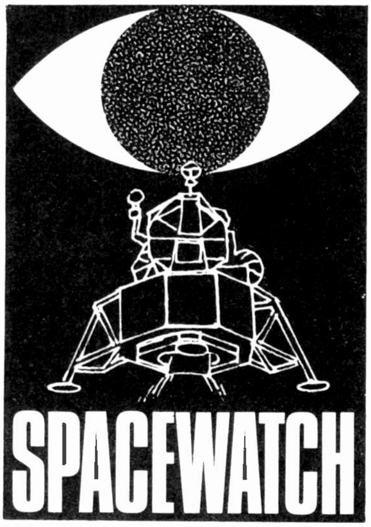
Guest International have won the U.K. franchise for marketing Litronix light emitting diodes in Britain. Guest expect to sell £200,000 worth this year and hope to reach a sales volume of £1 million in the U.K. by 1975/6.

Litronix research and development is carried out in California but the production unit is in Singapore. Device types available include matrix and segment displays as well as discrete devices.

SCIENCE OF THE SEAS

Look out for Oceanology International at Brighton, commencing on March 19. Two hundred firms from 15 countries will be showing the very latest in both surface and underwater technology. No less than 160 technical papers are to be presented and there will be plenty of ships to visit for those who have the right permits. One will be the Royal Navy's diving training ship HMS *Reclaim* which uses underwater television and electronic helium speech convertors; these convert the gobbledygook of divers breathing helium under pressure into understandable language.

A good 50 per cent of Oceanology International will feature electronics and how it is opening up a whole new world under the seas.



BY FRANK W. HYDE

PIONEER SPACECRAFT FOR JUPITER

Two spacecraft, that are the precursors to the missions to the outer planets, will be launched in March 1972 and April 1973. Each mission will last about two years under the names *Pioneer F* and *Pioneer G* respectively.

They will be the first spacecraft to penetrate the asteroid belt and attain their objectives of taking a close look at the giant planet Jupiter. This entails a trip of more than 500 million miles from Earth, each spacecraft taking a week to swing round the planet. Of this period, about 100 hours will be spent at the closest approach, which is also the point of maximum scientific interest while Jupiter turns about ten times on its axis. The distance from the planet at that time will be about 100,000 miles.

The amount of data collected will be considerable. One objective of the missions is to assess the hazards of deep space, to develop the technology and operations experience that will be required for the Grand Tour missions to the outer planets planned for the late seventies.

THIRTEEN EXPERIMENTS

There will be 13 scientific experiments on board which will make a broad study of a number of interplanetary phenomena. They will examine the possible hazards of flying through the asteroid belt, the effect of the solar wind on the magnetosphere of the planet, and the solar influence in this area of the solar system.

It is also expected to make studies of the boundary between the heliosphere, the region of the sun's influence on space environment, and determine where galactic space proper begins. These particular studies will provide data for a better understanding of the nature of the sun and the effects of the heliosphere on Earth.

Near to the planet Jupiter the instruments are expected to afford some clues to the mysteries of the giant of the solar system. Some of these include the red spot, the intense low frequency radiation, and the coloured bands and belts with the white spot formation.

There is considerable uncertainty as to whether the planet is solid, liquid or gas. Interpretation of the visual and spectroscopic observations have led to a number of models; the radio studies have led to other conclusions, although none are positive or final. One of the important new clues anticipated is why the planet, which is 11 times the diameter of the Earth, rotates more than twice as fast as Earth.

ENERGY RADIATION

Jupiter is the only planet which radiates more energy than it receives from the sun. Present observations indicate that this radiated energy is twice as much as that absorbed. If this should be correct then speculation suggests that Jupiter has a very dynamic interior and may well have processes similar to that of the sun operating within it.

The infrared experiments to be carried out should provide an analysis of the thermal balance of the planet from several different angles. This may lead to information which reveals whether the planet does have an unusual internal source of energy.

The onboard instruments will measure the radiation belts, which are about a million times more intense than those round the earth, and also the magnetic field which is about 20 times as strong as that of the earth.

Also to be studied is the upper part of the atmosphere and records of any hot-spots that may occur, the auroral areas near the poles, and the thermal radiation from the dark side of the planet. It could be that due to the short time in which any part of the planet is away from the sun's rays, there is very little cooling and this might account for the high level of radiation.

INSTRUMENTATION

The 13 experiments to be conducted each have their own instruments. One of these, the "imaging photo-polarimeter", is a special and versatile instrument that can take images which are later built up into a complete picture.

Brightness, polarisation and colour of the asteroids and Jupiter will be measured. The instrument consists of a 1in telescope which collects the light from the object, passes it through an analyser to determine the polarity, and then divides it into red and blue components.

The rotation of the spacecraft will enable the instrument to scan narrow strips of the planet. These will be 0·3 degree wide so that a complete picture will be built up in about an hour.

The resolution of the first pictures will be about the same as those taken by Earth-based instruments. About 7 degrees of the field of view will be occupied by the image of the planet. On close approach the image will occupy about 40 degrees of the field.

A helium vapour magnetometer will determine magnetic fields, a solid state detector will study the composition of charged particles and a Geiger tube telescope will study the Jupiter charged particles. A cosmic ray particle detector will be used to study cosmic ray energy spectra.

The plasma in the environment will be detected and evaluated by an electrostatic analyser, and a trapped radiation detector will deal with the radiation belts. Ultra violet radiations and the thermal structure will be studied by an ultraviolet photometer and an infrared radiometer.

METEOROID DETECTION

For the study of asteroids and meteorites on the way to its destination the spacecraft will use four optical telescopes. These are 8in Cassegrain units with photo multipliers, and it is expected that any small particles will be detected if they come within one kilometre of the telescopes.

For meteoroid detection there are 5 sq ft of cells to register impact. A penetration 0·001in is equal to an impact of 10^{-9}gr. There will be 216 cells in all.

For the celestial mechanics experiment the S-band spacecraft transmitter will be used to determine occultation conditions just before and just after it passes behind the planet. This will last about an hour. For the other celestial mechanics data, the deep space doppler radar from earth will be used in conjunction with the spacecraft itself. Monitoring and control will be by the 85ft and the 210ft managed by the Jet Propulsion Laboratory at Pasadena, California.

The craft will be powered by four radio-isotope thermoelectric generators producing 120 watts. These are mounted on booms that stand out from the spacecraft. The stabilisation is set at five revolutions per minute in the plane of the Earth's orbit so that the 9ft diameter aerial is always facing Earth.

Pioneer G may fly out of the ecliptic plane and turn in towards the sun. It would then pass over the poles of the inner planets. The speeds for these two spacecraft will be of the order of 32,400 miles per hour, the fastest any man-made object has ever travelled in space.

PATENTS REVIEW...

SLEEP DRIVING ALARM

ONE of the perennial problems for night drivers is the risk of dosing off at the wheel. Anyone who has driven at night while tired will know what I am referring to.

One characteristic effect of lapsing into sleep or pre-sleep is that the driver's muscles, and particularly those of his hands, will relax below their normal working level. Now Societe Autoveil, of Paris, have patented the idea (BP 1 240 618) of using this relaxation effect as the basis for a detection and alarm system for drivers.

BP 1 240 618

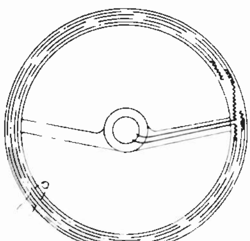


Fig. 1

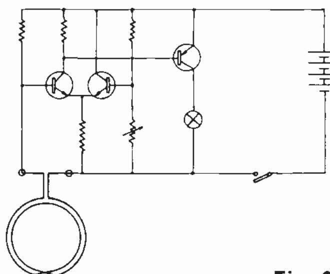


Fig. 2

What Autoveil do is to use an electrically conductive wire of carefully chosen electrical resistance and so attach it to the steering wheel of a car that the wire will be shunted by the driver's hands under all normal driving conditions. This shunting will, of course, reduce its effective resistance. The wire is connected to an electrical control circuit which provides an alarm signal if and when the resistance rises, i.e. if the conductive wire is suddenly no longer shunted, and thus exhibits an increased resistance with consequential current flow drop.

By now the idea should be pretty clear—while the driver is firmly holding the wheel the wire will be shunted and when he starts to doze off his grip will slacken and shunting of the wire will lessen.

The resistances involved are very high, for instance 100 kilohms; Autoveil suggest several ways of winding the wire to ensure however small the area of grip there will still be a detectable shunt. The wire can be folded in a zig zag fashion and form two or more loops coaxial with the wheel (Fig. 1). The designers also give (Fig. 2) a fairly straightforward and easily understandable battery-powered circuit for operating an alarm which can be either a bell or a lamp, or better still both. Sensitivity can be controlled by the potentiometer to suit the driver's grip. The wire loops on the steering wheel are shown in Fig. 1 and bottom left of Fig. 2. A switch provides for disconnection, e.g. for town driving.

BETTER CONTACTS FOR ROTARY AUTO-TRANSFORMERS

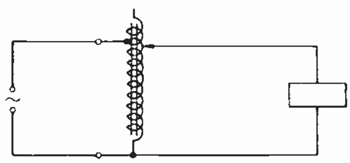
ADVANCE ELECTRONICS of Ilford have a new British patent BP 1 241 274 for what could be a very useful constructors' component—an inductive device with a winding engaged by a movable contact. In this way there is provided a pretty well infinitely variable tapping point on the winding and of course a device of this kind could be very valuable as a voltage selecting or variable transformer.

In their drawings (Fig. 3) Advance show a core of magnetic material with a winding for connection to an a.c. source. Any load is connected between one of these terminals and a brush contact movable across and engageable with the turns of the coil. It is not too hard to see that the device will operate as an auto-transformer and, by movement of the brush, the transformer effective ratio can be varied so as to vary the voltage output to the load.

But an obvious problem is engagement of the brush with two coil turns at the same time. This is where the invention proper comes in. Now such "shorting" could be compensated by giving the brush a high inherent resistance, but this would put an extra resistance in series with the load. Thus the brush resistance will have to be a compromise between avoiding inter-turn shorts and avoiding excess resistance.

The inventors suggest as such a compromise a material which is anisotropic spectroscopically. Such a material will have a resistance in one direction which is substantially greater than in another

BP 1 241 274



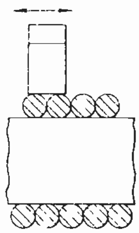


Fig. 3

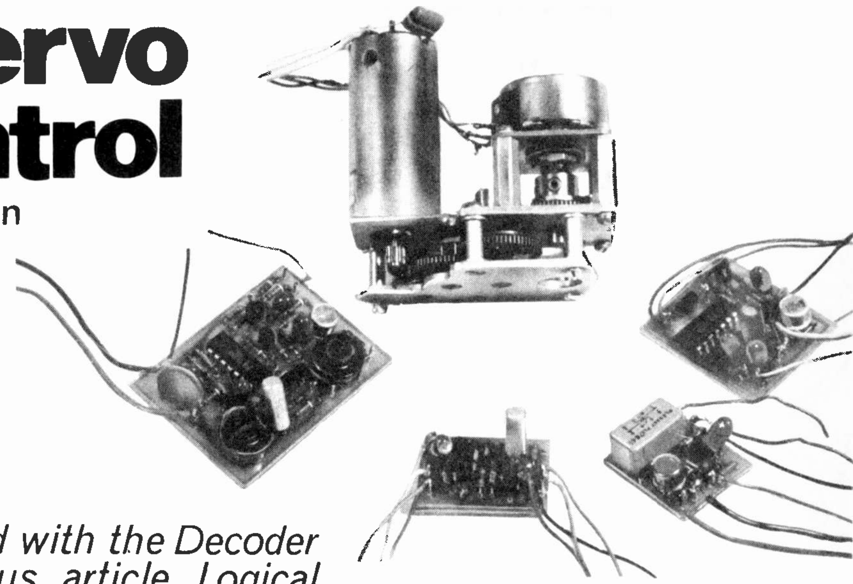
direction—the necessary directions will be obvious—and a suitable material is anisotropic graphite.

Apparently pyrolytically deposited graphite can produce electrical resistivities which vary in orthogonal directions by ratios of as much as 100 to 1. If the gadget works as claimed it could make life much easier for anyone operating sensitive equipment as the electricity supply tends to fluctuate more during the winter period when heavy loads are experienced.

Model Servo Control

By A.J. Dunn

Part 1



This servo system is used with the Decoder described in the previous article Logical Radio Control

ALTHOUGH the number of servo amp units required corresponds to the channels used, it does not follow that the mechanical requirements are identical. A feasible arrangement is one using servo amplifier type "C" for non-exacting requirements—as for example gun turrets on a model battleship, and servo amplifier type "B" for the steering gear. These will be described later.

Also described is a "fail safe" unit used with the servo amplifiers to cause the model to react in a predetermined manner in the case of signal or system failure. In the case of model aircraft, control failure should be associated with engine cut out; for a model boat the reverse is true, and the rudder should not be left so as to perform endless inaccessible circles.

TORQUE UNIT

The servo amplifier described here is intended for use with a torque unit which is simply a d.c. motor coupled to a potentiometer through a gear train.

Individual requirements will vary considerably and it is left to the constructor to determine these, but the following comments should provide the basic information.

A small d.c. motor should be selected that is small, light, of low inertia, runs reliably and preferably has a "start-to-run" voltage of the order of 2V.

The motor should be secured to a frame of gears or alternatively to a plate on which a train of light plastic gears can be built; the train ratio being that which will provide adequate *torque* to operate the model function, e.g. boat rudder, but not so excessive that undue time is taken over a range of operations. The final gear not only provides the output movement (normally restricted to less than 180 degrees) but is connected to a small potentiometer.

Either mechanical end stops should be provided to prevent damage to the potentiometer or, preferably, a slipping clutch may be employed made simply by making the final gear a slipping fit on the potentiometer spindle. The unit shown in the photograph is a heavy duty unit intended for large model boat operation: for aircraft use, the torque unit must be much lighter.

SERVO SYSTEM

Individual channel outputs from the decoder are first integrated and the resultant d.c. signal compared with the voltage derived from the torque unit potentiometer. A change in the input d.c. level is arranged to switch, as necessary, the motor so that it will revolve in a direction such that the potentiometer output changes to equal the signal voltage.

Normally, it may be arranged that the signal voltage may be changed by a given amount before the motor is switched in either direction—this can be considered as a "dead zone" of the torque unit potentiometer and corresponds to the state when the motor switches itself off after having followed any signal voltage change. This is obviously desirable from the point of view of battery drain but this condition is only attained at the expense of certain compromises which are considered in detail against component values.

It is desirable that the dead zone of the potentiometer should be as small as practicable in order that the mechanical resolution should be good and that no obvious "backlash" appears in the transmitter controls.

Since every motor and gear train has inertia it happens that after being switched off, a motor will continue to revolve to the extent that the potentiometer wiper may traverse a narrow dead zone and initiate the switching sequence that causes it to run in the reverse direction. In such cases the motor will repeatedly reverse or "hunt" rapidly.

If a small light motor is used with a frictional load, this effect will not arise for reasonable dead zones; servo amplifier "A" will be satisfactory for this application.

INTEGRATING INPUT PULSES

In cases where a larger motor must be used and where the dead zone must be small the second circuit is recommended for reasons described in the circuit details. The integrated input signal can be considered as a d.c. level as shown in Fig. 1, the degree of smoothing being a function of the values of R1 and C1 in Fig. 2. If very smooth, the final a.c. component will be smaller than the corresponding dead zone and may be neglected. However, the time constant (product of *C* in farads and *R* in ohms) determines the rate at which the d.c. level can change, and hence the system response time.

Assuming that a response time associated with 10 pulses is used, a mid-range signal level of approximately 0·4V could change by approximately 70 per cent in *CR* seconds, equal to 50 milliseconds (cycle time) × 10 (pulse cycles) or 0·5 second. The rate of change is approximately 7/10 × 0·4V ÷ 10 per cycle and the peak-to-peak value of the a.c. component Fig. 1 is approximately 0·03V 8 per cent of the signal.

In order that the servo amplifier can accommodate this a.c. component without the motor hunting, the dead zone must be greater than 8 per cent of its working range. This may be satisfactory for certain model functions where a fast response is necessary and poor resolution can be tolerated.

If a slower response is satisfactory, the product of R_1 C_1 can be increased reducing the a.c. component: the percentage width of the dead zone can be reduced and the resolution increased. If good resolution is required (narrow dead zone) coupled with a fast response time, then servo amplifier circuit "B" should be used and a compromise effected between system response time and battery drain.

SERVO AMPLIFIER "A"

The circuit could be constructed using discrete components throughout, i.e. five transistors replacing IC1 but the integrated circuit used has the advantage that the transistors TR5–6 are already connected in

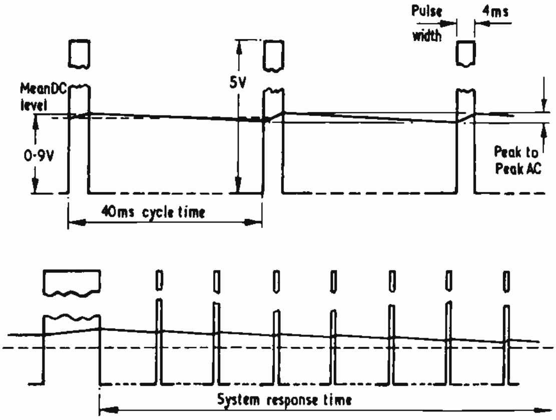


Fig. 1. The incoming pulses from the logic decoder is integrated by R1 and C1 and may look like this

the long-tailed pair arrangement. Their V_{BE} is matched to 5mV and all transistors are thermally coupled. The contents of IC1 is shown in Fig. 2, each transistor having an I_{Cmax} of 50mA, a gain of 110 and an individual power rating of 300mW.

The input signal from a decoder output is applied to point P7 and is integrated by R1 and C1 to give a d.c. range of approximately +0·05 to −0·9V with respect to 0V.

The emitter follower TR1 output is applied to the base (pin 4) of the long tailed pair TR5 and TR6,

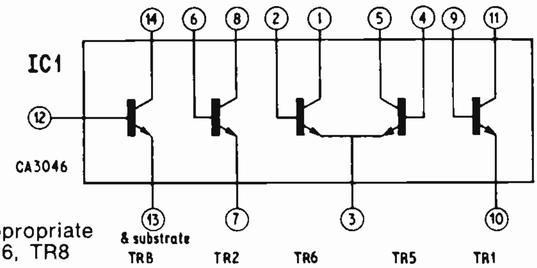
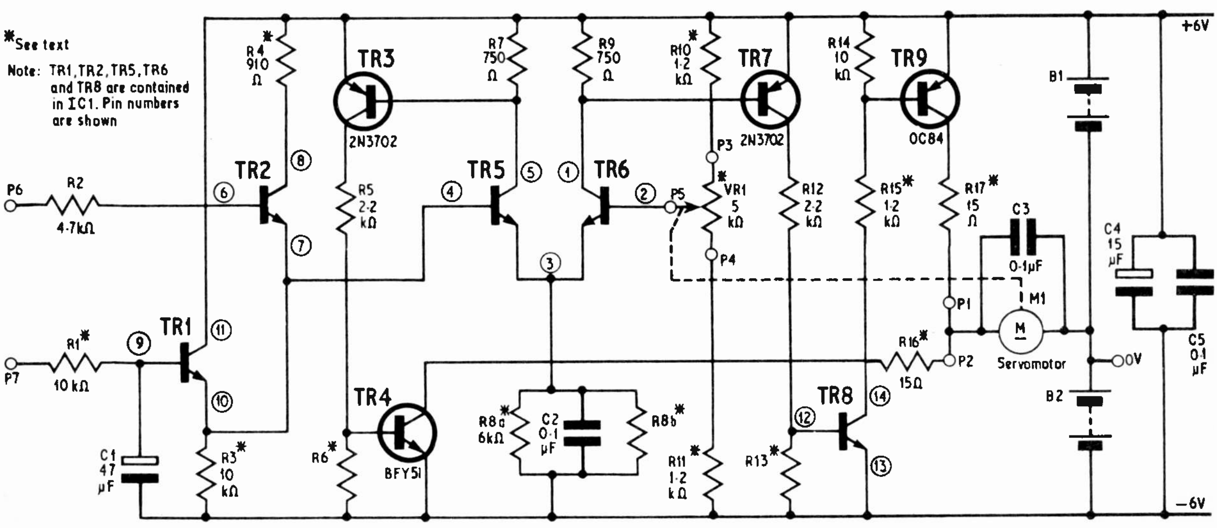
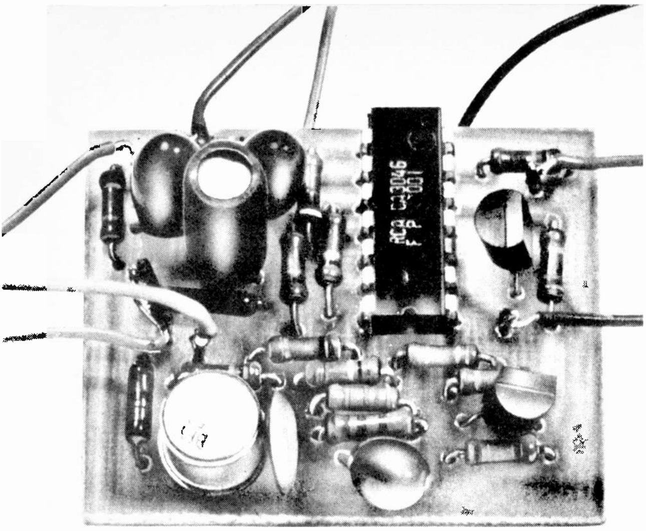


Fig. 2. The circuit diagram of servo amplifier "A" with appropriate integrated circuit pin connections (right) for TR1, TR2, TR5, TR6, TR8





Finished servo amplifier "C" board

the current of which is defined by R8 to be such that, when equally divided, the voltage across R7 and R9 is insufficient to turn on TR3 or TR7.

The action of the servo amplifier is as follows: Consider that the input signal is increased (corresponding to a greater pulse length) the base (pin 4) voltage is made more positive causing TR5 to conduct more and TR6 less.

The increased current through R7 develops a voltage sufficient to turn on TR3 supplying sufficient current through R5 to turn on and bottom TR4. The motor is now connected via R16 and TR4 to the −6V supply line causing it to revolve so as to make the output voltage from VR1 increase, so increasing the current through TR6, and consequently diminishing the current through TR5 until TR3 and TR4 cut off.

REVERSE ACTION

If the signal input is reduced the reverse action takes place with TR6 taking more current and TR7 turning on, so turning on TR8 and TR9.

The motor is now connected via R12 and TR9 to the +6V supply line, making it revolve in the opposite direction until TR5 and TR6 are in approximate balance. Resistors R13 and R14 are used to hold down the bases of the respective transistors when in the cut-off condition.

The transistor TR2 is used with the fail safe device described later; with R4 not connected it plays no part, but otherwise point P6 must be connected to approximately −2V with respect to the zero voltage line cutting it off.

If input signals to the decoder fail, for example when the model is out of range, the fail safe circuit will act operating a relay and changing the connection of P6 to the +6V supply (together with similar points on other servo amps), thus turning on and bottoming TR2. Current can then flow via R4 and, dependent upon the value of R4, the voltage across R3 will rise, cutting off TR1 since the input (pin 9) is at 0V.

By selection of R4 (approximately 90 per cent of R3) the voltage input to TR5 can be made between zero and 1V positive with respect to 0V, and the torque unit will take up the desired preset position until radio control is re-established.

COMPONENT VALUES

The values of R1 and C1 should be determined, after preliminary testing the degree of compromise necessary between system response time and resolution itself, being a function of the inertia of the torque unit. R3 may be initially 10 kilohms to keep the input impedance of TR1 greater than five times the value of R1 (approximately 10kΩ), R8a should be approximately 6kΩ, and R8b not less than 6kΩ, corresponding to a tail resistance of 3kΩ, in which case both TR3 and TR7 would be turned on simultaneously, shorting the supplies through R17 and R16.

Capacitor C2 is 0·1μF and used to prevent h.f. oscillation; if a large value electrolytic capacitor is used, hunting of the torque unit is increased. VR1 may be of any convenient value bearing in mind that the active part of the track (according to the angle of rotation actually used) corresponds to approximately 1V and the remainder together with R10 and R11 to 11V.

A 500 ohm 270 degree potentiometer restricted to 180 degrees gives therefore

$$500 \text{ ohms} \times \frac{180}{270}$$

which is equivalent to 1V or 330 ohms per volt; and R10 and R11 + 170 ohms or 11 × 330 ohms or to the nearest preferred value for R10 and R11, 1·2 kilohms. In practice, R10 should be slightly larger than R11 and may be adjustable (small valued series potentiometer on torque unit) in order to centralise any mechanical control against battery or temperature variations if desired. Potentiometer VR1 should be a quality component of 500 to 5 kilohms capable of good service.

Resistors R16 and R17 (nominally of 15 ohms) are chosen to restrict the motor current to the maximum rating of TR9 (OC84 is 500mA) and TR4 (BFY50 is 1A).

A bench test with a stalled motor on a 6V supply will give this figure which may subsequently be increased, if found necessary to dampen out any hunting effects, providing that adequate torque output is available. The shunt capacitor C3 is used for suppression purposes and should be mounted directly on the motor terminals.

SUPPLY

The circuit is amenable to changes in equal supply voltages by the variation of R8a but it is essential that supply fluctuations do not occur and a good battery or well charged Deacs should be used with additional decoupling capacitors.

CONSTRUCTION AND TESTING

The components, with the exception of resistors R4 and R8b and capacitor C1, should be soldered on to the printed circuit board as shown in Fig. 3. As with the logic circuits previously described, it is worth adding extra blank space to the board pattern to allow for fixings. In certain models it may be advantageous to group together some of the servo amplifiers, placing the torque units close to the point of operation.

The output points P1 and P2 should be separately connected via 6V lamps or other indicators to 0V and the motor terminals disconnected from P1 and P2.

COMPONENTS . . .

SERVO AMPLIFIER "A"

Resistors

- R1 10kΩ approx (see text)
- R2 4·7kΩ
- R3 10kΩ approx (see text)
- R4 910Ω approx (see text)
- R5 2·2kΩ
- R6 10kΩ
- R7 750Ω
- R8a 6kΩ
- R8b see text
- R9 750Ω
- R10 1·2kΩ approx (see text)
- R11 1·2kΩ approx (see text)
- R12 2·2kΩ
- R13 10kΩ
- R14 10kΩ
- R15 1·2kΩ approx (see text)
- R16 15Ω approx (see text)
- R17 15Ω approx (see text)

All ±5%, $\frac{1}{10}$W

Potentiometer

- VR1 5kΩ linear carbon

Capacitors

- C1 47μF tantalum (see text)
- C2 0·1μF tantalum
- C3 0·1μF polyester
- C4 15μF tantalum
- C5 0·1μF ceramic disc

Transistors and Integrated Circuit

- TR1, TR2, TR5, TR6, TR8 are all in IC1 type CA3046
- TR3 2N3702
- TR4 BFY51 or BFY52
- TR7 2N3702
- TR9 OC84

Batteries

- B1 and B1 6V (see text)

Miscellaneous

- Fibreglass printed circuit board 1¾in × 1¾in for etching
- Solder pins and flexible connecting wire
- Servo motor and gear train as required for model (see text)

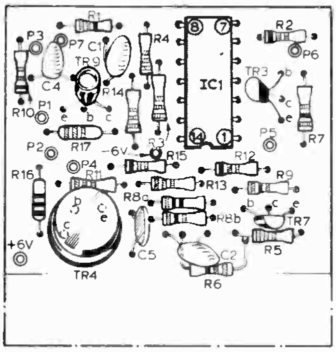


Fig. 3. Component layout on the printed circuit board of amplifier "A"

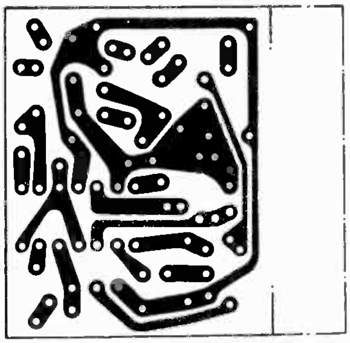


Fig. 4. Printed circuit pattern (full size) for amplifier "A"

Using any convenient potentiometers and 1½V dry cell, apply approximately ½V positive with respect to 0V to input P7 and switch on the +6V and −6V supplies. One lamp only should light and should be made to extinguish and the other lamp come on by rotating an uncoupled potentiometer for VR1. Note the approximate angle of the "dead zone"—both lamps extinguished.

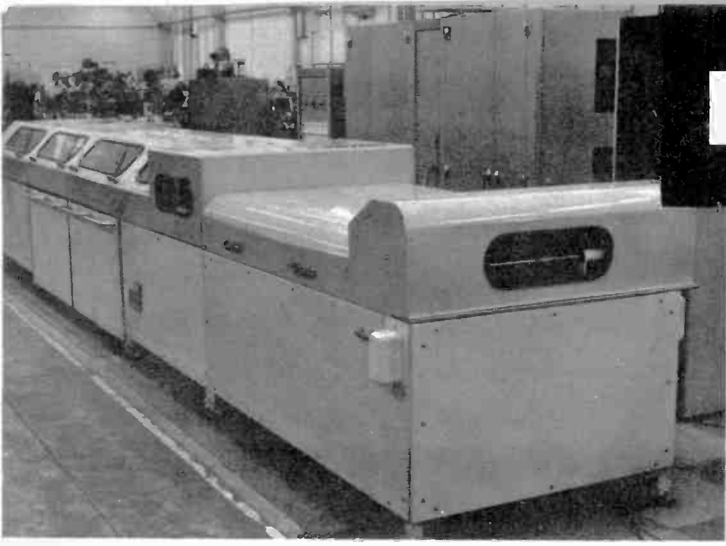
Various values for R8b (approximately 6·2 kilohms) should be tried to determine the lowest safe value or the elimination point of the "dead zone".

Fit a value for R8b (approximately 8·2 kilohms) that corresponds to a dead zone of approximately 10 degrees mechanical rotation of the potentiometer and remove the test lamps. Connect the motor between 0V and points P1 and P2 as in Fig. 2, with VR1 mechanically coupled. Switch on the supplies and note whether the motor rotation stops, hunts or continues in one direction only with clutch slipping; in the latter case the motor connections are reversed.

If the motor hunts the supply current should be monitored and R16 and R17 increased in value. When satisfactory R8b should be reduced in value to determine the resolution possible consistent with operation over the required range of VR1 by varying the d.c. to point P7.

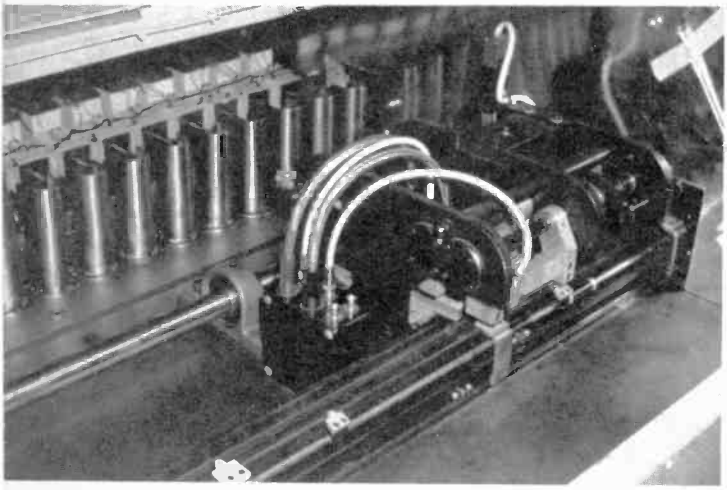
If the fail-safe circuit is to be used, point P7 should be connected to 0V, point P6 connected to +6V and R4 (approximately 8·2 kilohms) fitted, R3 being 10 kilohms. Tests should be made, adjusting the value of R4 until the torque unit centralises. The next test is to connect P7 to 0V and switch P6 between approximately −2V and the +6V supply, noting the time taken for the output gear to rotate to one end, then to centralise. A low leakage capacitor C1 is then fitted, such that the product of C_1R_1 is greater than the value given earlier. The unit is finally tested with the decoder and coder, care being taken to connect the 0V point to the negative decoder supply.

Next month: Servo amplifiers "B" and "C" and the fail-safe system.



ELECTRO

Computer Controlled Power



ENGINEERS at the Stockport semiconductor plant of Mullard Ltd have designed and built what is believed to be the first ever fully-automatic machine (top left) for testing and sorting power semiconductors. It handles a wide range of devices in many different outlines. Known as "Apollo", the machine has taken two and a half years to build at a cost of about £80,000.

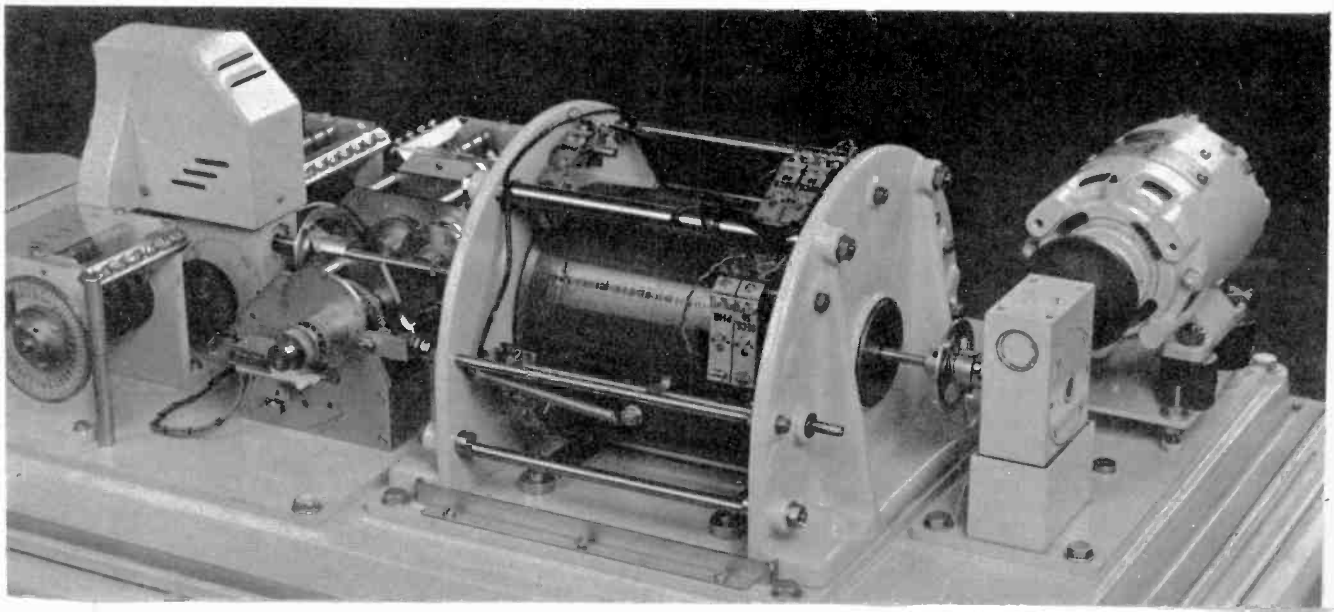
"Apollo" can test up to 10,000 Zener diodes, rectifiers or triacs an hour, and sort them into one of 36 categories. It performs a full range of tests at both 25°C and 130°C. The complete test schedule is controlled by a digital computer which also stores up to twelve test programmes (including Government Department CV schedules), processes test data and performs self-checking and diagnostic routines. Control of "Apollo" for normal operations is achieved via a teletype key board. "Apollo" may be rapidly reprogrammed to a new device type by typing the device name on the teletype.

Test specifications will be compiled by the computer to generate a test control programme which will be stored on the disc file where it will be readily available for future use. The computer can calculate the yields of devices in any of the 36 categories (as requested by operator before testing commences) as a percentage of devices entering "Apollo" to be tested.

Devices for test are placed in special jigs; these hold either 12 or 21 devices, depending upon the type and style. The jigs are placed upon the input conveyor from where they are

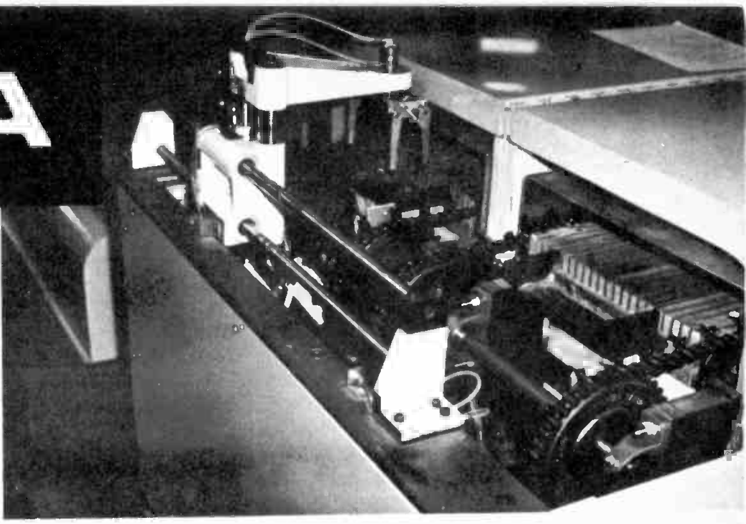
Post Office Speaking Clocks Due for Overhaul

AFTER eight years' continuous service, the London based P.O. Speaking Clocks are being overhauled and given fresh recorded announcements from the original master tape first made in 1963. The magnetically recorded neoprene drum which carries the announcements is shown below in the centre. It is bathed in a thin film of silicon oil to lubricate the traversing in-contact pick-off heads. The programme sequencing cams and switches are on the left and synchronous drive on the right. Similar clocks at Liverpool will serve the public in their absence.



NORAMA

Semiconductor Tester



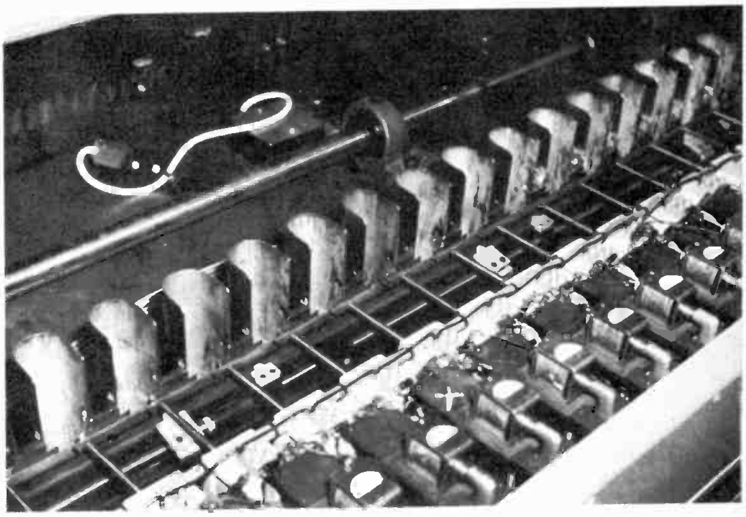
transported, in single file, past a number of measuring stations (left). At one preselected station, contact is made successively with the terminals of each device and all the scheduled tests are rapidly carried out.

The time for a single d.c. test normally takes 17ms; a pulse test of up to 5A, 10ms; and up to 250A, 50ms. The computer sets the conveyor speed to suit each device family, and the mechanism is automatically halted should a test sequence not be completed before the device is due to move away from the test contacts.

Once past the test heads, a mechanical handler turns the jig through 90 degrees and places it upon a transfer belt. At the end of this belt another handler rotates the jig and places it upon a second transport mechanism, running parallel to the first, but in the opposite direction. This carries the jig past 36 sorting stations.

Electromechanical rams activated by information derived from the tests and subsequently stored in the computer, eject devices from the jig so that each one falls into the appropriate chute; they are thus automatically sorted according to their individually measured performance.

Certain devices require hot tests at 130°C and in such cases the "Apollo" tester is programmed to route the jigs further down the machine and onto the heaters in the hot section (top right), which is traversed in about 10 minutes. The jigs then are transported to one of the testing stations, and finally to the sorter (right) as before.



AN EXCITING FUTURE

As a mass population in a civilised and sophisticated technological society, we in the U.K., in Europe, and indeed in the Western World, must by the force of natural motivation, seek ways to make the survival of mankind, in the face of much adversity, a pleasant and happy one. As technology grows, so too does our leisure time grow—a vicious circle perhaps!

Mass population must bring mass technological progress, which must bring mass communication and therefore mass entertainment. Is it so very difficult to visualise which way the wind is likely to blow, when the complexity of a digital i.c. has been multiplied several hundreds of times with a reduction in overall package size during the last ten years.

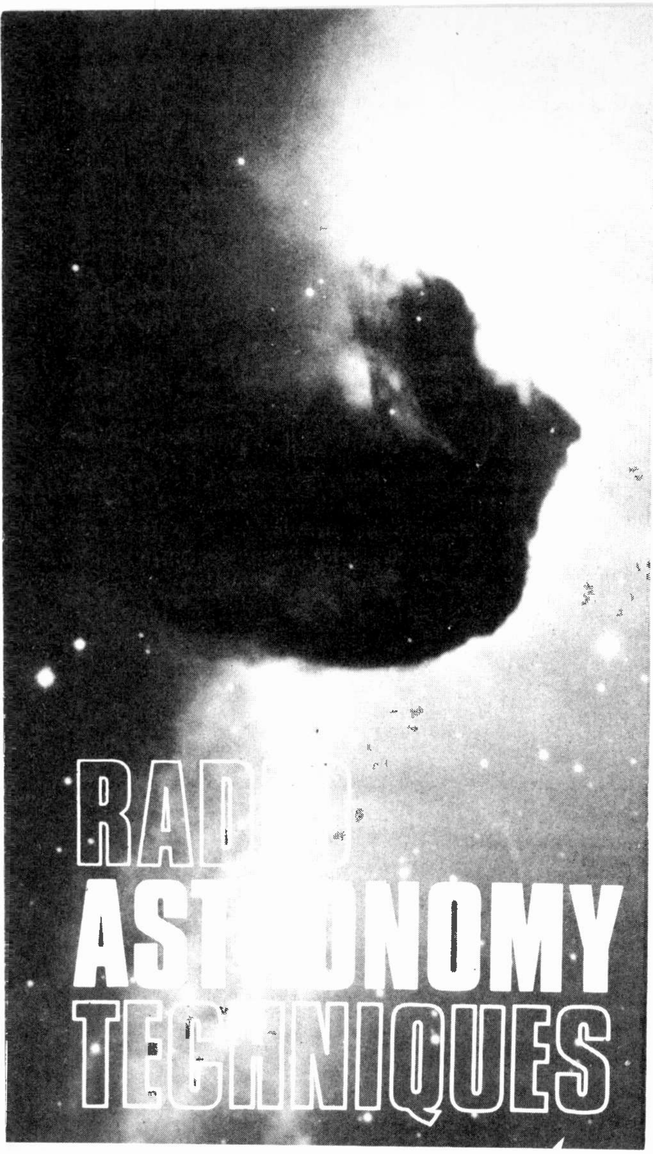
Will your wrist watch become a crystal controlled digital i.c. with luminous semiconductor readout? Will your new audio-visual telephone set be fed with 12GHz laser-driven, frequency modulated, light waves through a multi-channel fibre optic cable under the street paving? The escalating trend for miniaturisation in calculators is quite likely to lead to a one-chip i.c. in a pocket size packet at a price comparable with present day slide rules.

Imagine, if you will, an f.m. radio receiver made up with two or three i.c.s, no coils, ceramic filters the size of a transistor, and digital tuning. Or perhaps your television (in colour, of course) with a digital memory tuner, controlled by a pocket calculator style controller for programme selection and tuning, optical transmission and reception, and flat "lineless" display using a semiconductor laser element screen and shift register sequence scanning.

In the opinion of one experienced scientist and engineer, the answers to all these questions are based on current and projected development work in Western Germany, France, U.K., U.S.A., and Japan. Many of these ideas have actually been designed and proven in basic form, and should not take long to become commercially widespread, provided the politicians of these countries are not pedestrian in giving material encouragement.

Dr Walter Bruch, inventor of the PAL colour television system and colour television tape and disc recording techniques, gave us this delicious food for thought at the second Schoenberg Memorial Lecture of the Royal Television Society. Dr Bruch, who has been with Telefunken since 1935, and is currently Chief of the Basic Television Research Department, is no fanciful dreamer. His forecasts are based on fact and all of us, whether directly concerned with electronics or not, must prepare ourselves for what promises to be an exciting technological leisure time founded on present day research work.

We cannot afford to rest on our laurels nor recline in a cloud of post recession gloom. We must all look to the future and a completely changed way of life brought about by a social, cultural, and technical semi-revolution, while economics still struggles to keep pace in the eyes of the politician.



"Horsehead" Nebula in Orion south of Zeta Orionis. IC434. Barnard 33. Photographed in red light. 200in. (Photograph from Hale Observatories)

RADIO ASTRONOMY TECHNIQUES

BY F.W.HYDE · PART 9

THIS month the possibilities for a more sophisticated interferometer system at the present project frequency will be discussed, and then follow some suggestions for improving the single aerial system for those who are unable to set up an interferometer.

HIGHER SENSITIVITY

In order to obtain higher sensitivity with the interferometer equipment already described, some more advanced electronic circuitry with provision for phase switching can be employed.

Fig. 9.1a shows the circuit for a selective amplifier and phase sensitive detector. Examination of the switch generator and driver unit circuit given in Fig. 9.1b will show that the multivibrator formed by V1A, V1B feeds the grids of V4 and V5 in the phase sensitive detector shown in Fig 9.1a and at the same time energises the transistor driver unit TR1, TR2 which operates the diode switch. The transistors TR1 and TR2 can be balanced by adjustment of VR1 and VR2 so that the current through the diodes is equalised. If OA47 diodes are used, then the current needs normally to be about 50mA. However, there are alternative diodes that can be used and in such cases the current may well be lower. The important parameter is that the forward resistance of the diode must be less than 5 ohms and the current that achieves this is the optimum.

INDIVIDUAL OR GROUP ACTIVITIES

By using an interferometer, resolution is automatically improved very considerably. For those able to set up this kind of system the incorporation of the high gain units just described will provide an observatory of considerable value, because there is still much that the private enthusiast can do in the field of radio astronomy. The important factor here is the availability of contact with others interested in the same field. To this end, the author is prepared to help to collate data and offer help to like-minded enthusiasts.

But those who are unable to build an interferometer system can still undertake worthwhile observations with the single aerial system. And the results thus obtained could still usefully supplement the available data with collation of group results.

Apart from group activities many may wish to pursue the subject for its own sake and their private pleasure, without being involved in activities outside their own observatory. It is for this reason that other projects are being described in this and next month's concluding article. Before proceeding to that stage the alternative, single aerial, system will first be discussed.

THE SINGLE AERIAL SYSTEM

The aerial is the important part of any radio telescope since its area of collection determines a radio telescope's sensitivity. The first step then for those restricted to a single aerial is to consider a system where more elements can be brought into use.

This can be done in two ways: by increasing the length of the aerial units, or by stacking them. Here again the matter has to be decided by the local situation. It could well be that to stack two corner reflectors would be easier than increasing the unit length. The ideal could be the design of a unit which is two corner units high and two units in length. This would give a narrower beam in both vertical and horizontal directions.

Taking the corner reflector designed (see Part 4) the stacked height of the unit would be about 16ft if it were taken to its full height. However, it would not be of much use since the acceptance angle would be parallel with the surface of the earth. The normal useful angle will be about 30 degrees and even 45 degrees in a built-up area. This means that a two-high stack in its position of greatest use would stand at about 12ft in height.

The unit can be simplified for erection by hinging at the base, but it can naturally be suspended at its centre of gravity. Variation in altitude is all that will be required as it would be better to use this as a fixed aerial in azimuth and allow the earth to carry

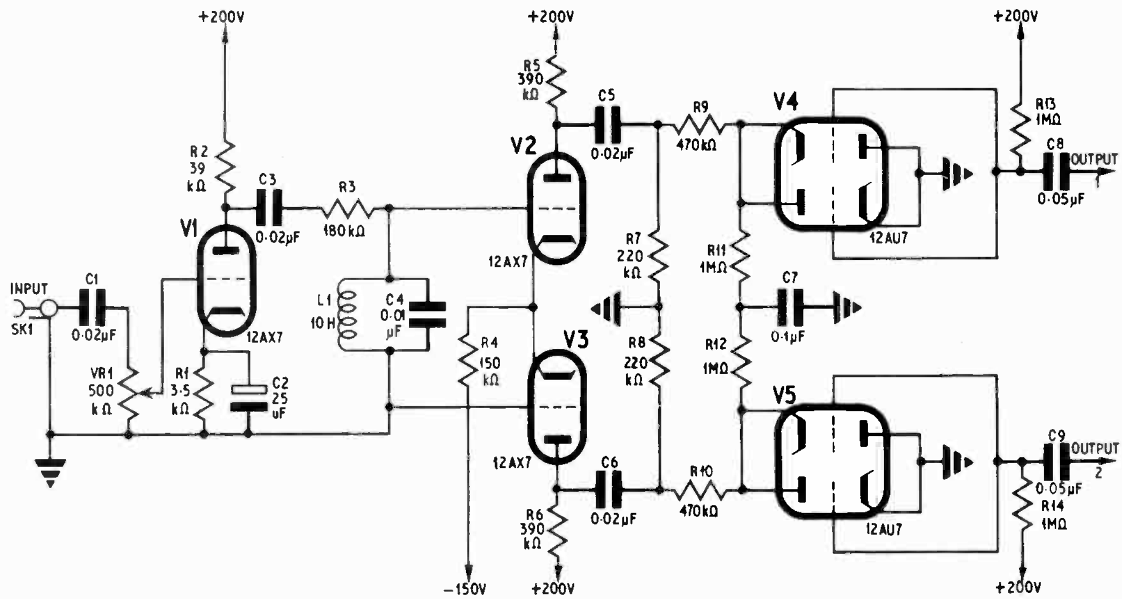


Fig. 9.1a. Circuit of the selective amplifier and phase sensitive detector

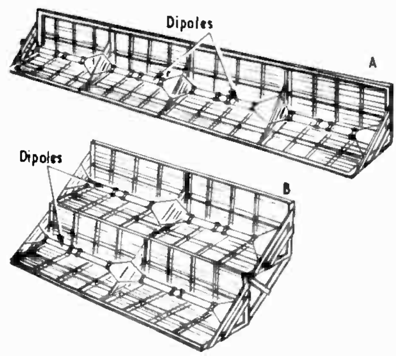


TABLE OF BEAM WIDTH		
VERTICAL	HORIZONTAL	Area of Combination
55°	14·3°	
30°	28°	

Fig. 9.2. Arrangement of eight aerial units in one system to give higher gain and resolution, (a) eight half-wave dipoles in line, (b) stacked four by two

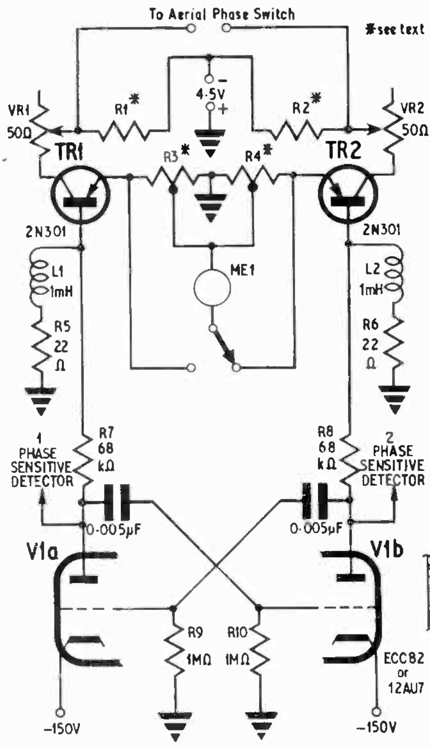


Fig. 9.1b. Circuit of the switch generator and driver unit

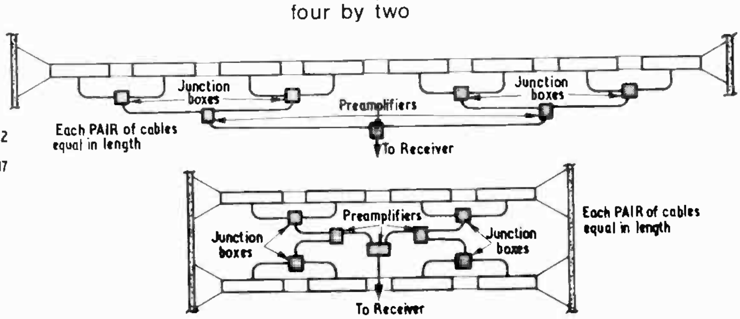


Fig. 9.3. Connections of the dipoles shown in the two arrangements in Fig. 9.2, (a) in line, (b) stacked four by two

out the scanning process, with the consequent ease of mechanical construction.

MAXIMUM LENGTH

If the stacking is not practical then try to achieve the maximum length. If there is space available for a longer unit but not enough for an interferometer it means that the space available is less than five wavelengths between centres.

In the case of the frequency chosen this means something less than 44ft. Allowing for room to get around at each end the useful length available is likely to be some 36ft. Bear in mind that this is strictly on the east-to-west base line. Working on 36ft this will give four wavelengths for the possible maximum aperture. Using the formula for beam width, that is

the width of beam at half power points =

$$\frac{\text{one wavelength}}{\text{number of wavelengths in length of system}} \times 573 \text{ degrees}$$

$$= \frac{57{\cdot}3}{4} = 14{\cdot}3 \text{ degrees approx.}$$

To accomplish this, eight half-wave units or four one-wavelength units are required. Since the details for a half-wave dipole unit have already been given but it must be remembered that the more dipoles in line there are, the narrower will the width of the beam be. The beam width for each arrangement is given in the table in Fig. 9.2. The connection of the dipoles is shown in detail in Fig. 9.3.

AERIAL PRE-AMPLIFIERS

It will be seen that the pre-amplifiers have to be located at the aerial for the interconnections to be properly made. The level of each amplifier will need to be set so that outputs are substantially the same from each. It would be of some advantage to have an accurately tunable front end to each amplifier because the maximum performance is required to offset the losses due to the various connections and the length of cables involved. Every socket and plug contributes to mismatch and noise. It is important to take care of the weatherproofing of the electronic units.

At the receiver end the front section would normally be tunable, but it could be advantageous to use a coupling unit which can match and tune. This is left to the individual again for it is part of the fun to do such modifications. So much for the aerials and resolution. The sensitivity of the overall system can be increased by the use of the unit given in Fig. 9.1a, with outputs 1 and 2 linked together and fed into the d.c. amplifier.

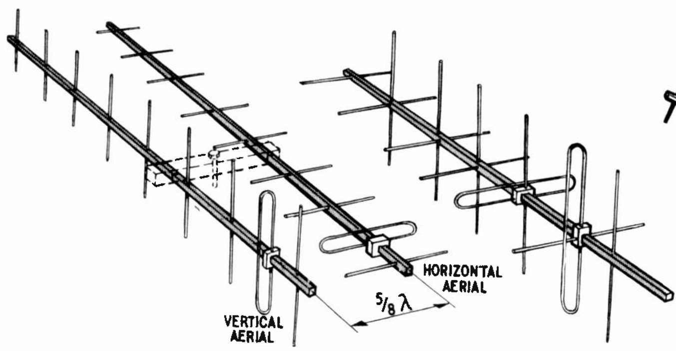


Fig. 9.4a. Separate vertical and horizontal Yagi arrays

Fig. 9.4b. Crossed Yagi arrays on one boom. One set is a quarter of a wavelength behind the other with separate feeders

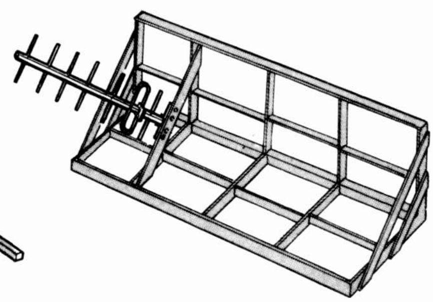


Fig. 9.4c. Combined corner reflector and Yagi array. The Yagi dipole is at right angles to the reflector dipole but in the same ground plane

in Part 4 (Fig. 4.7), the short units can be used. The setting up of the reflector can be in sections of 8ft or two units of 16ft. Probably the shorter units will be easier to make from the practical point of view and the lengths of timber available. If a type of slotted angle is used then since this usually comes in 10ft lengths the four 8ft reflectors seem the best solution.

In arranging the dipoles the centre of the whole system will be the spacing between the centre pair of dipoles. This spacing will be 12in leaving 18in at each end of the array. Thus the dipole string will be the required distance inside the ends of the reflector unit.

The diagrams in Fig. 9.2 show the possible alternatives for layout. The choice is with the individual,

POLARISATION MEASUREMENTS

A project worth considering and one that could yield some very important data about solar radiations is the monitoring of polarisation changes. The frequency already chosen is very suitable for this purpose and the method of operation relatively simple. It may be undertaken as an adjunct to other observations, using the existing equipment. Alternatively, two Yagi aerials could be made up specially for the purpose.

In the latter case, the most useful system is crossed Yagis, and this is the type of aerial used for the reception of signals from weather satellites. The

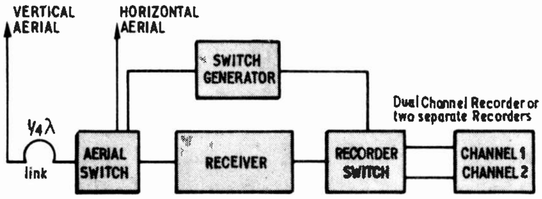


Fig. 9.5. Block diagram of set-up for polarisation measurement

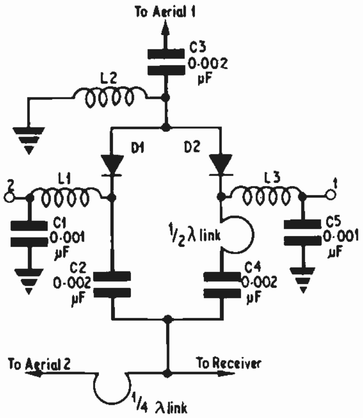


Fig. 9.6. Modified aerial switching circuit

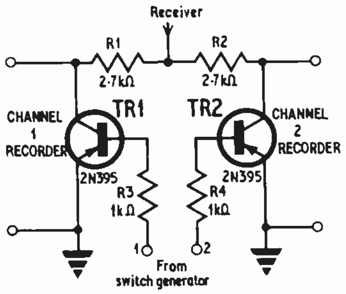


Fig. 9.7. Channel recorder switching circuit

vertical and horizontal elements are displaced by one quarter-wavelength and this can be performed in one of two ways.

The first method is to add a quarter-wavelength section in coaxial cable to one set of elements, and the second is to stagger the elements so that one set is one quarter-wavelength behind the other.

It is perhaps simpler to set up two Yagis, or alternatively a Yagi in addition to the corner reflector. So long as the dipole of the Yagi is at right angles to the dipoles in the corner reflector, the former could be mounted on the side of the corner reflector.

Whichever aerial system is decided upon, the layout of the system is the same so far as the receiving equipment is concerned; see the block diagram in Fig. 9.5.

It will be observed that two channels of recording are required. If this can be performed using two pens on a single chart this would be ideal. It is possible to obtain second-hand multi-channel recorders. However, two separate recorders will be quite satisfactory so far as results are concerned. If polarisation is changing during the period of observation the displacement of the peaks of the radiation will indicate this. When both channels are on the same chart the noting of changes is of course very much easier.

RECORDER SWITCH CIRCUIT

There is a slight change in the arrangement of the electronics, one new unit being introduced and a small modification at the input to the aerial switch. The diode switch is modified slightly and to avoid a reference back the complete modified circuit is shown in Fig. 9.6.

The new item is the recorder switch, see Fig. 9.7. This operates like the synchronous detector in that it reverses in time with the aerial switch. The aerial switch changes the aerials and the recorder switch puts the correct recorder to the output of the receiver to agree with its own aerial.

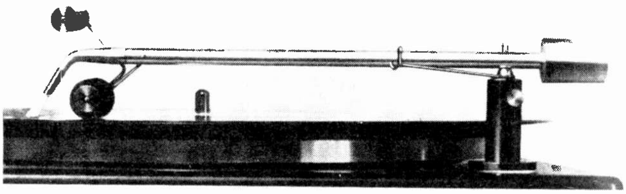
There is an alternative to this as well. It is possible to use two channels all the way from aerial to recorder. This arrangement does however offer certain difficulties since the frequency changer oscillators may be out of phase with each other. Obviously it would be an advantage to use one oscillator to feed both receivers.

HELICAL AERIALS

The system just described, for polarisation observations, opens up possibilities for using a pair of helical aerials, one wound left-handed and one wound right-handed. One advantage of the helical aerials is that the space required is very small.

This system is ideally suited for tracking artificial satellites and for receiving signals from the automatic picture weather satellites so that a facsimile map can be produced.

Next month's article is the final part of this series; it will describe a Jupiter Project, give details of other observation activities, and show how a radio map of the sky may be produced.



Bib Groov-Kleen model 42

MARKET PLACE

Items mentioned in this feature are usually available from electronic equipment and component retailers advertising in this magazine. However, where a full address is given, enquiries and orders should then be made direct to the firm concerned.

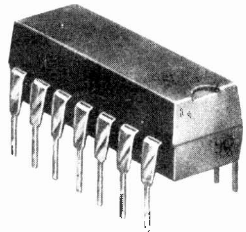
I.C. RELAY

To fulfil the demand for subminiature relays, which are both electrically and mechanically compatible with standard 14-lead dual-in-line i.c.s, **Keyswitch Relays** have just marketed a relay which will plug in to a standard dual-in-line i.c. socket.

For use with standard 5V 40mA drivers the D.I.P. relay is capable of switching 100V d.c. 0·25A, 10W. The contact material is high quality Rhodium and has a life of 10 to 100 million operations, depending on load conditions. The speed of operation is claimed to be 1ms and a release time of 0·5ms.

The small size of the relay make it particularly suitable for portable equipment where dense packaging of components on printed circuit boards is necessary.

Further information and literature may be obtained from Keyswitch Relays Ltd., Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18.



Dual-in-line relay from Keyswitch Relays

SOLDERING IRON CONTROLLER

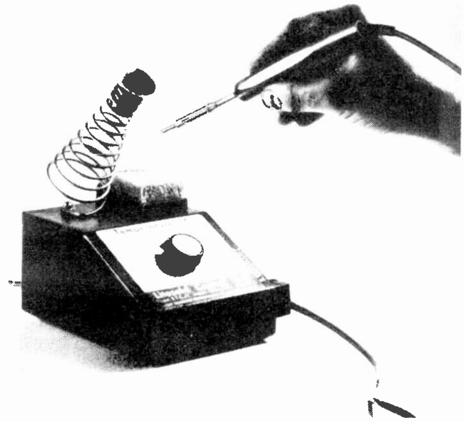
The lastest product from **Light Soldering Developments Ltd** consists basically of a lightweight soldering iron fed from a solid state power control unit. The controller varies the temperature of the iron bit over a range of 150 to 400 degrees Centigrade.

One of the features of the ETC/1, as the unit is designated, is that it is claimed that it does not generate any r.f. interference.

The plug-in soldering iron contains no control components except the temperature sensor. The long-life bits which slip over the heating element are available in a range of tip sizes.

RECORD CLEANER

As a result of an enthusiastic demand for the record cleaner Model 40, **Bib** have now produced a Groov-Kleen Model 42. This device automatically removes dust from the record grooves prior to the



The ETC/1 solid state power controller for soldering irons from Light Soldering Developments

stylus so improving reproduction and reducing record wear.

In chrome finished aluminium, it resembles a pick-up arm, but with a brush at one end and an adjustable counterweight at the other.

In use the brush is lowered on the first grooves of the record. As the turntable revolves dust removed is collected by a fixed velvet roller which follows the brush. After tracking, dust on the roller is removed by a separate hand brush, included with the outfit. The height of the arm on the mounting pillar is adjustable.

The Groov-Kleen has been designed to fit (by a self-adhesive base) practically any make of turntable or record changer, and retails at £1·99.

HI FI TIPS

Also from Bib comes the book "Hi Fi Stereo Hints and Tips" by John Borwick which contains basic practical information on routine care and maintenance of an audio installation. This is lightly informative and reasonable value at 25p.

BACK NUMBERS WANTED

Anyone who can supply the undermentioned are asked to communicate directly with the reader.

We regret that back numbers of Practical Electronics can no longer be supplied. We will try to publish announcements of readers' requirements (without a guaranteed date) free of charge.

June, July, August 1971
Mr. C. D. Grace, 22 Pixie Ridge Road, Burghfield Common, Berkshire.

December 1970, January, February, March 1971
Mr. J. A. Steven, "Andor", Skitten, Nr Wick, Caithness.

August 1971
K. Meeres, 133 Churchgreen Road, Bletchley, Bucks.

September, November, December 1970, January to May 1971, November 1971
Mr. D. G. Harrington, 25 Poynter Road, Bush Hill Park, Enfield, Middlesex.

April to August 1971
Mr. P. Groome, "The Steps", Well Street, Loose, Kent.

December 1968
Mr. E. G. Dowley, 8 Felstead Avenue, Clayhall, Ilford, Essex.

November 1965
Mr. S. H. North, 17 Jenkins Grove, Portsmouth, Hampshire, PO3 6HE.

June 1968
Mr. F. G. Smith, 5 Kimptons Close, Shelley, Ongar, Essex.

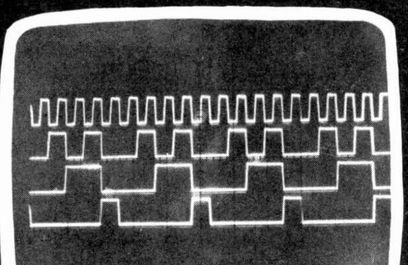
July, August, September 1971
Mr. P. B. Ayre, Moredun House, Carrington Road, Edinburgh, EH4 1QR.

January 1969
Mr. A. J. Campbell, "Donegal", 9 Medina Gardens, East Oakley, Basingstoke, Hampshire.

January, February, June, July, August, November 1968, March 1971
Mr. S-O Karolusson, Box 64, S-452 01 Strömstad, Sweden.

August, November 1971
Mr. J. Blake, 423B Angus Street, New Westminster, British Columbia, Canada.

February 1971
Mr. C. Clark, 94 Pensby Road, Heswall, Wirral, Cheshire.



Oscilloscope beam splitter

By D.Burn Ph.D.

Now that digital i.c.s are freely available at very economical prices, many electronics enthusiasts will doubtless be experimenting with them. The value of the oscilloscope as an aid to both design and fault location in digital systems will quickly become apparent, but so too will its limitations.

A single-beam instrument will afford the detailed examination of the waveform at one point in such a system, but to examine the time relationship between pulse trains at different points, they must of course be displayed simultaneously. Two waveforms may be observed with a double-beam instrument, but more than two is not possible unless a beam-splitting unit is used.

The unit described in this article has been designed to permit the simultaneous presentation of up to four digital waveforms on a single-beam, or five on a double-beam oscilloscope. It is not suitable for use with linear waveforms, or digital signals that are outside the limits of TTL capability, i.e. between 0V and 5V.

SYSTEM OPERATION

To explain the functions of each section it is convenient to describe their operation by reference to the system diagram of Fig. 1. The circuit diagram of the whole unit is shown in Fig. 2.

The whole system is controlled by a clock generator in the form of a multivibrator comprising TR1 and TR2. This runs at about 250-350Hz and its frequency can be controlled by adjusting VR1.

The output from this clock drives a divide-by-four counter formed from an SN7473 TTL dual JK flip-flop, IC1. The input signals to the unit are fed to a digital gate system which determines which of the four waveforms is switched through to the oscilloscope at any given instant. This switching is performed by gates G2a to G2c and G3a which are enabled in sequence by the output from the counter. The inversion, which is not necessary, is eliminated by gate G3b acting as a NOR gate to the inverted outputs of the four input gates.

These gates are standard TTL NAND devices, G2a, G2b and G2c being the individual parts of an SN7410 triple 3-input package IC2, while G3a and G3b are the parts of an SN7420 dual, 4-input package IC3.

A digital-to-analogue converter produces a different voltage for each state of the counter. This output, which determines the position of the trace on the screen, together with the output from the input selector, suitably attenuated by R6 and R7, is fed to an operational amplifier IC4.

The gain of this amplifier is around ×3 and is set by the feedback resistor R17. Capacitor C11 and the combination C10 and R18 are compensation components necessary to reduce the gain of the amplifier at high frequency so that oscillation cannot occur.

Since both digital and analogue parts of the circuit are controlled by the same clock, the overall effect is that the oscilloscope sweep is deflected so as to produce four equally spaced traces; each one corresponds uniquely to one of the four gates, G2a to G2c and G3a, and hence the input waveforms. The input to SK1 is arranged to carry the top trace, the others following in order.

DIGITAL-TO-ANALOGUE CONVERTER

The circuit, which produces the different voltages for different states of the divide-by-four counter, is an extremely simple digital-to-analogue converter.

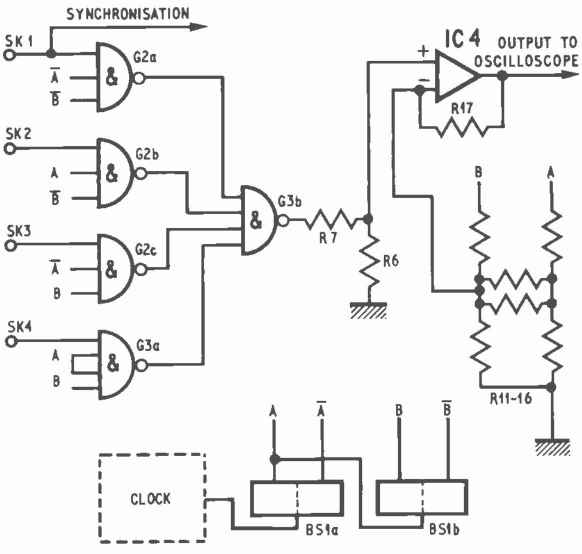
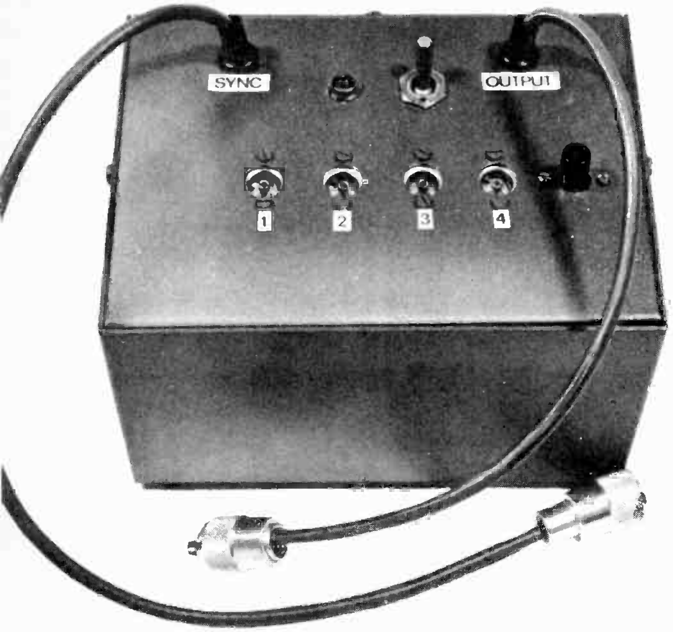


Fig. 1. Diagram of the complete system



It consists simply of six 10 kilohm resistors, R11 to R16, connected between the counter "A" and "B" outputs. Its operation may be explained with the aid of Fig. 3.

The inputs to the resistor network (A and B) will be at either ground potential, or very near (logic "0"); or about +3·6 volts, the average TTL logical "1" voltage, depending upon the states of the bistables BS1a and BS1b, see Fig. 3a. Thus as the counter steps through its four possible states the inputs to the network adopt the values shown in Fig. 3b.

The network may be simplified in each case to give the equivalent forms shown in Fig. 3c, from which the output voltages may be determined as shown. Hence the output increases in equal steps with successive clock pulses, giving rise to the waveforms shown in Fig. 4.

The positive-going staircase from the network is applied to the inverting input of the operational amplifier whose output is therefore the negative-going staircase necessary to put the first trace at the

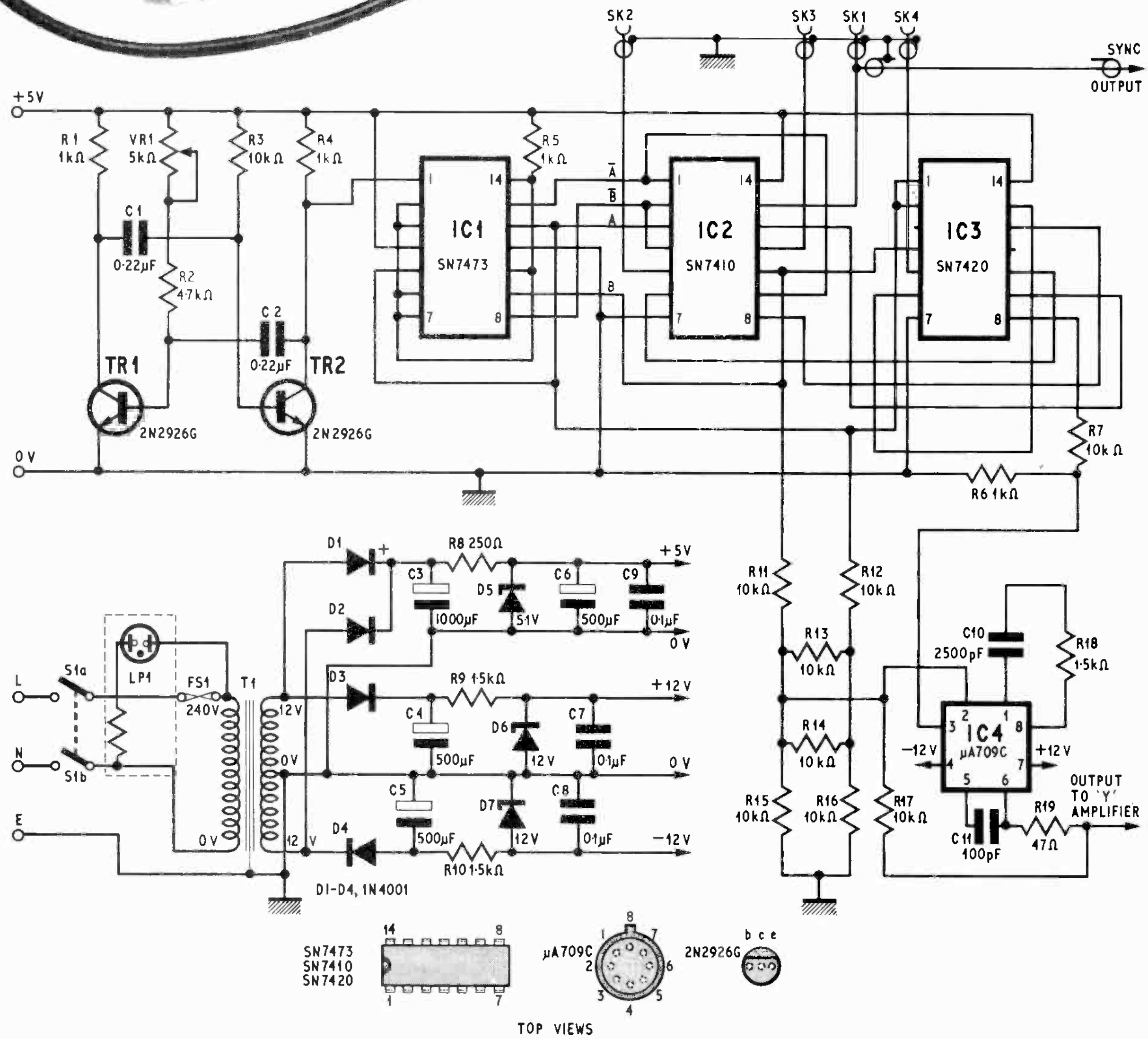


Fig. 2. Circuit diagram of the beam-splitting unit

top of the screen. The potential divider formed by R6 and R7 attenuates the signal from the input selector so that its amplitude is just less than the separation between the traces.

SYNCHRONISATION

A problem that arises with the use of beam-splitting devices concerns the synchronisation of the oscilloscope timebase. Clearly there will be a tendency for the timebase to lock on to the switching frequency rather than on to the input waveforms. Where a double beam oscilloscope is used, one of the input waveforms can be fed to the Y1 amplifier and the timebase internally synchronised to it, the beam-splitter output being applied to the Y2 amplifier.

Where a single beam oscilloscope is used, the timebase should be set for external synchronisation and one of the input waveforms applied to the sync input; this is provided for by a lead connected to the signal input of gate G2a and terminating in a

COMPONENTS...

Resistors
- R1 1k Ω
- R2 4·7k Ω
- R3 10k Ω
- R4 1k Ω
- R5 1k Ω
- R6 1k Ω
- R7 10k Ω
- R8 250 Ω 5W
- R9 1·5k Ω
- R10 1·5k Ω
- R11 10k Ω ±5%
- R12 10k Ω ±5%
- R13 10k Ω ±5%
- R14 10k Ω ±5%
- R15 10k Ω ±5%
- R16 10k Ω ±5%
- R17 10k Ω
- R18 1·5k Ω
- R19 47 Ω

All 10% ¼W unless otherwise stated

Potentiometers
- VR1 5k Ω preset

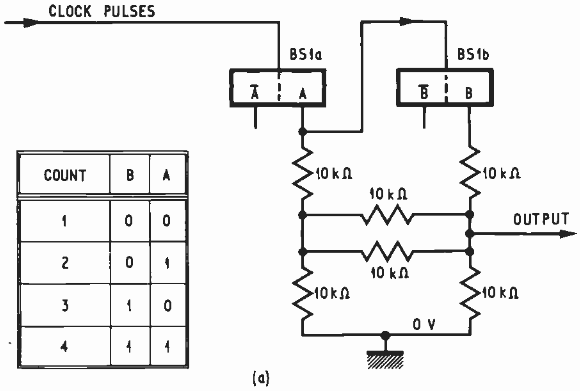
Capacitors
- C1 0·22μF
- C2 0·22μF
- C3 1,000μF elect. 25V
- C4 500μF elect. 25V
- C5 500μF elect. 25V
- C6 500μF elect. 25V
- C7 0·1μF
- C8 0·1μF
- C9 0·1μF
- C10 2,500pF
- C11 100pF

Integrated Circuits
- IC1 SN7473 (BP73) dual JK flip-flop
- IC2 SN7410 (BP10) triple 3-input gate
- IC3 SN7420 (BP20) dual 4-input gate
- IC4 μA709C, BP709P or L709P (8-lead TO5)

Transistors
- TR1, TR2 2N2926G *or* similar (2 off)

Diodes
- D1–D4 1N4001 or any 50 p.i.v. 1A diode (4 off)
- D5 5·1V 5W Zener
- D6, D7 12V 400mV Zener (2 off)

Miscellaneous
- T1 Mains transformer, 12-0-12V 1A secondary
- LP1 Mains neon with resistor
- S1 Double pole on-off mains switch
- SK1-SK4 Coaxial sockets (4 off)
- FS1 250mA fuse and fuseholder
- 6in × 3½in 0·1in matrix s.r.b.p. board and terminal pins
- 7in × 5in × 4in metal case
- Coaxial cable, plugs and test probes (4 off)
- Grommets, solder tags, metal for brackets, single-core insulated wire



COUNT	B	A
1	0	0
2	0	1
3	1	0
4	1	1

Fig. 3a. The circuit of the digital-to-analogue converter

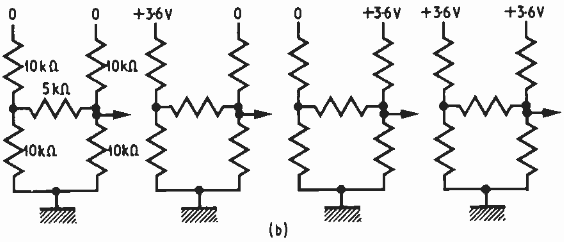


Fig. 3b. Actual voltages for different states of the counter

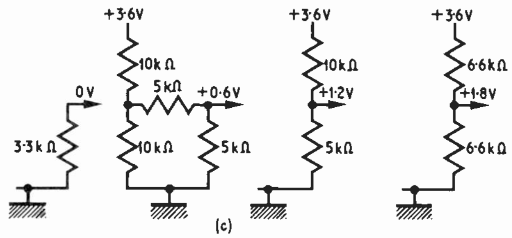


Fig. 3c. Equivalent circuits and corresponding output voltages

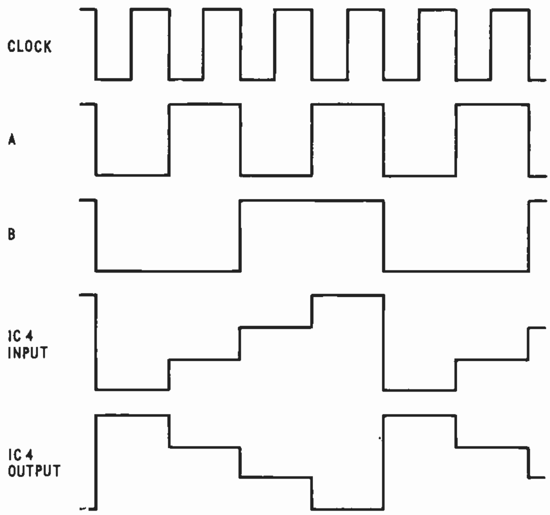


Fig. 4. Waveforms produced by the digital-to-analogue converter

BEAM SPLITTER CIRCUIT BOARD

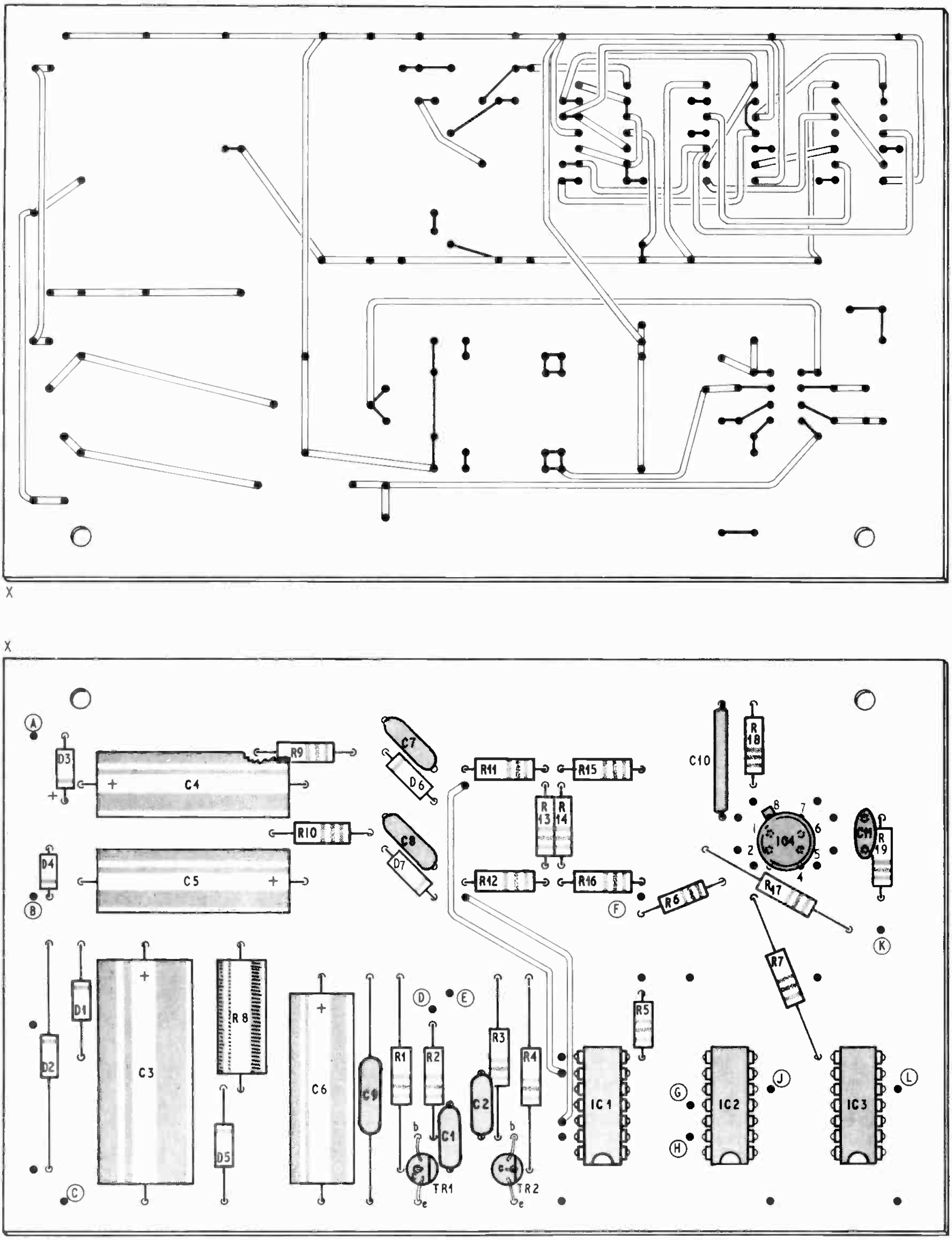


Fig. 5. Layout of the components on the perforated board

GARLAND BROS. LTD,
DEPTFORD BROADWAY, LONDON, SE8 4QN

CAPACITORS

2·2pF	500V	S/M	7½p
3·3pF	500V	S/M	7½p
5pF	500V	S/M	7½p
10pF	125V	P.S.	5p
10pF	500V	S/M	7½p
15pF	125V	P.S.	5p
15pF	500V	Cer.	4p
18pF	500V	S/M	7½p
22pF	125V	P.S.	5p
22pF	500V	S/M	7½p
25pF	500V	S/M	7½p
27pF	500V	Cer.	4p
33pF	125V	P.S.	5p
33pF	500V	S/M	7½p
39pF	500V	S/M	7½p
47pF	125V	P.S.	5p
47pF	500V	Cer.	4p
50pF	500V	S/M	7½p
56pF	500V	S/M	7½p
68pF	125V	P.S.	5p
68pF	500V	S/M	7½p
75pF	500V	S/M	7½p
82pF	500V	S/M	7½p
100pF	125V	P.S.	5p
100pF	500V	S/M	7½p
100pF	500V	Cer.	5p
120pF	500V	S/M	7½p
150pF	125V	P.S.	5p
150pF	500V	S/M	7½p
150pF	500V	Cer.	5p
180pF	500V	S/M	7½p
200pF	500V	S/M	7½p
220pF	125V	P.S.	5p
220pF	500V	Cer.	5p
250pF	500V	S/M	8p
270pF	500V	Cer.	5p
300pF	500V	S/M	8p
330pF	125V	P.S.	5p
330pF	500V	S/M	8p
390pF	500V	S/M	8p
470pF	125V	P.S.	5p
470pF	750V	Disc	5p
500pF	500V	S/M	8p
560pF	500V	S/M	8p
680pF	125V	P.S.	6p
680pF	500V	S/M	8p
820pF	500V	S/M	8p
0·001μF	100V	Mylar	3p
0·001μF	125V	P.S.	6p
0·001μF	400V	Poly.	3p
0·001μF	500V	S/M	10p
0·001μF	500V	Cer.	5p
0·001μF	1,000V	MDC	6p
0,0015μF	400V	Poly.	3p
0·0015μF	500V	S/M	10p
0·0015μF	500V	Cer.	5p
0·0018μF	500V	S/M	10p
0·002μF	100V	Mylar	3p
0·002μF	400V	Paper	7p
0·002μF	500V	Cer.	5p
0·0022μF	125V	P.S.	6p
0·0022μF	500V	S/M	10p

0·0022μF	1,000V	MDC	6p
0·0027μF	500V	S/M	15p
0·003μF	500V	Cer.	5p
0·0033μF	125V	P.S.	6p
0·0033μF	500V	Poly.	6p
0·0033μF	1,000V	MDC	6p
0·0036μF	500V	S/M	15p
0·0047μF	125V	P.S.	9p
0·0047μF	500V	Poly.	6p
0·0047μF	500V	S/M	20p
0·0047μF	1,000V	MDC	6p
0·005μF	100V	Mylar	3p
0·005μF	500V	Cer.	5p
0·0068μF	125V	P.S.	10½p
0·0068μF	500V	S/M	30p
0·0068μF	500V	Poly.	6p
0·0082μF	125V	Poly.	10½p
0·0082μF	500V	S/M	30p
0·01μF	12V	Disc	4p
0·01μF	125V	P.S.	10½p
0·01μF	160V	Poly.	4p
0·01μF	250V	M.F.	3p
0·01μF	400V	Poly	3p
0·01μF	500V	Cer.	5p
0·01μF	500V	S/M	30p
0.01μF	500V	Paper	6p
0·01μF	1,000V	MDC	9p
0·015μF	160V	Poly.	3p
0·015μF	400V	Poly.	3p
0·02μF	100V	Mylar	3p
0·022μF	18V	Disc	5p
0·022μF	250V	M.F.	3p
0·022μF	400V	Poly.	3p
0·022μF	600V	MDC	7½p
0·022μF	1,000V	MDC	9p
0·033μF	250V	M.F.	4p
0·033μF	400V	Poly.	4p
0·047μF	12V	Disc	6p
0·047μF	160V	Poly.	3p
0·047μF	250V	M.F.	3p
0·047μF	400V	Poly.	4p
0·047μF	500V	Paper	8p
0·047μF	1,000V	MDC	10p
0·1μF	30V	Disc	6p
0·1μF	250V	M.F.	4p
0·1μF	400V	Poly.	5p
0·1μF	600V	MDC	10p
0·1μF	1,000V	MDC	13p
0·15μF	250V	M.F.	5p
0·22μF	160V	Poly.	6p
0·22μF	250V	M.F.	5p
0·22μF	400V	Foil	10p
0·22μF	1,000V	MDC	15p
0·33μF	250V	M.F.	8p
0·47μF	250V	M.F.	8p
0·47μF	400V	Foil	15p
0·47μF	1,000V	MDC	20p
1·0μF	250V	M.F.	15p

Note: S/M = silver mica 1% tol.
P.S. = polystyrene 2% tol.
MDC — a.c. rating = 300V.
M.F. = Mullard min. foil.
Cer. = ceramic.

RESISTORS

All 5%, high-stability. E12 values.
½ watt—1½p; 1 watt—4p; 2 watt—6p.

LOW Ω RESISTORS

2½ watt wire-wound. 1 Ω, 1·8 Ω, 2·7 Ω, 3·3 Ω, 3·9 Ω, 4·7 Ω, 5·6 Ω, 6·8 Ω, 8·2 Ω.

10p

CONTROLS, Log. or Lin.

Single, less switch, **15p**
Single, D.P. switch, **24p**
Tandem, less switch, **40p**
5k Ω, 10k Ω, 25k Ω, 50k Ω, 100k Ω, 250k Ω, 500k Ω, 1M Ω, 2M Ω.

FUSES

1¼in glass—2½p
60, 100, 150, 250, 500, 750mA; 1, 1·25, 1·5, 2, 2·5, 3, 5, 7·5, 10, 15 amp.

⅜in glass—2½p
100, 250, 500mA; 1, 2 amp.

Anti-surge 1¼in—8p
250, 500, 750, 850mA; 1, 1·5, 2, 3 amp.

Anti-surge 20mm—5p
80, 125, 200, 315, 400, 500, 630, 800mA; 1, 2 amp.

ELECTROLYTICS

10μF	64V	8p
25μF	50V	8p
50μF	50V	10p
100μF	25V	10p
100μF	50V	10p
250μF	25V	12p
250μF	50V	17p
500μF	25V	18p
500μF	50V	25p
1,000μF	25V	27p
1,000μF	50V	39p
2,000μF	25V	36p
2,000μF	50V	53p
2,500μF	25V	45p
2,500μF	50V	60p
3,000μF	25V	48p
5,000μF	25V	55p
5,000μF	50V	98p

SILICON BRIDGE RECTIFIERS

40 P.I.V., 1·5 amp.

50p

PANEL FUSE-HOLDERS

For 1¼in fuses	18p
For 20mm fuses	15p

ZENER DIODES

From 2 to 33 volts.
400mW, 15p; 1·5 watt, 22½p

TRANSISTORS

AC127	17p	BC109	11p	BFX29	38p	ST141	23p
AC128	18p	BC147	12p	BFX84	25p	UT46	35p
AC176	22p	BC148	12p	BFX88	30p	2N696	15p
AC187	28p	BC149	12p	BFY50	21p	2N706A	12p
AC188	27p	BC157	15p	BFY51	21p	2N2926G	14p
ACY19	23p	BC158	14p	BFY52	22p	2N2926Y	13p
AD149	47p	BC159	14p	MAT100	25p	2N2926O	12p
AD161/162	72p	BD131	75p	MAT101	29p	2N3053	25p
ADT140	62p	BD132	75p	MAT120	25p	2N3054	60p
AF118	45p	BF115	25p	MAT121	29p	2N3055	72p
AF124	22p	BF178	32p	OC28	58p	2N3702	15p
AF125	19p	BF179	56p	OC35	48p	2N3703	14p
AF126	20p	BF180	30p	OC44	12p	2N3704	15p
AF127	19p	BF181	32p	OC45	12p	2N3705	14p
AF178	67p	BF184	30p	OC71	11p	2N3706	14p
AF179	66p	BF185	32p	OC72	12p	2N3711	14p
AF180	66p	BF194	14p	OC75	20p	2N3819	35p
AF239	32p	BF195	14p	OC200	27p	2N4058	17p
BC107	11p	BF196	28p	OC201	38p	2N5459	60p
BC108	11p	BF197	15p	OCP71	60p		
		BFW10	70p	ST140	15p		

MINIATURE ELECTROLYTICS

1μF	25V	30μF	15V
2·5μF	64V	50μF	15V
4μF	40V	100μF	15V
5μF	64V		
8μF	15V		
8μF	40V		
10μF	15V		
16μF	40V		
25μF	25V		

7p

DIODES

AA119	11p
OA47	7½p
OA90	7½p
OA91	7½p
OA202	10p
BY100	15p
BY127	22½p
BYZ12	22½p

GARLAND BROS. LTD.

are South-East London's leading components store and have been helping enthusiasts for 26 years.

If you are able to visit us you will find thousands of other components at reasonable prices.

Phone 01-692 4412

MAIL ORDERS: C.W.O. only. Please include 10p p. & p. (Air mail extra). S.A.E. with all enquiries please.

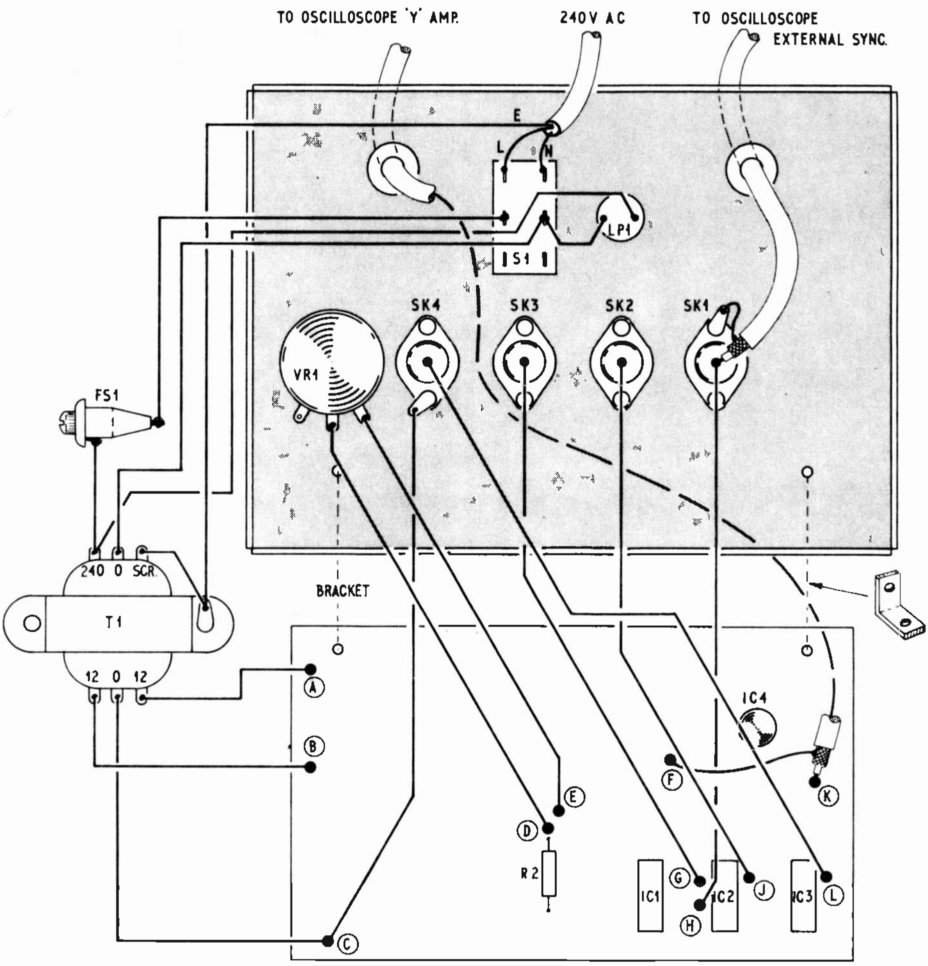


Fig. 6. Interwiring diagram of the completed unit and general layout of components on rear of the front panel. The hole for the sync lead is not necessary if a double beam oscilloscope is to be used (see text)

plug appropriate to the sync terminal of the oscilloscope. Remember that it is easiest to synchronise the oscilloscope to the input with the lowest repetition frequency.

POWER SUPPLIES

The power supplies for the unit are derived from a single 12V-0-12V transformer T1. The two half-wave rectifiers D3 and D4 provide positive and negative supplies which are regulated to +12V and −12V by Zener diodes D6 and D7, and provide power for the operational amplifier.

In addition, diodes D1 and D2 provide a further full-wave rectified output which is regulated to +5V by D5, and powers all the logic circuits.

CONSTRUCTION

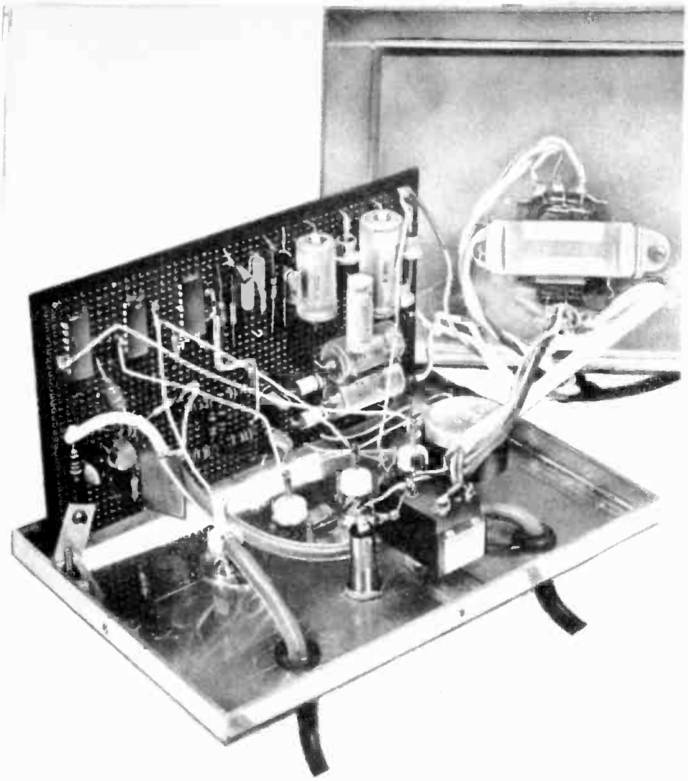
Apart from the transformer T1, all the components are mounted on a single piece of 0·1in matrix perforated board, about 6in × 3½in. A suitable layout, although this is not critical, is shown in Fig. 5. The components are held in place by passing their leads through conveniently placed holes, using the leads for the great majority of the wiring.

The i.c.s. require somewhat different treatment. Those in the dual-in-line packages are interconnected with lightweight, single-core insulated hook-up wire, which also serves to hold them in place on the board. Careful soldering is vital.

The eight leads of IC4 (TO5 can) are passed through the board and anchored to eight, well-spaced, terminal pins. The pin numbering for the i.c.s is shown in the main circuit diagram. The 5 watt resistor, R8, quickly warms up and is mounted about ½ to 1in from the board to avoid heating adjacent components.

The completed circuit board is mounted on the top of the case by two small brackets and the interwiring is completed as shown on Fig. 6. Note the coaxial lead on SK1, this is for the connection to the sync terminal of a single-beam oscilloscope and may be omitted if the unit is to be used with a double-beam oscilloscope.

Four test leads should be prepared from coaxial cable, each about 2ft long and having a coaxial plug at one end and a suitable probe at the other.



THE UNIT IN USE

To check that the unit is operating correctly, its output is plugged into the oscilloscope Y input. With synchronisation set to internal, adjustments of the timebase should display the inverted staircase waveform shown in Fig. 4.

If the first input (to SK1) is earthed, the top step should be displaced downwards by almost the height of one step. Similarly earthing the second input should cause the second step to move down almost to the level of the third. If the magnitude of the displacement is very different from the required amount it may be corrected by adjusting the value of R7.

If the timebase is then allowed to free-run, i.e. without synchronisation, at a higher frequency, four equally spaced horizontal lines will be displayed, their spacing being determined by the oscilloscope Y-gain. Typical values for the prototype were 1·8 volts as the spacing between the traces and 1·4 volts as the amplitude of each trace. Thus a setting of 2V/cm will be a suitable Y-gain for most small or medium sized oscilloscope tubes.

The Y amplifier may be set to either d.c. coupling, or if the traces are displaced too far off centre for the Y-shift to cope with, a.c. coupling may be used.

The signals to be examined are then applied to the inputs and the timebase adjusted to display a convenient number of pulses. The methods of obtaining the necessary synchronisation have already been described. With the oscilloscope timebase set to below 1ms/cm flicker becomes annoying. Thus only waveforms with a frequency of above about 250Hz can be viewed satisfactorily.

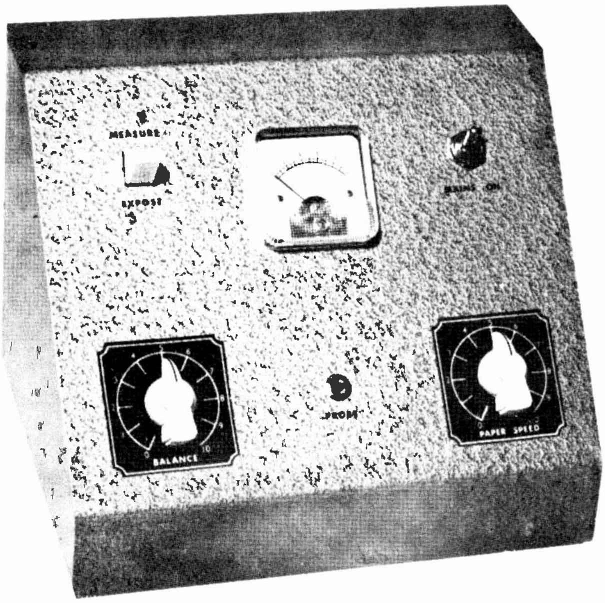
If the repetition rate of the waveforms being studied is close to a multiple of the beam-switching frequency, a distracting flickering will be produced. In such cases, the preset control VR1 should be adjusted to give an acceptable trace. ★

Photo-Print Process Control Unit

By A.WOODROW

PART TWO

LAST month the circuit theory of the process control unit was explained. This month we deal with the construction and methods of printing both monochrome and colour.



COMPONENT BOARD

The construction of the control unit is quite straightforward. The majority of the components are mounted on a 5in × 3¾in Veroboard panel, the remainder being mounted directly onto the case.

Details of the Veroboard panel are shown in Fig. 4. The four mounting holes are first drilled 6BA clearance. The breaks in the copper strips are then cut with a small drill or spot face cutter. At first sight, it would appear that not all of the breaks are necessary for the operation of the unit, but it should be remembered that the stabiliser is at mains potential.

To avoid any possibility of the accessible parts of the control unit from becoming live through insulation breakdown, it is advisable to isolate this corner of the panel completely from the remainder of the circuit; hence the row of copper strip breaks down the centre of the board.

The components are then mounted on the panel. The links are fitted first, using insulated wire, then the horizontally mounted resistors, capacitors and diodes are soldered in place. The polarity of electrolytic capacitors and diodes should be observed. The vertically mounted resistors and remaining semiconductors follow, and the panel is completed with the fitting of terminal pins in the positions shown. A photograph of the completed board, ready for assembly into the case, is shown.

MOUNTING OF COMPONENTS

As the components made by different manufacturers may vary, all parts should be checked before any drilling is begun, to ensure that the components will fit the holes provided, see Fig. 5. In particular, relays may vary.

No mounting holes were provided on the relay used in the prototype, and two Terry clips were fitted to the case, the relay coil being clipped into these. Many relays are, however, already fitted with mounting holes, and the case drilling should be modified to fit where necessary.

The labelling of the front panel can be undertaken at this stage, using Letraset and/or transfers. The scales on the "balance" and "paperspeed" controls are arbitrary, and are necessary only so that any control setting can be reset as required.

LAST MONTH'S COVER. The Gnome Enlarger and the Masking Frame were loaned by Wallace Heaton, Fleet Street, London, E.C.4.

The case-mounted components are then fitted, using the rear-view diagram as a guide. The Veroboard panel is not fitted at this stage. The four 4BA holes on the base are used for fitting rubber feet. Referring to Fig. 5, the wiring is then completed, omitting any wires going to the Veroboard, and the small components R11, R10, R15, C3 and D2 are fitted.

Lengths of wire are soldered to each of the terminal pins on the Veroboard, and the panel is fitted into the case, using distance pieces to space the board away from the case. Each wire is then cut to length and connected into the unit. R1 is then added to complete the construction of the control unit.

The layout of the unit is in no way critical, and any alternative method of construction may be used if required.

THE PROBE

A probe, containing the light dependent resistor, is made from a small plastic box. A hole is drilled in the top, and the l.d.r. is fitted with its sensitive surface uppermost.

The lead, with a 3·5mm jack plug on one end, is connected at the other end to the l.d.r. This lead should not be too stiff, as it may pull the probe out of position from the enlarger baseboard; audio screened lead is suitable. Extra weight may be added to the probe head, so that it will stay where it is placed on the baseboard. A few pieces of Plasticine

TRANSFORMERS

MAINS ISOLATING SERIES
PRIMARY 200/250V. SEC. 240V. C.T. 120V. & EARTH SHIELDED
ALSO AVAILABLE WITH 115/120V. SEC. WINDINGS

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	£	P & P p
07	20	1	11	7 × 6 × 6·5	1·40	30
61	100	5	12	10·2 × 8·9 × 8·3	2·28	52
62	250	12	4	9·5 × 12·7 × 11·4	5·05	67
63	500	27	0	17·1 × 11·4 × 15·9	9·74	*
92	1000	40	0	17·8 × 17·1 × 21·6	17·94	*
128	2000	63	0	24·1 × 21·6 × 15·2	29·66	*
129	3000	84	0	21·6 × 21·6 × 20·3	46·38	*
190	6000	178	0	31·1 × 35·6 × 17·1	76·11	*

AUTO SERIES (NOT ISOLATED)

Ref. No.	VA (Watts)	Weight lb	oz	Size cm.	Auto Taps	£	P & P p
113	20		11	7·3 × 4·3 × 4·4	0-115-210-240	0·74	20
64	75	1	14	7·0 × 6·4 × 6·0	0-115-210-240	1·44	30
4	150	3	0	8·9 × 6·4 × 7·6	0-115-200-220-240	1·74	36
66	300	6	0	10·2 × 10·2 × 9·5	,, ,,	3·38	52
67	500	12	8	14·0 × 10·2 × 11·4	,, ,,	5·03	67
84	1000	16	0	11·4 × 14·0 × 14·0	,, ,,	9·12	82
93	1500	28	9	13·5 × 14·9 × 16·5	,, ,,	13·22	*
95	2000	40	0	17·8 × 16·5 × 21·6	,, ,,	17·26	*
73	3000	45	8	17·4 × 18·1 × 21·3	,, ,,	23·47	*

TOTALLY ENCLOSED 115V AUTO TRANSFORMER

115V 500 Watt totally enclosed auto transformer, complete with mains lead and two 115V outlet sockets, **£6·85.** P & P 67np.

LOW VOLTAGE SERIES (ISOLATED)
PRIMARY 200-500 VOLTS 12 AND/OR 24 VOLT RANGE

Ref. No.	Amps. 12V	Amps. 24V	Weight lb	oz	Size cm.	Secondary Windings	£	P & P p
111	0·5	0·25		12	7·6 × 5·7 × 4·4	0-12V at 0·25A × 2	0·74	22
213	1·0	0·5	1	0	8·3 × 5·1 × 5·1	0-12V at 0·5A × 2	0·88	22
71	2	1	1	0	7·0 × 6·4 × 5·7	0-12V at 1A × 2	1·16	22
18	4	2	2	4	8·3 × 7·0 × 7·0	0-12V at 2A × 2	1·62	36
70	6	3	3	12	10·2 × 7·6 × 8·6	0-12V at 3A × 2	1·95	42
72	10	5	6	3	7·9 × 10·8 × 10·2	0-12V at 5A × 2	2·56	52
17	16	8	7	8	12·1 × 9·5 × 10·2	0-12V at 8A × 2	3·95	52
115	20	10	11	13	12·1 × 11·4 × 10·2	0-12V at 10A × 2	5·03	67
187	30	15	16	12	13·3 × 12·1 × 12·1	0-12V at 15A × 2	9·28	82
226	60	30	34	0	17·0 × 14·5 × 12·5	0-12V at 30A × 2	17·05	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
112	0·5	1	4	8·3 × 3·7 × 4·9	0-12-15-20-24-30V	0·88	22
79	1·0	2	0	7·0 × 6·4 × 6·0	,, ,,	1·18	36
3	2·0	3	2	8·9 × 7·0 × 7·6	,, ,,	1·75	36
20	3·0	4	6	10·2 × 8·9 × 8·6	,, ,,	2·16	42
21	4·0	6	0	10·2 × 10·0 × 8·6	,, ,,	2·56	52
51	5·0	6	8	12·1 × 10·0 × 8·6	,, ,,	3·18	52
117	6·0	7	8	12·1 × 10·0 × 10·2	,, ,,	3·79	52
89	10·0	12	2	14·0 × 10·2 × 11·4	,, ,,	6·21	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
102	0·5	1	11	7·0 × 7·0 × 5·7	0-19-25-33-40-50V	1·16	30
103	1·0	2	10	8·3 × 7·3 × 7·0	,, ,,	1·69	36
104	2·0	5	0	10·2 × 8·9 × 8·6	,, ,,	2·34	42
105	3·0	6	0	10·2 × 10·2 × 8·3	,, ,,	3·18	52
106	4·0	9	4	12·1 × 11·4 × 10·2	,, ,,	4·20	52
107	6·0	12	4	12·1 × 11·1 × 13·3	,, ,,	6·21	67
118	8·0	18	9	13·3 × 13·3 × 12·1	,, ,,	8·10	97
119	10·0	19	12	16·5 × 11·4 × 15·9	,, ,,	10·15	97

60 VOLT RANGE

Ref. No.	Amps.	Weight lb	oz	Size cm.	Secondary Taps	£	P & P p
124	0·5	2	4	8·3 × 9·5 × 6·7	0-24-30-40-48-60V	1·18	36
126	1·0	3	0	8·9 × 7·6 × 7·6	,, ,,	1·64	36
127	2·0	5	6	10·2 × 8·9 × 8·6	,, ,,	2·56	42
125	3·0	8	8	11·9 × 9·5 × 10·0	,, ,,	3·90	52
123	4·0	10	6	11·4 × 9·5 × 11·4	,, ,,	5·03	67
120	6·0	16	12	13·3 × 12·1 × 12·1	,, ,,	7·28	82
122	10·0	23	2	16·5 × 12·7 × 16·5	,, ,,	12·05	*

*Carriage via B.R.S.

LEAD ACID BATTERY CHARGER TYPES
PRIMARY 200-250 VOLT
FOR CHARGING 6 OR 12 VOLT BATTERIES

Ref. No.	Amps.	Weight lb	oz	Size cm.		£	P & P p
45	1·5	1	9	7·0 × 6·0 × 6·0	Please note, these units do not include rectifiers	1·17	30
5	4·0	3	11	10·2 × 7·0 × 8·3		1·77	42
86	6·0	5	12	10·2 × 8·9 × 8·3		2·67	52
146	8·0	6	4	8·9 × 10·2 × 10·2		3·04	52
50	12·5	11	14	13·3 × 10·8 × 12·1		4·52	67

All ratings are continuous. Standard construction: open with solder tags and wax impregnation. Enclosed styles to order.

TRANSISTORS
TO MANUFACTURERS FULL SPECIFICATIONS

BC107/108/109 9p each
25 + 7p
100 + 6p
500 + 5p
Minimum order 10 pieces this range.

2N 3055 68p each with mica and bushes
25 + 60p
100 + 45p
500 + 40p

AD 161/162 60p pair with mica and bushes
25 + 55p
100 + 50p
500 + 45p
1000 + 40p

★ Quantity prices on application

Also stocked: SEMICONDUCTORS · VALVES
MULTIMETERS · MAINS KEYNECTOR
ELECTROSIL METAL OXIDE RESISTORS

BARRIE electronics
11 MOSCOW ROAD, QUEENSWAY
LONDON W2 4AH Tel: 01-229 6681/2
NEAREST TUBE STATIONS: BAYSWATER, QUEENSWAY

TECHNICAL TRAINING

in radio television and electronics

Whether you are a newcomer to radio and electronics, or are engaged in the industry and wish to prepare for a recognized examination, ICS can further your technical knowledge and provide the specialized training so essential to success. ICS have helped thousands of ambitious men to move up into higher paid jobs—they can help you too! Why not fill in the coupon below and find out how?

Many diploma and examination courses available, including expert coaching for:

- **C. & G. Telecommunication Techns'. Certs.**
- **Radio Amateurs' Examination**
- **General Radiocommunications Certificate**
- **C. & G. Radio Servicing Theory**
- **General Certificate of Education, etc.**

Now available, Colour T.V. Servicing

Examination Students coached until successful

NEW SELF-BUILD RADIO COURSES

Learn as you build. You can learn both the theory and practice of valve and transistor circuits, and servicing work while building your own 5-valve receiver, transistor portable, and high-grade test instruments, all under expert tuition. Transistor Portable available as separate course.

POST THIS COUPON TODAY

for full details of ICS courses in Radio, T.V. and Electronics

Member of the ABCC *Accredited by the CACC*

ICS EST. 1891

INTERNATIONAL CORRESPONDENCE SCHOOLS

Dept. CB25, Intertext House, Stewarts Rd., London SW8 4UJ

Please send me the ICS prospectus—free and without obligation.

(state Subject or Exam.)

NAME AGE
(Block Capitals Please)
ADDRESS

2/72

INTERNATIONAL CORRESPONDENCE SCHOOLS

PHOTO-PRINT PROCESS CONTROL CIRCUIT BOARD

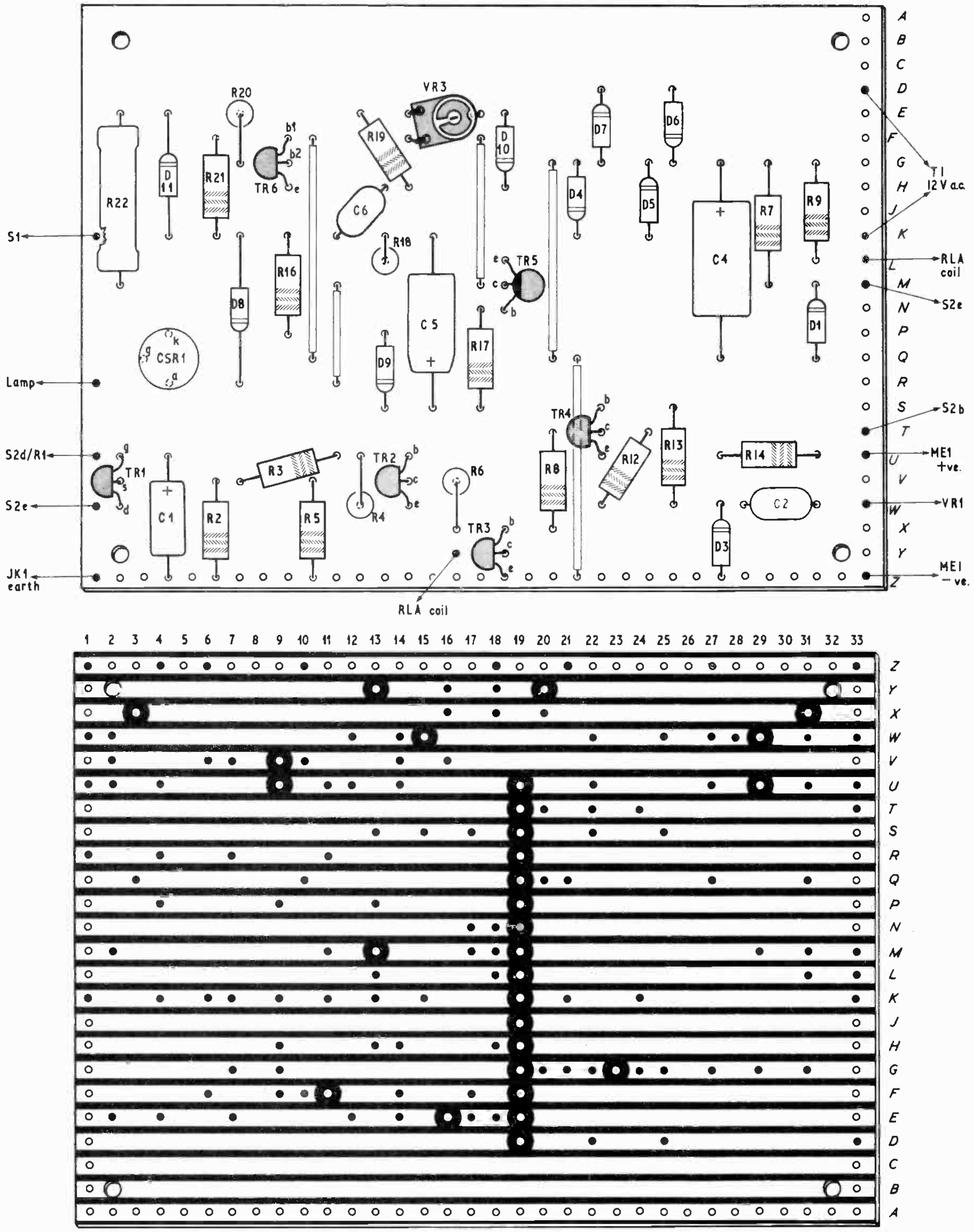


Fig. 4. Layout of components and underside of circuit board showing breaks in copper strips

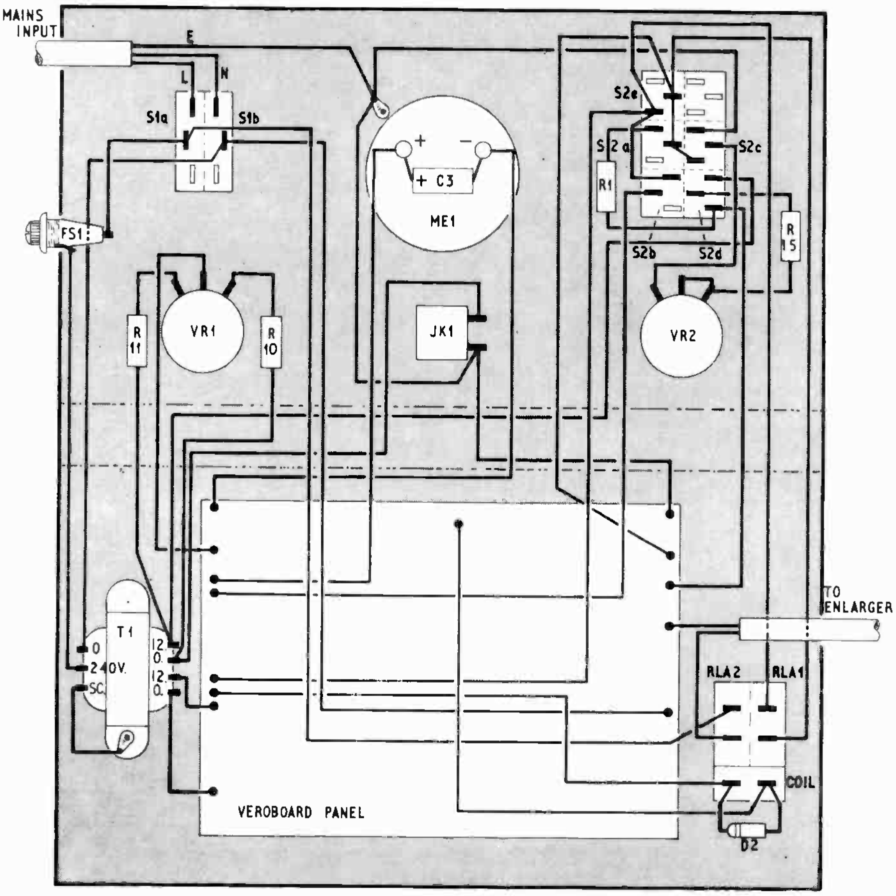


Fig. 5. Interwiring details and layout of components in case

inside the box will do the trick. The probe used with the prototype is shown with the photograph of the rear view of the completed unit.

THE DIFFUSER PLATE

The negative is measured using the integration method; the light transmitted by the negative is scrambled, using a diffuser, such that no detail reaches the baseboard, and the probe measures the average light level. A diffuser plate is therefore required.

If a piece of opal glass or plastic is available, this can be used. Otherwise, a piece of clear Perspex is rubbed gently with fine sandpaper or emery cloth. The process should be continued, rubbing each side alternately, until, when the diffuser is placed just below the enlarger lens, no detail of the negative can be seen projected on the baseboard.

The diffuser plate is fitted to the enlarger such that it can be swung into place an inch or two below the lens, and can be moved out of the way when not required. Many enlargers are already fitted with a red swing filter, and the diffuser may be fitted to the mounting for this, either in place of, or in addition to, the red filter. Alternatively, the diffuser can be attached to one of the mounting holes of a suitable capacitor clamp, the clamp then being fitted to the lens barrel.

FILTERS

The third accessory, required only for colour printing, is a set of filters, one each of red, green and blue. Suitable types are the Kodak Wratten types 29 (red), 61 (green) and 47B (blue). These are required to be placed, in turn, in the light beam in addition to the diffuser plate. To prevent damage to the filters, they can be mounted, either separately in transparency mounts, or together in a home made mount with three windows.

INITIAL CHECKS

For the initial checks, VR3 is set to the fully anti-clockwise position, i.e. with the slider at the end remote from TR5 collector. The probe is plugged in, and the control unit switched on. With the function switch in the centre position, nothing should happen.

When the switch is set to "measure", a click should be heard as the relay energises. If the enlarger lamp has been connected at this stage, the lamp will light.

BUDGET HIGH-FIDELITY STEREO SYSTEMS

PREMIER STEREO SYSTEM "ONE" consists of the new Premier 800 all transistor stereo amplifier, Garrard 2025 T/C auto manual record player unit fitted stereo mono ceramic cartridge with diamond stylus and mounted in teak finish plinth with perspex cover and two matching teak finish loudspeaker systems. Absolutely complete and supplied ready to plug in and play. 800 amplifier has an output of 5 watts per channel with inputs for ceramic and magnetic pick-up, tape and tuner also tape output socket and headphone socket. Controls: Bass, Treble, Volume, Balance, Selector. Mono/Stereo switch. Headphone socket. Power on/off. Black leatherette cabinet with aluminium front panel. Size 12¼in × 6¾in × 2⅜in. (Amplifier available separately if required **£16·25.** Carr. 40p.)

PREMIER STEREO SYSTEM "TWO", as above but with Garrard SP25 Mk. III and magnetic cartridge—**ONLY £48.** Carr. £1·75.

ONLY £40·95 carr. £1·75

ONLY £57·75 carr. £1·75

PREMIER STEREO SYSTEM "THREE." This consists of KLINGER KC903 stereo amplifier giving 6 watts rms per channel with Bass, Treble, Volume and Balance Controls. Inputs for Magnetic and ceramic pick-up, tuner, tape in and out. Stereo earphone socket. Garrard SP25 Mk. III in teak finish plinth with cover and fitted Sonotone 9TAHCD diamond stereo cartridge. A pair of HMF Speakers size 16½in × 10¼in × 9in fitted EMI units complete the matching system. **ONLY £57·75.** Carr. £1·75.

FREE STEREO HEADPHONES and all leads and plugs supplied with all systems

PREMIER HI-FI OFFERS!

Philips 580 Stereo Amplifier (List £29·00)	£23·00
Rogers Ravensbrook 11 Stereo Amplifier in teak case (List £52·50)	£39·50
Rogers Ravensbourne Stereo Amplifier in teak case (List £64)	£49·00
Metrosound ST20E Stereo Amplifier in teak case (List £39·50)	£28·50
Goldring GL75 less cartridge (List £41·61)	£29·00
Garrard SP25 111 with Goldring G800 cartridge (List £28·35)	£15·50
Garrard AP76 less cartridge	£19·50
Garrard 3500 with Sonotone 9TA stereo cartridge (List £15·50)	£9·97
Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge	£9·97
Garrard 2025 T/C with Sonotone 9TAHC Diamond Cartridge ready wired in teak plinth with cover	£14·00

Carriage and Insurance 50p extra any item.

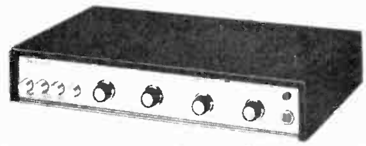
SP25 Mk III SPECIAL!

Garrard SP25 Mk. III Single Record Player. Fitted Goldring G800 Magnetic Stereo Cartridge as available. Complete in Teak Plinth with Rigid Perspex Cover.

Total list Price over £34.

PREMIER PRICE £18·90 P. & P. 50p

NEW LOW COST PREMIER 800 STEREO AMPLIFIER



A truly high quality stereo amplifier—compare the specification, compare the price. Output: 5 watts per channel. Frequency response: 30–20,000Hz ± 2db. Distortion: 1%. Output Impedance 8 ohms nom. Inputs equalised to R.I.A.A.
Magnetic 4mV. Ceramic 100mV. Tuner 100mV. Tape 100mV. Tape out 150mV. Din sockets for inputs and outputs. Mono/Stereo switch. Stereo Headphone socket. Attractive slim line design black leatherette cabinet with aluminium front panel. Size 12¼in × 6¾in × 2⅜in.

ONLY £16·25 Carr. 40p

HI-FI STEREO HEADPHONES

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

£2·47 P. & P. 25p

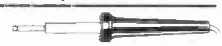
STEREO STETHOSCOPE SET Low imp. **£1·25.** P. & P. 10p

MONO STETHOSCOPE SET Low imp. **52p.** P. & P. 10p

"WELLER EXPERT" SOLDER GUN

Saves time and simplifies soldering in the home and service dept. Two position trigger gives instant dual heat 100/140 watt. 240 volt A.C.

£4·25 P. & P. 30p



"Weller Marksman" Soldering Iron
Lightweight. $\frac{3}{16}$in pencil bit, 25 watt. 240 volt A.C. **£1·50** P. & P. 15p

E.M.I. 13×8in. HI-FI SPEAKERS

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

£3·47 P. & P. 40p

TAPE CASSETTES

C60	(60 min.)	37p	3 for £1·05
C90	(90 min.)	62p	3 for £1·80
C120	(120 min.)	87p	3 for £2·55

P. & P. 5p

FREE Cassette Head Cleaner with every 10 cassettes purchased

All cassettes can be supplied with library cases at 3p extra each.

"VERITONE" RECORDING TAPE

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

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

LP3	3"	250'	P.V.C.	28p
TT3	3"	450'	POLYESTER	37p
DT3	3½"	600'	POLYESTER	57p
SP5	5"	600'	P.V.C.	42p
LP5	5"	900'	P.V.C.	50p
DT5	5"	1200'	POLYESTER	75p
LP6	5¾"	1200'	P.V.C.	75p
DT6	5¾"	1800'	POLYESTER	£1·12
TT6	5¾"	2400'	POLYESTER	£1·67
SP7	7"	1200'	P.V.C.	62p
LP7	7"	1800'	P.V.C.	75p
DT7	7"	2400'	POLYESTER	£1·25
TT7	7"	3600'	POLYESTER	£2·50

TAPE SPOOLS 3" 5p, 5", 5¾", 7" 9p.

Post and Packing 3" 5p, 5", 5¾" 8p, 7" 10p. (3 reels and over Post Free.)

PREMIER RADIO

10 & 23, TOTTENHAM COURT ROAD, LONDON, W.1 TEL: 01-636 3451/2639
HEAD OFFICE & MAIL ORDER DEPT. 23, TOTTENHAM CT. RD. TEL: 01-636 3451

The meter should also deflect, and an adjustment to either the balance or paper speed controls will vary the reading.

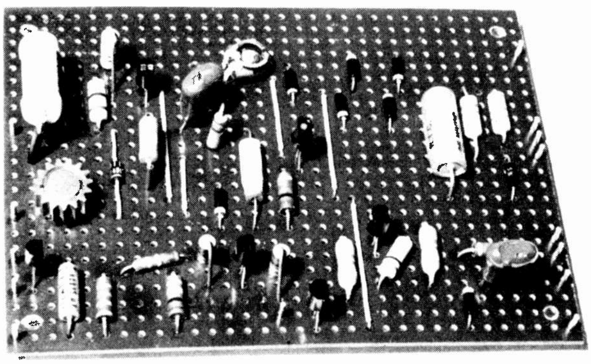
Under conditions of daylight or bright room lighting, it is unlikely that the meter can be balanced, but shading the l.d.r. from direct light should produce a minimum reading on the meter at some setting of the controls. Returning the function switch to the centre position will de-energise the relay, and the meter reading will drop to zero.

The balance control is now set to the maximum clockwise position; depressing the function switch momentarily, the relay should energise, and remain so for about 60 seconds, when it will de-energise automatically. Any variation either way on this time is not important, being due to component tolerances.

With the balance control in its mid-position, the time should be in the order of 10 seconds, and in the fully anti-clockwise position, one second. If the above checks prove satisfactory, the exposure meter and timer are operating correctly.

VARIATION OF MAINS VOLTAGE

The testing and setting-up of the lamp stabiliser requires the use of a variable voltage mains supply —actually, two mains voltages are needed, with a means of switching between them. The lower voltage should be about 220–225V, the higher about 240–245V.



Completed wiring board, ready for assembly into case

These voltages may be obtained from a large transformer, either isolating or auto, providing it has suitable tappings and can handle the power of the enlarger lamp. A variable voltage transformer can also be used, although switching between the two voltages cannot be achieved as quickly as is desirable.

A third method is the insertion of a resistor in series with the live mains lead. A resistor of about 40 ohms 10W is suitable for a 150W lamp, 80 ohms 10W for a 75W lamp. A switch is connected across the resistor, so that either voltage can be selected.

If the last method is used, it may be necessary to select the time at which the setting-up is carried out; particularly during the winter months, the mains voltage is likely to be low, and it will be difficult to achieve the higher voltage. If the work is carried out in the late evening, no difficulty should be experienced.

It should be remembered that, whichever method is used, the components in the switch circuit are at mains potential, and any adjustments should be made very carefully, to avoid contact with live mains.

SETTING UP

The lamp should now be connected to the control unit, if this has not already been done. The initial adjustments may be made in normal lighting.

With the function switch in the "measure" position, and the mains at the higher level, adjust VR3 clockwise until the lamp dims a little. Observing the lamp, switch to the lower voltage, and check that the lamp dims.

Return to the higher mains voltage and adjust VR3 a little further clockwise. Switch to low mains and observe that the lamp dims. Continue with these adjustments until, when the mains is switched between low and high levels and back, there is little or no change in the brightness of the lamp.

The stabiliser takes a short time to adjust to such abrupt changes of voltage, and will brighten or dim when the mains is raised or lowered respectively, before settling back to a steady level. In spite of this effect, a reasonably accurate setting for VR3 can be found. Final checks are carried out in darkroom conditions.

With illumination only from the darkroom safelight, and the higher mains voltage applied, adjust the paper speed control for minimum deflection on the meter, with the balance control at its approximate mid-position. No negative need be in the enlarger.

If necessary, the balance control can be adjusted to obtain a balance. Note the readings on the control unit. Switch to the lower mains voltage, and with all other conditions as before, adjust the balance control to restore a balance on the meter.

The two readings should be identical, or very close. If necessary, readjust VR3 to obtain the smallest difference between the two readings. Referring to the scales used on the prototype, a difference of not more than 0·1 should be obtainable.

PILOT LIGHT

In most darkrooms, sufficient illumination will be available from the safelight to enable the meter to be seen easily. In cases where is is not so, space has been left over the meter to enable a pilot light to be fitted to the control unit. A neon type is most suitable, this being connected to the transformer side of S1.

The lens colour must be selected to give a photographically safe light. For colour printing, an amber lens is suitable, this also being safe for monochrome. If black and white only is to be printed, a red lens may also be used. If there is any doubt as to the safety of the light, it should be tested by exposing printing paper to the light for several minutes, processing the result, and examining the paper for fogging.

PRINTING MONOCHROME

A negative is chosen to produce a print for calibrating the paper speed control of the unit. The negative should have a full range of tones between black and white, but without large areas of either very light or very dark. A good print is made from this negative using trial and error methods, such as a test strip.

For calibration purposes, the print should be of the size most commonly used by the photographer, and the enlarger should be adjusted to produce a print requiring about 10 to 15 seconds exposure.

The enlarger must be fed through the control unit, so that the lamp is supplied from the stabiliser.

Once this print has been made, the enlarger settings must not be changed, and the required exposure time is noted.

The next step is to set the controls of the unit to give an exposure the same as that required for the calibration print. This is done by adjusting the balance control until, when the function switch is pushed, the timer switches on the lamp for the required time.

With the room lights out, and the enlarger set as for the calibration print, the function switch is set to "measure". The clear rebate areas of the negative should be masked such that only the picture area is projected onto the baseboard. The diffuser plate is placed in position under the lens to integrate the light, and the probe of the control unit is placed on the baseboard, in the centre of the pool of light so formed. With the balance control set to the position previously determined, the paper speed control is adjusted to give minimum deflection on the meter.

The setting of the paper speed control so found should be used whenever paper of that make and grade is used for printing. The calibration must be repeated when any other type of paper is used, and a new paper speed setting determined.

USING OTHER NEGATIVES

To make a print from any other negative, the paper speed control is set to the correct setting for the paper to be used for the print.

The negative is placed in the enlarger, with the clear areas masked as before. With the function switch in the "measure" position, the enlarger is adjusted to the required degree of enlargement and focused, then the lens is stopped down to the selected aperture. The diffuser is placed in the light beam, and the probe is put on the baseboard. The control unit is adjusted for minimum meter deflection, using the balance control.

Switch the function control to the centre position to extinguish the lamp, and remove the diffuser and probe. Place a sheet of printing paper on the baseboard and depress the function switch to "expose", releasing it once the relay has energised. The timer will now expose the print automatically for the correct time, and the print can be processed in the normal way.

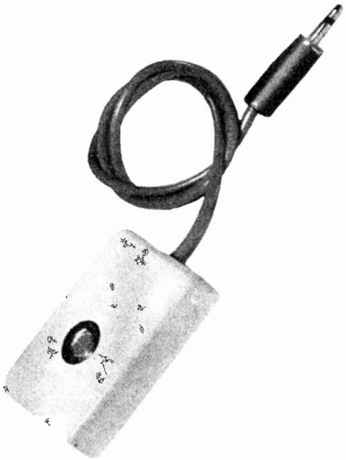
If prints come out consistently too light or too dark, the cause is probably that an unsuitable negative was used for the calibration print. The cure is to make a small adjustment to the paper speed setting; if the unit is wired in the same way as the prototype (see Fig. 5), an increase in the paper speed will produce an increased exposure.

PRINTING COLOUR

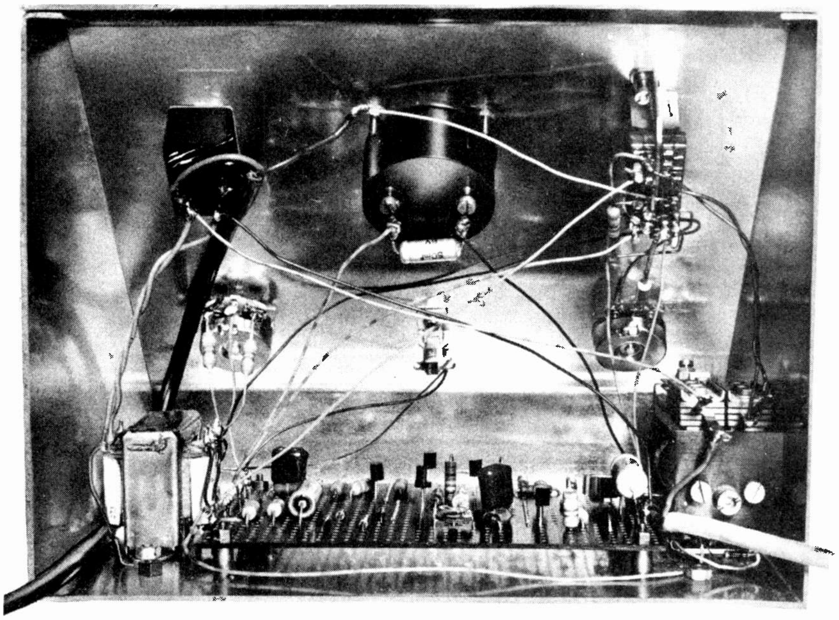
As with monochrome printing, the first step in colour work is to produce a good print by trial and error methods. The negative chosen for this print should conform to the requirements of the black and white negative; in addition, this one should have a full range of colours, with approximately equal areas of red, green and blue. In assessing colours, other hues can be broken into the three primaries, e.g. yellow can be considered as red plus green.

When the print has been made, the filter pack and exposure time are noted. The "basic pack", which is printed on each packet of paper, is subtracted from this.

The control unit is then set for measurement, and the negative is placed in the enlarger—as before, the enlarger controls are set exactly as for the calibration print. With the balance control set to zero, adjust the paper speed control for balance, with the diffuser plate and the red filter in the light beam. Note the reading obtained. With no other alterations to the setup, replace the red filter with the green, and rebalance using the balance control. Repeat for the blue filter.



The probe, as used in the prototype, showing how the l.d.r. is held in position by a rubber grommet



Rear view of the completed unit. Hole sizes for the meter and switches will vary as to the type used. Note that no fuse is shown

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230/240V a.c. 50/60 OUTPUT VARIABLE 0-260V
All Types
from ½ to 50 amp from stock.

SHROUDED TYPE

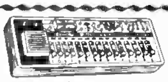
1 amp, £7·00	20 amp, £49·00
2·5 amp, £8·05	25 amp, £58·00
5 amp, £11·75	37·5 amp, £82·00
10 amp, £22·50	50 amp, £98·00
15 amp, £25·00	

(Panel Mounting) ½ amp, £4·75. 2·5 amp **OPEN TYPE**
1 amp, £7·00. 2½ amp, £8·05. All carriage paid.

L.T. TRANSFORMERS

All primaries 220–240V

Type No.	Sec. Taps	Price	Carr.
1	30, 32, 34, 36V at 5A	£4·68	45p
2	30, 40, 50V at 5A	£6·88	45p
3	10, 17, 18V at 10A	£4·95	45p
4	6, 12V at 20A	£6·43	45p
5	17, 18, 20V at 20A	£7·28	55p
6	6, 12, 20V at 20A	£6·88	55p
7	24V at 10A	£5·23	45p
8	4, 6, 24, 32V at 12A	£7·15	45p
9	6 and 12V at 10A	£3·75	45p



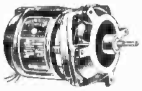
ELECTRONIC ORGAN KIT

Easy to build. Solid State. Two full octaves (less sharps and flats). Fitted hardwood case. Powered by two penlite 1½V batteries. Complete set of parts including speaker, etc., together with full instructions and 10 tunes. Price £3·00. P. & P. 22p.

50 in 1 ELECTRONIC PROJECT KIT
50 easy to build Projects. No soldering, no special tools required. The kit includes Speaker, Meter, Relay, Transformer, plus a host of other components and a 56-page instruction leaflet. Some examples of the 50 possible Projects are: Sound Level Meter, 2 Transistor Radio, Amplifier, etc. Price £7·75. P. & P. 30p.

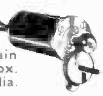
CRYSTAL RADIO KIT
Complete set of parts, including: Crystal Diode, Ferrite Aerial, Drilled Chassis, and Personal Ear Piece. No soldering, easy to build, full step by step instructions. £1·75 inc. post.

BODINE TYPE N.C.I. GEARED MOTOR



(Type 1) **71 r.p.m** Torque 10lb. inch. **Reversible.** 1/70th h.p., 50 cycle, 0·38 amp. **(Type 2) 28 r.p.m.** Torque 20lb. inch. **Reversible.** 1/80th h.p., 50 cycle, 0·28 amp. "As new" condition. Input voltage of motor 115V a.c. Supplied complete with transformer for **230/240V a.c. input.** Price, either type **£3·15** plus 35p. P. & P. or less transformer **£2·13** plus 27p P. & P.

12 VOLT D.C. MOTOR



Powerful 1 amp. REVERSIBLE motor. Speed 3,750 r.p.m. complete with external gear train (removable) giving final speed of approx. 125 r.p.m. Size: 4½in · 2½in dia. Price **95p** inc. post.

230V/240V COMPACT SYNCHRONOUS GEARED MOTORS

Manufactured by either Sangamo, Haydon or Smith. Built-in gearbox.

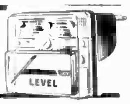
1 r.p.m. cw.	1 r.p.h. a/cw.	10 r.p.h. a/cw.
30 r.p.m. cw.	2 r.p.h. cw.	15 r.p.h. a/cw.
60 r.p.m. cw.	3 r.p.h. a/cw.	20 r.p.h. cw.
	6 r.p.h. cw.	30 r.p.h. cw.

cw. = clockwise rotation; a/cw. = Anticlockwise. Fraction of makers' price. All at **75p** incl. P. & P.

6-12V D.C. MINI-MOTOR

Small, powerful, precision made, smooth running, reversible motor. 7,000 r.p.m. Weight only 2oz. £1 incl. P. & P.

MINIATURE LEVEL METER



Approximately 300 micro amp basic, as fitted to Tape Recorders, etc. Strip type dual coloured dial. **50p + 8p P. & P.**

VENNER Electric Time Switch

200/250V Ex. GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 15A **£3·25**, 20A **£3·75**. P. & P. 20p. Also available with solar dial ON dusk OFF dawn. Price as above.

36V 30 AMP. A.C. OR D.C. VARIABLE L.T. SUPPLY UNIT

INPUT
220/240V a.c.
OUTPUT
CONTINUOUSLY VARIABLE 0–36V
Fully isolated. Fitted in robust metal case with Voltmeter, Ammeter Panel Indicator and handles. Input and output fully fused. Ideally suited for Lab. or Industrial use. £58 plus £2 P. & P.

STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.

EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions **£6·30**, plus 25p P. & P.

NEW INDUSTRIAL KIT
Ideally suitable for schools, laboratories, etc. Roller tin printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1-80 f.p.s. Price **£10·50**. P. & P. 50p.

HY-LYGHT STROBE MK III
This strobe has been designed and produced for use in large rooms, halls and the photographic field and utilises a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. Light output approx. 4 joules. **£12·00.** P. & P. 50p. **SPECIALLY DESIGNED, FULLY VENTILATED METAL CASE.** For industrial or Hy-Lyght. Including reflector. **£4·00** P. & P. 45p. Post paid with kit.

THE 'SUPER' HY-LYGHT KIT

Approx. four times the light output of our well proven Hy-Lyght strobe. Incorporating:
- Heavy duty power supply.
- Variable speed from 1-23 flash per sec.
- Reactor control circuit producing an intense white light.

Never before a Strobe Kit with so HIGH an output at so LOW a price. ONLY **£20** plus 75p P. & P. **ATTRACTIVE, ROBUST, FULLY VENTILATED METAL CASE** specially designed for the Super Hy-Lyght Kit including reflector **£7·00** P. & P. 45p.

7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price **53p**, P. & P. 13p or post paid with kits.

INSULATION TESTERS *NEW!*

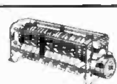
Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L.8in. W.4in. H.6in. weight 6lb. 1,000V, 1,000 megohms, **£34·00** carriage paid.

MOTOROLA MAC 11/6 PLASTIC TRIAC 400 PIV. 10 AMP
Now available **EX STOCK.** Supplied with full data and applications sheet. Price **£1·05.** P. & P. 7p. Suitable DIAC (RCA 40583) **30p** each.

G.E.C. 12 WAY 15 AMP CONNECTORS

NEW in makers carton. BAKELITE **£1·25** per doz. FLEXIBLE **£1·50** per doz. Post paid (Minimum 1 doz).

PROGRAMME TIMERS

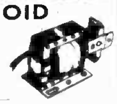


(Mfg. by Magnetic Devices Ltd.). 240v A.C. 5 r.p.m. 'Croouzet' motor. Drives 15 cams, each operating a 10 amp c/o micro switch. Cams are individually variable, allowing innumerable combinations. Ideally suited for machinery control, automation, etc. Also in the field of entertainment, for chaser lights, animated displays, etc. NEW PRICE **£5·75.** P. & P. 25p.

D.C. AMMETERS *NEW!*

1A, 5A, 15A, 20A, **£1·75**, incl. P. & P. 0–300V a.c. **£1·90**, incl. P. & P.

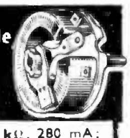
230V A.C. SOLENOID



Extremely powerful with approx. 14lb pull, 1in travel. Fitted with mounting feet. Size: 4in long, 2¾in wide, 3in high. **£2·00** incl. P. & P.

230-250 VOLT A.C. SOLENOID
Manufactured by Westool Ltd. (similar in appearance to above illustration). Approx. 1½lb pull. Feet size 1¾in · 1¼in. Price **85p** incl. P. & P.

Superior Quality Precision Made NEW POWER RHEOSTATS



100 WATT. 1 ohm, 10A; 5 ohm, 4·7A; 10 ohm, 3A; 25 ohm, 2A; 50 ohm, 1·4A; 100 ohm, 1A; 250 ohm, 0·7A; 500 ohm, 0·45A; 1 kΩ, 280 mA; 1·5 kΩ, 230mA; 2·5 kΩ, 2A; 5 kΩ, 140mA. Diameter 3½in Shaft length ⅜in, dia. ¼in. All at **£1·50** each. P. & P. 5p.
50 WATT. 1/5/10/25/50/100/250/500/1/1·5/2·5/5kΩ. **All at £1·12 each.** P. & P. 11p.
25 WATT. 10/25/50/100/250/500/1/1·5/2·5/3·5/5kΩ. **All at 78p each.** P. & P. 15p.

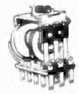
RELAYS SIEMENS, PLESSEY, Etc.

MINIATURE RELAYS · COMPETITIVE PRICES

Coil ohms	Working d.c. volts	Contracts	Price
45	6–9	2 HD M	50p
185	12–18	4 c/o	73p
280	9–12	2 c/o	73p*
700	16–24	4M 2B	63p*
700	16–24	4 c/o	78p*
700	12–24	2 c/o	63p*
700	15–35	2 c/o HD	73p*
700	16–24	6M	65p*
1,250	24–36	4 c/o	63p*
2,500	36–45	6M	63p*
2,400	30–48	4 c/o	50p
5,800	40–70	4 c/o	63p*
9,000	40–70	2 c/o	50p*
15k	85–110	6M	50p*

Col. (1) Coil ohms. Col. (2) Working d.c. volts. Col. (3) Contracts. Col. (4) Price. HD = Heavy duty. *Incl. Base. All post paid.

12 VOLT D.C. RELAY

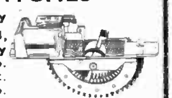


Three sets c/o contacts rated at 5 amps. **78p** including P. & P. (Similar to illustration below.)

'DIAMOND H' 230 VOLT A.C. RELAYS (Unused)
Three sets c/o contacts rated at 5 amps. PRICE: **50p.** P. & P. 10p. (100 lots £40 including P. & P.)

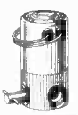
'KEY SWITCH' 230 VOLT A.C. RELAYS
One set c/o contacts rated at 7·5 amps. Boxed. PRICE: **40p.** P. & P. 5p. (100 lots **£32** including P. & P.)

UNISELECTOR SWITCHES



NEW **4 Bank 25 Way** 24V d.c. operation. **£5·88**, P. & P. 12p. **6 Bank 25 Way** 24V d.c. **£6·50**, P. & P. 12p. **8 Bank 25 Way,** 24V d.c. operation. **£7·62** plus 22p. P. & P.

230 VOLT A.C. SOLENOID OPERATED FLUID VALVE



Adjustable flow control, all metal construction. Will handle hot or cold liquids, water, oil, paraffin, etc. Available with ⅜in inlet/outlet or ⅛in inlet/outlet. Either type **£1·50.** P. & P. 20p.

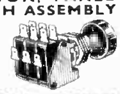
LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with adjustable lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP12 or similar cell. Both units are single hole fixing. Price per pair **£2·75.** P & P. **18p.**

LIGHT SENSITIVE SWITCHES

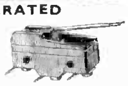
Kit includes ORP.12 Photocell, Relay Transistor Circuit. For 6 or 12V D.C. operation. **Price £1·50** plus 12p P. & P. **ORP. 12 and Circuit 63p post paid.**

"HONEYWELL" PUSH BUTTON, PANEL MOUNTING MICRO SWITCH ASSEMBLY



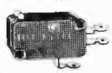
Each bank comprises a c/o rated at 10 amps 240V. A.C. Black knob 1in. Fixing hole ⅞in. ONE bank **30p**; TWO bank **40p**; THREE bank **55p**; incl. P. & P.

'HONEYWELL' LEVER OPERATED MICRO SWITCH



15 amps 250 volt A.C. c/o contacts. NEW in maker's carton. PRICE: 10 for **£1·90** including P. & P.

MICRO SWITCH



5 amp c/o contacts. Fitted with removable push button assembly. Ex. P.O. 20 for £1 inc. post. (Min. order 20).

All Mail Orders—Callers—Ample Parking
Dept. PE2, 57 BRIDGMAN ROAD LONDON W4 5BB
Phone 01-995 1560
Showroom open Mon.-Fri.

SERVICE TRADING CO.

Personal callers only. Open Sat.
9 LITTLE NEWPORT STREET LONDON WC2H 7JJ
Phone 01-437 0576

HENRY'S FOR LOW COST FIRST GRADE BRAND NEW BRANDED GERMANIUM and SILICON TRANSISTORS, DIODES, RECTIFIERS, TRIACS, FETS, ZENERS, BRIDGES and INTEGRATED CIRCUITS

BY ATES · EMIHUS · FAIRCHILD · FERRANTI · I.T.T. · MULLARD · NEWMARKET · PHILIPS · R.C.A. · TEXAS

TRANSISTORS

A SELECTION FROM OUR LIST

AAY30 10p
AAY42 15p
AAZ13 10p
AAZ15 10p
AAZ17 10p
AC107 35p
AC126 30p
AC127 25p
AC127Z 50p
AC128 20p
AC176 20p
AC187 25p
AC188 25p
ACY17 30p
ACY18 25p
ACY19 25p
ACY20 20p
ACY21 20p
ACY22 10p
ACY39 55p
ACY40 20p
ACY41 15p
ACY44 25p
AD140 50p
AD149 50p
AD161 35p
AD162 35p
AF114 25p
AF115 25p
AF116 25p
AF117 20p
AF118 60p
AF124 25p
AF125 20p
AF126 20p
AF127 20p
AF139 30p
AF180 50p
AF181 45p
AF185 50p
AF186 40p
AF239 40p
ASY26 25p
ASY27 30p
ASY28 25p
ASY29 30p
ASZ21 55p
BA100 15p
BA102 30p
BA110 25p
BA115 7p
BAX13 5p
BAX16 7p
BAY31 7p
BAY38 15p
BC107 10p
BC108 10p
BC109 10p
BC109C 12p
BC113 10p
BC114 20p
BC115 20p
BC116 20p
BC116A 25p
BC117 20p
BC118 20p
BC119 30p
BC134 20p
BC135 15p
BC136 20p
BC137 20p
BC138 20p
BC147 12p
BC148 10p
BC149 12p
BC153 20p
BC154 20p
BC167 15p
BC169 12p
BC169C 15p
BC177 20p
BC178 20p
BC179 20p
BC182L 10p
BC183L 10p
BC184L 12p
BC212L 12p
BC213L 12p
BC214L 15p
BCY30 35p
BCY31 40p
BCY32 60p
BCY33 30p
BCY34 35p
BCY38 45p
BCY39 £1·00
BCY40 50p
BCY70 15p
BCY71 20p
BCY72 15p

BD115 75p
BD123 35p
BD124 80p
BD131 75p
BD132 80p
BDY11 £1·50
BDY17 £1·50
BDY38 65p
BDY60 £1·00
BF115 25p
BF154 20p
BF158 15p
BF159 25p
BF180 35p
BF194 15p
BF195 15p
BF196 15p
BF197 15p
BFX13 25p
BFX29 25p
BFX30 25p
BFX84 25p
BFX85 30p
BFX86 25p
BFX87 25p
BFX88 20p
BFY18 25p
BFY50 20p
BFY51 20p
BFY52 20p
BFY53 15p
BFY90 65p
BSX20 15p
BSX21 20p
BSY27 15p
BST95A 12p
BSY95 12p
BU105 £2·25
BY100 15p
BY126 12p
BY124 15p
BY182 90p
BYZ10 35p
BYZ11 30p
BYZ12 30p
BYZ13 25p
BZY78 £1·00
GET102 35p
GET103 25p
GET111 45p
GET113 25p
GET114 20p
GET115 50p
GET116 55p
GET880 45p
GET882 30p
GEX66 £1·50
GM378A 55p
MAT101 25p
MAT121 25p
MC724P 60p
MJ420 80p
MJ421 80p
MJ2801 £1·10
MJ2901 £1·50
MJE340 50p
MJE370 20p
MJE371 80p
MJE520 75p
MJE521 70p
MJE2955 £1·10
MJE3055 75p
MPSA06 25p
MPSA56 20p
MPSA70 15p
MPSU06 50p
MPSU56 55p
NKT214 20p
NKT216 35p
NKT403 75p
NKT404 55p
OA5 25p
OA10 25p
OA47 10p
OA70 10p
OA79 10p
OA81 8p
OA90 8p
OA91 7p
OA95 7p
OA200 7p
OA202 10p

OC16 50p
OC20 35p
OC22 50p
OC23 60p
OC24 60p
OC25 40p
OC26 25p
OC28 60p
OC29 60p
OC35 50p
OC36 60p
OC42 40p
OC43 50p
OC44 15p
OC45 12p
OC70 12p
OC71 12p
OC72 20p
OC75 25p
OC76 25p
OC77 40p
OC81 20p
OC81D 20p
OC81Z 40p
OC83 25p
OC84 25p
OC139 25p
OC140 40p
OC141 60p
OC170 25p
OC171 30p
OC200 40p
OC201 75p
OC202 80p
OC206 95p
OCP71 97p
ORP12 50p
ORP60 40p
ST140 15p
ST141 20p
TIP29A 50p
TIP30A 60p
TIP31A 60p
TIP32A 70p
TIP33A £1·00
TIP34A £1·50
TI843 40p
TI850 12p
TI851 10p
TI852 10p
TI860 18p
TI861 20p
TI862 25p
V405A 25p
VR525 35p
WO1 30p
WO6 45p
ZTX107 15p
ZTX108 12p
ZTX109 15p
ZTX300 12p
ZTX301 15p
ZTX302 20p
ZTX303 20p
ZTX304 25p
ZTX500 15p
ZTX501 15p
ZTX502 20p
ZTX503 17p
ZTX504 40p
ZTX531 26p
IN914 7p
IN916 10p
1N4148 7p
IS44 7p
IS921 7p
IS922 8p
2G301 25p
2G302 30p
2G303 35p
2N404 20p
2N696 15p
2N697 15p
2N698 30p
2N706 10p
2N706A 12p
2N708 15p
2N930 20p
2N987 40p
2N1131 25p
2N1132 25p
2N1302 18p

2N1303 18p
2N1304 22p
2N1305 22p
2N1306 25p
2N1307 25p
2N1308 25p
2N1309 25p
2N1613 20p
2N2147 75p
2N2160 60p
2N2217 25p
2N2218 20p
2N2218A 25p
2N2219 20p
2N2219A 25p
2N2220 25p
2N2221 20p
2N2221A 25p
2N2222 20p
2N2222A 25p
2N2369 15p
2N2369A 15p
2N2646 40p
2N2904 20p
2N2904A 25p
2N2905 25p
2N2905A 25p
2N2906 20p
2N2906A 25p
2N2907 23p
2N2907A 25p
2N2925 15p
2N2926 10p
2N3011 20p
2N3053 20p
2N3054 50p
2N3055 75p
2N3525 £1·00
2N3614 55p
2N3702 10p
2N3703 10p
2N3704 12p
2N3705 10p
2N3707 12p
2N3708 10p
2N3714 £2·00
2N3715 £2·20
2N3716 £2·85
2N3771 £2·00
2N3772 £2·05
2N3773 £2·85
2N3791 £2·75
2N3819 35p
2N3820 55p
2N3823 50p
2N3824 95p
2N3903 20p
2N3906 25p
2N4058 12p
2N4061 12p
2N4062 12p
2N4289 12p
2N4290 12p
2N4871 35p
2N5457 30p
2N5458 35p
2N5459 40p
40250 50p
40360 40p
40361 40p
40362 50p
40430 £1·00
40543 65p
40594 £1·05
40595 £1·05
40636 £1·10

Full transistor list available— send for your free copy today!

HENRY'S LOW COST INTEGRATED CIRCUITS

BRAND NEW FULL SPECIFICATION TTL74 SERIES BRANDED FAIRCHILD, I.T.T. AND TEXAS

DEVICES MAY BE MIXED TO QUALIFY FOR QUANTITY PRICING

No.	Description	1-11	12-24	25-99	100+	250+
7400	Quadruple 2-input NAND gates	20p	18p	16p	14p	12p
7401	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7402	Quad 2-input NOR gates	20p	18p	16p	14p	12p
7403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
7404	Hextuple inverters	20p	18p	16p	14p	12p
7405	Hex inverters with open collector outputs	20p	18p	16p	14p	12p
7410	Triple 3-input NAND gates	20p	18p	16p	14p	12p
7413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
7420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
7430	Single 8-input NAND gates	20p	18p	16p	14p	12p
7440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
7441	BCD-Decimal decoder/Nixie driver	75p	72p	70p	60p	55p
7442	BCD-Decimal decoder (4-10-line) TTL O/P	75p	72p	70p	60p	55p
7443	Excess 3-Decimal decoder TTL outputs	£1·00	95p	90p	80p	70p
7447	BCD-Decimal 7 seg. decoder/indicator driver	£1·75	£1·60	£1·45	£1·30	£1·15
7448	BCD-Decimal 7 seg. decoder/driver TTL O/P	£1·75	£1·60	£1·45	£1·30	£1·15
7450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7453	Quad 2-input expand AND-OR-INVERT gates	20p	18p	16p	14p	12p
7454	4-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
7460	Dual 4-input expanders	20p	18p	16p	14p	12p
7470	Single J-K flip-flop (gated inputs)	30p	27p	25p	22p	20p
7472	Single J-K flip flop (gated inputs)	30p	27p	25p	22p	20p
7473	Dual J-K flip flop	40p	37p	35p	33p	30p
7474	Dual D flip flop	40p	37p	35p	33p	30p
7475	Quadruple bistable latch	45p	42p	40p	38p	35p
7476	Dual J-K flip-flops with Preset and Clear	40p	37p	34p	31p	28p
7480	Gated Full Adder	80p	75p	67p	59p	55p
7481	16-bit read/write memory	£1·25	£1·15	£1·10	£1·00	90p
7482	2-bit binary Full Adder	87p	80p	70p	65p	60p
7483	4-bit binary Full Adder	£1·00	90p	85p	80p	73p
7484	16-bit RAN with gated write inputs	90p	85p	80p	75p	71p
7486	Quadruple 2-input Exclusive OR gates	45p	41p	38p	35p	33p
7490	BCD decade counter	75p	70p	65p	60p	55p
7491	8-bit shift register	£1·00	95p	90p	80p	70p
7492	Divide twelve counter	75p	70p	65p	60p	55p
7493	4-bit binary counter	75p	70p	65p	60p	55p
7494	Dual entry 4-bit shift register	80p	75p	70p	65p	60p
7495	4-bit up-down shift register	80p	75p	70p	65p	60p
7496	5-bit parallel/serial in/out shift register	£1·00	97p	95p	90p	83p
74100	8-bit bistable latch	£2·50	£2·30	£2·00	£1·75	£1·50
74118	Hextuple Set-Reset latches	£1·00	95p	90p	80p	70p
74121	Monostable multivibrators	60p	55p	50p	46p	41p
74141	BCD-Decimal decoder/Nixie driver	£1·00	95p	90p	80p	70p
74145	BCD-Decimal decoder (1-4-line) TTL O/P	£1·50	£1·40	£1·30	£1·10	£1·00
74150	16-bit data selector/multiplexer	£3·35	£3·20	£2·95	£2·15	£2·05
75151	8-bit data selector/multiplexer	£1·10	95p	90p	80p	70p
74153	Dual 4-line to 1-line data selector multiplexer	£1·35	£1·27	£1·20	£1·15	£1·10
74154	16-bit decoder/demultiplexer	£2·00	£1·75	£1·55	£1·30	£1·05
74155	Dual 2-line to 4-line decoder/demultiplexer	£1·55	£1·47	£1·35	£1·10	£1·05
74156	Dual 2-line to 4-line decoder/demultiplexer	£1·55	£1·47	£1·35	£1·10	£1·05
74190	Sync decade up-down counter, 1-line mode	£1·95	£1·85	£1·75	£1·60	£1·50
74191	Sync 4-bit up-down counter, 1-line mode	£1·95	£1·85	£1·75	£1·60	£1·50
74192	Sync decade up-down counter, 2-line mode	£2·00	£1·90	£1·80	£1·65	£1·55
74193	Sync 4-bit up-down counter, 2-line mode	£2·00	£1·90	£1·80	£1·60	£1·40
74196	Asynchronous presettable decade counter	£1·50	£1·40	£1·30	£1·10	£1·00
74197	Asynchronous presettable 4-bit binary counter	£1·50	£1·40	£1·30	£1·10	£1·00

Texas I.C. Handbook. Complete information on 100 types. 40p. Post 10p.

Complete data on the above in booklet 20 pages. Ref. 29, issue 2 at 15p post paid.

Integrated circuit sockets 14 pin D.I.L. 25p; 16 pin D.I.L. 30p.

QUANTITY OFFERS ! FROM STOCK

AF117 Mullard **20p**
25 + 17p
100 + 15p
500 + 12p
1000 + 10p

2N2646 Motorola **40p**
25 + 35p
100 + 32p
500 + 28p
1000 + 25p

OC170 Mullard **25p**
25 + 20p
100 + 18p
500 + 15p
1000 + 13p

BY127 Mullard **15p**
25 + 12p
100 + 10p
500 + 9p
1000 + 8p

OC35 Mullard **50p**
25 + 45p
100 + 40p
500 + 35p
1000 + 30p

2N2926 Green **10p**
25 + 9p
100 + 8p
500 + 6p
1000 + 5p

BC107 All Makes **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

2N3055 Fairchild **75p**
25 + 65p
100 + 50p
500 + 40p
1000 + 35p

BYZ13 Mullard **25p**
25 + 20p
100 + 17p
500 + 15p
1000 + 12p

OA202 **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

OC28 Mullard **60p**
25 + 55p
100 + 50p
500 + 45p
1000 + 40p

2N3819 Texas **35p**
25 + 30p
100 + 25p
500 + 20p
1000 + 17p

BC108 and 9 All Makes **10p**
25 + 8p
100 + 7p
500 + 6p
1000 + 5p

AD161 AD162 35p each
25 + 32p
100 + 28p
500 + 25p
1000 + 22p

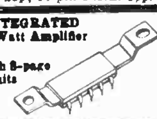
INTEGRATED CIRCUITS

Type	Price
MFC4000P	55p
MFC4010P	60p
IC12	£2·50
PA246	£1·50
TAD100	£1·50
TAD110	£1·50
MC724P	50p
702C (TO5)	75p
709C (TO5)	45p
709C (D.I.L.)	45p
723C(TO5)	£1·00
741C(TO5)	80p
MC1303P	£2·00
MC1304P	£2·25
SL403D	£1·50
741C(DIL)	75p
914(TO5)	40p
923(TO5)	40p
TOSHIBA 20 watt amp.	£4·47
TOSHIBA Pre amp	£1·50

PLESSEY INTEGRATED CIRCUIT 3 Watt Amplifier SL403D

Complete with 8-page booklet, circuits and data

£1·50 ea.



ZENER DIODES

	1-24	25+	100+	500+	1000+
400m/w BZY 88 series*	12p	10p	8p	7p	6p
1½ watt ZL series	25p	22p	20p	17p	15p
3 watt STZ series	30p	27p	25p	22p	20p
10 watt ZS series	+40p	37p	35p	30p	25p

All types are 5%. Wire Ended + these Stud. in voltages 3·3-100 volt in all standard values. *3·3-33 volt.

TRIACS

Stud with accessories

Type	P.I. volts	Current	1-11
SC35A	100	3 amps	80p
SC35B	200	3 amps	85p
SC35D	400	3 amps	90p
SC40A	100	6 amps	90p
SC40B	200	6 amps	£1·05
SC40D	400	6 amps	£1·00
SC45A	100	10 amps	£1·05
SC45B	200	10 amps	£1·15
SC45D	400	10 amps	£1·25
SC50A	100	15 amps	£1·35
SC50B	200	15 amps	£1·45
SC50D	400	15 amps	£1·75
SC40E	500	6 amps	£1·25
SC46E	500	10 amps	£1·45
SC50E	500	15 amps	£1·95
DIAC SD2			25p

SILICON RECTIFIERS

1 AMP MINIATURE PLASTIC WIRE ENDED

Type	P.I.V.	1-49	50+	100+	500+	1000+
IN4001	50	6p	5p	4½p	4p	3½p
IN4002	100	7p	6p	5p	4½p	4p
IN4003	200	8p	7p	6p	5p	4½p
IN4004	400	8p	7p	6p	5p	4½p
IN4005	600	10p	9p	8p	7p	6p
IN4006	800	12p	10p	9p	8p	7p
IN4007	1000	15p	12p	10p	9p	8p

BRIDGE RECTIFIERS

Miniature Potted Silicon ½" × ½" × ⅛"

Type	P.I.V.	Current	1-12	Type	P.I.V.	Current	1-11
1002	100	2a	55p	4004	400	4a	75p
2002	200	2a	65p	6004	600	4a	60p
4002	400	2a	75p	1006	100	6a	70p
6002	600	2a	80p	2006	200	6a	75p
1004	100	4a	65p	4006	400	6a	£1·00
2004	200	4a	70p	6006	600	6a	£1·10

OUR RANGE IS ALWAYS EXPANDING — Enquiries invited for new types arriving daily

ADDITIONAL DISCOUNTS —10% 12+ : 15% 25+ : 20% 100+ —DELIVERY IS FROM STOCK

HENRY'S RADIO LTD. SEMI-CONDUCTOR DEPARTMENT
303 EDGWARE RD., LONDON, W2 TEL 01-723 1008/9
CALLERS 356 EDGWARE ROAD W2.

NEW LIST NEW PRICES 1971 TRANSISTOR LIST 15OO SEND FOR YOUR FREE COPY TODAY

DISCOUNTS 10% 12+ 15% 25 20% 100 } ANY ONE TYPE
POSTAGE 7p ALL ORDERS

We respectfully ask customers to include a minimum £1.00 per order, it helps to plan ahead & saves postage as well.

All of these measurements are made without the correction filters in place, i.e. those filters which are used when actually making the final print. Note the readings obtained on the balance control.

The aim is now to compare the readings for any other negative with the "standard" readings.

COMPARISON WITH STANDARD

Place the unknown negative in the enlarger. The paper speed is set as for the standard, and the balance control to zero. As before, no correction filters are used at this stage. With the diffuser and red filter in the light beam, the aperture of the enlarger lens is adjusted to obtain minimum deflection on the meter.

If a balance cannot be obtained, the degree of enlargement can be adjusted to make this possible. Replacing the red filter with the green, the balance control is adjusted to restore balance, and the process is repeated with the blue filter. The readings so obtained are compared with those for the standard negative.

The object is to produce the same figures as for the standard. If different readings are obtained, correction filters of yellow, magento or cyan are added, and the measurements on the unknown negative are repeated. For example, if the unknown negative gives a lower reading with the green filter compared to the standard, magenta filters are added to compensate for the difference.

Whenever the filter pack is altered, the measurement process must be repeated from scratch, starting with the balance control at zero, and balancing the bridge with the enlarger lens with the red filter in place. When the readings are identical with those obtained from the standard negative, the correction filter pack is noted. This is added to the "basic filters" for the batch of paper in use, and the filter pack required by the standard negative.

Any neutral density is subtracted from the result. The filter pack resulting from this sum is the correct one for printing the unknown negative.

The calibration for exposure is the same as for monochrome printing. The exposure time for the standard negative is set up on the control unit by adjustment to the balance control. With the filter pack used for the standard print in place, and the diffuser under the lens, adjust the paper speed control for balance.

With the unknown negative in the enlarger, and the previously determined filter pack in place, set the paper speed control to the position just found. With the diffuser plate and probe in the light beam, balance the bridge with the balance control. Remove the diffuser and probe, place a sheet of paper on the baseboard, and depress the function switch to expose the print.

A NUMERICAL EXAMPLE

Although the process may seem complicated, a numerical example may help in following it. When a few negatives have been analysed, the procedure becomes simpler.

The standard negative gives the following readings:

Red filter 0	Green filter 5·6
Blue filter 7·2	Paper speed control setting 3·7

This negative gave a successful print using a filter pack of 00 30 40 (this referring to yellow-magenta-cyan in that order), on paper with basic filters of 00 20 20.

To obtain the correct time exposure with the control unit, the paper speed setting was 5·8.

Filter pack for standard print	00 30 40
Subtract basic filter pack	00 20 20
Standard filter pack	00 10 20

Set paper speed to 3·7

The unknown negative to be printed initially gave readings of:

Red filter 0 Green filter 4·7 Blue filter 6·8

To correct the low green reading, add magenta filters.

To correct the low blue reading, add yellow filters.

With a filter pack of 00 30 10 in place, the readings obtained were identical with those of the standard negative. The print is to be made on paper having a basic filter pack 20 00 30.

The calculation is then made:

Standard filter pack	00 10 20
Correction filters	00 30 10
Basic filter pack of paper	20 00 30
New filter pack	20 40 60
Subtract neutral density	20 20 20
Filter pack required for print	00 20 40

With this filter pack in place, and the paper speed control set to 5·8, the balance control is adjusted for minimum meter deflection, and the print made as normal.

When a few negatives have been treated in this way, the experience gained will make the task considerably easier for future work. It is easy to become discouraged initially, but persistence in the first few attempts will later result in considerable savings in time and materials.

L.D.R. STABILISATION

When working at low light levels, the light dependent resistor will take a short time to adjust its resistance. For this reason, whenever exposures of 30 seconds or more are needed, the cell should be given a few seconds to stabilise before readings are taken. This effect is particularly noticeable when colour negatives are being analysed.

When readings are taken through the green and blue filters, the lower sensitivity of the l.d.r. to these colours may necessitate a delay of a minute or so before the cell reaches its final resistance.

A further point to be considered when very low light levels are being measured is the position of the darkroom safelight. If the safelight is too close to the enlarger, the l.d.r. may be affected, producing incorrect readings. This effect is not too important in colour measurements, when the red, green and blue filters will reduce the cell sensitivity, but monochrome measurements may be affected. ★

Tape Noise Limiter

ALTHOUGH vast improvements in the quality of cassette recorders has taken place since their introduction in 1963, one key problem has remained, that of tape noise, increasingly apparent at decreasing tape speeds. The Dutch laboratories of Philips have now developed a circuit, which can either be a separate unit or built into new recorders, which provides hiss free replay of musical signals. They designed the circuit to be effective only during replay so that all users of cassette recorders could benefit. The system, known as the Dynamic Noise Limiter (DNL), can also be used with other sound sources such as record players or tape recorders.

CRITERIA OF DESIGN

When music is played softly it consists almost entirely of pure tones in the low and middle frequency ranges with hardly any harmonics. It is during these soft passages that tape hiss is particularly noticeable. When instruments are played loudly many harmonics are produced which mask tape hiss.

Thus the problem the designers faced was that of producing a low-pass filter which would only come into operation during passages with low amplitude, high frequency signals, i.e. when hiss is most apparent.

CIRCUIT OF THE DNL

The DNL acts as a steep low pass filter tripped by high frequency signals in such a way that high frequency signals above a certain level will bypass the filter action. The circuit diagram of the final unit is shown below.

The first stage, formed by TR1 and associated components, is a phase-splitter producing two identical signals in antiphase containing all the elements of the music as well as tape hiss. One signal goes through an audio pass filter formed by C2 and R5 and is fed to the output via VR1.

The other signal is fed to an active high pass filter formed by TR2 and associated components. This only allows frequencies above 4 kHz to pass on to the next stage which is simply an amplifier formed by TR3 and TR4. The gain of this stage is limited by diodes D1 and D2. The amplified high frequency signal is then fed to a signal dependent attenuator formed by D3 to D6 and C8 and C9.

The overall effect is that when high amplitude, high frequency signals are present large attenuation takes place, whilst low amplitude signals are hardly affected.

The "processed" and "unprocessed" signals are then combined at the junction of C10 and C11. Because they are in antiphase the "processed" signal is in fact subtracted from the "unprocessed". Thus tape hiss is amplified and subtracted from the original signal, whilst high amplitude, high frequency signals are attenuated by the processor so subtraction leaves the original virtually unaltered.

PERFORMANCE

The designers claim that the result is a more pure clean sound with all the noise in the soft passages suppressed. The louder passages retain all their brilliance and character. Unweighted measurements show that the DNL provides a signal to noise ratio improvement of more than 10dB at 6kHz and 20dB at 10kHz.

The Philips DNL will be available as an accessory suitable for all existing cassette recorders. In late 1972 there will also be available a stereo cassette recorder and deck with a switchable DNL facility built-in as part of the unit. ★

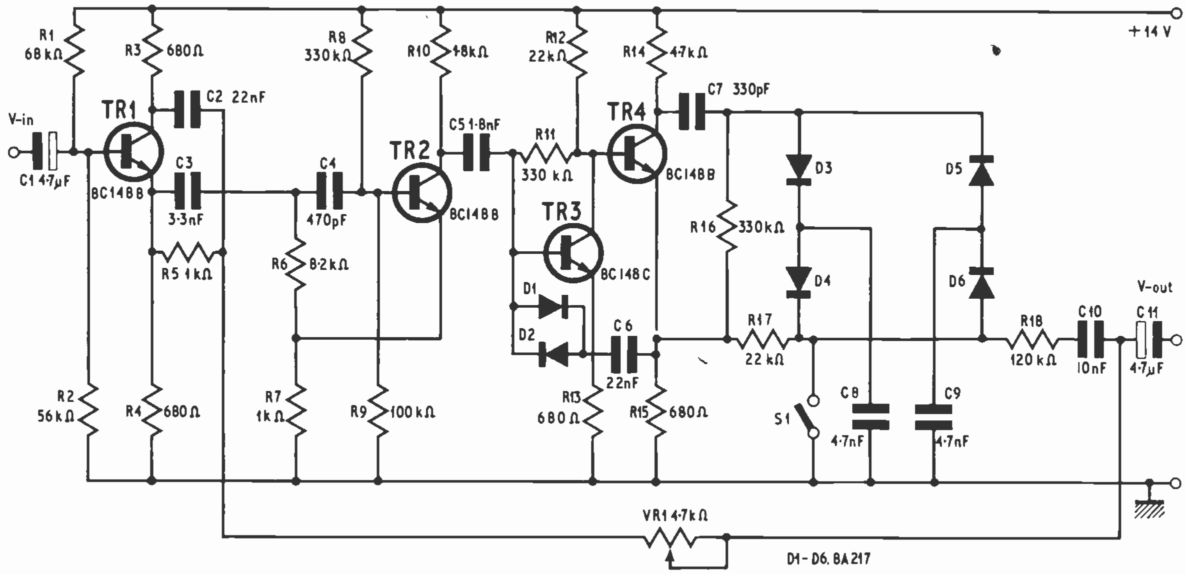
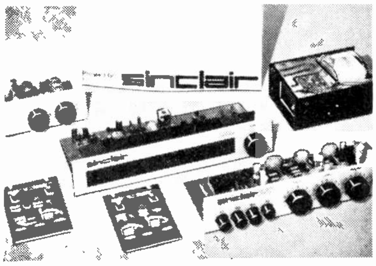
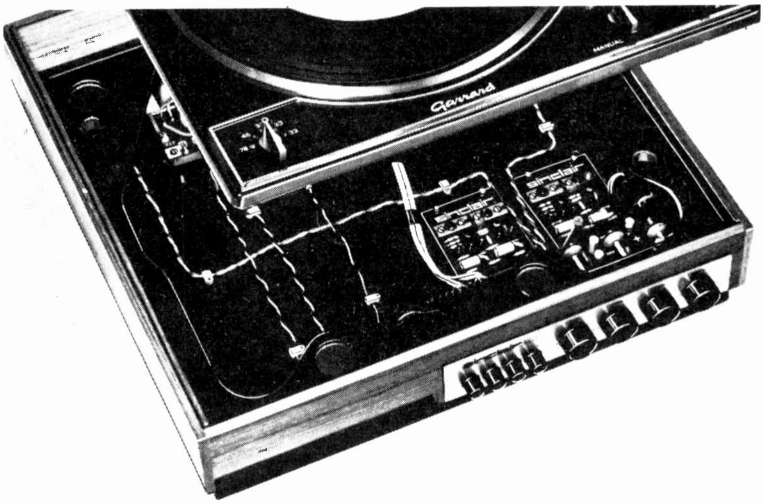


Fig. 1. Circuit diagram of the Philips dynamic noise limiter

Sinclair Project 60

The World's leading range of high fidelity modules





New!

Project 605

The easy way to buy and build Project 60

Project 605 is one pack containing, one PZ5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

Complete Project 605 pack with comprehensive manual, post free **£29.95**

All you need for a superb 30 watt high fidelity stereo amplifier.

Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.

Performance characteristics are so good they hold their own with any other available system irrespective of price or size.

Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	**Z.30**	Crystal P.U., 12V battery volume control	**£4.48**
Mains powered record player	**Z.30, PZ.5**	Crystal or ceramic P.U. volume control etc.	**£9.45**
20+20 W. stereo amplifier for most needs	**2 x Z.30s, Stereo 60, PZ.5**	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	**£23.90**
20+20 W. stereo amplifier with high performance spkrs.	**2 x Z.30s, Stereo 60, PZ.6**	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc	**£26.90**
40+40 W. R.M.S. de-luxe stereo amplifier	**2 x Z.50s, Stereo 60 PZ.8, mains trsfrmr**	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. Filter Unit **(£5.98)** may be added as required.

Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire PE17 4HJ.
Tel: St. Ives (048 06) 4311

sinclair

Sinclair Q16/Micromatic

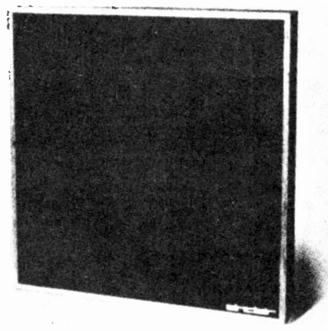
Q16 High fidelity loudspeaker

The Q16 employs the well proven acoustic principles specially developed by Sinclair in which a special driver assembly is meticulously matched to the characteristics of the uniquely designed cabinet. In reviewing this exclusive Sinclair design, technical journals have justly compared the Q16 with much more expensive loudspeakers. Its shape enables the Q16 to be positioned and matched to its environment to much better effect than is the case with conventionally styled enclosures. A solid teak surround with a special all-over cellular foam front is used as much for appearance as its ability to pass all audio frequencies without loss.

This elegantly designed shelf mounting speaker brings genuine high fidelity within reach of every music lover.

Specifications:

Construction: Special sealed seamless sound or pressure chamber with internal baffle.
Loading: up to 14 watts RMS.
Input Impedance: 8 ohms.
Frequency response: From 60 to 16,000 Hz. confirmed by independently plotted B and K curve.
Driver unit: Special high compliance unit having massive ceramic magnet of 11,000 gauss, aluminium speech coil and special cone suspension for excellent transient response.
Size and styling: 9¾ in. square on face x 4¾ in. deep with neat pedestal base. Black all over cellular foam front with natural solid teak surround.
Price £8.98.



Britain's smallest radio

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

Specifications:

Size: 36 x 33 x 13 mm (1.8 x 1.3 x 0.5 in.)
Weight: including batteries, 28.4 gm (1 oz.)
Case: Black plastic with anodised aluminium front panel and spun aluminium dial.
Tuning: medium wave band with bandspread at higher frequencies (550 to 1,600 KHz).
Earpiece: Magnetic type.
On/off switching: By inserting and withdrawing earpiece plug.
Kit in pack with earpiece, case, instructions and solder **£2.48.**
Ready built, tested and guaranteed, with earpiece **£2.98.**
Two Mallory Mercury batteries type RM675 required from radio shops, chemists, etc.

To: SINCLAIR RADIONICS LTD LONDON ROAD ST. IVES HUNTINGDONSHIRE PE17 4HJ

Please send ______________________

____

____

for which I enclose cash/cheque/money order

Name ______________________

Address ______________________

____

P.E. 2/72

Sinclair Radionics Ltd., London Rd, St. Ives
Huntingdonshire PE17 4HJ.
Telephone St. Ives (048 06) 4311

sinclair

AT HOME SOLDERING?

Our miniature irons are used all over the world in that most exacting market—the modern electronics industry, the rapidly developing technology of which has made possible the enormous growth of activities available to the technical hobbyist.

He now also requires equipment to the highest commercial standards. Like our soldering irons, for example.

Look at the ADAMIN Model 15. If there is a smaller iron for mains use, we haven't seen it. It weighs a mere $\frac{1}{2}$oz (less flex) and is about 7 inches long.

But it has a big performance. Used with interchangeable bits from $\frac{3}{64}$in to $\frac{3}{16}$in it is suitable for all work, from Hearing Aids to Colour Television.

Use the mains version at home or clip the 12 volt model to the car battery or 12 volt power unit (consumption only 1·25A).

Send for HOBBY PACK 37 consisting of Model 15 iron with four bits, $\frac{3}{64}$in, $\frac{3}{32}$in, $\frac{1}{8}$in, $\frac{3}{16}$in and tube of Bit Lubricant. State voltage required—12V or 220/240V.

PRICE: HOBBY PACK £2·30
P. & P. FREE

LIGHT SOLDERING DEVELOPMENTS LTD.

28 Sydenham Road, Croydon CR9 2LL
Telephone 01-688 8589 and 4559

MARSHALL'S INTEGRATED CIRCUITS

NEW LOW PRICES LARGEST RANGE
BRAND NEW FULLY GUARANTEED

MOTOROLA

We can now offer a vast range of Motorola IC's at industrial distributor prices.

Examples	£p	Data Sheets
MC724P	0·66	
MC790P	1·24	£0·12½
MC1303L	2·70	extra

FAIRCHILD (RTL)

	1–5	6–11	12+
L900	40p	37p	35p
L914	40p	37p	35p
L923	40p	37p	35p

Data sheet 12½p

LINEAR

Op. Amps.		1–11 £p	12–24 £p	25–99 £p
L702A	TO5	2·80	2·70	2·60
L702C	TO5	0·77	0·72	0·67
L703C	TO5	0·62	0.57	0·52
L709A	TO5	1·25	1·20	1·15
L709C	TO5	0·47	0·42	0·37
L709C	DIL	0·45	0·40	0·35
L710C	TO5	0·47	0·42	0·37
L710C	DIL	0·45	0·40	0·35
L711C	TO5	0·49	0·44	0·39
L711C	DIL	0·45	0·40	0·35
L716	TO5	1·87	1·75	1·70
L723C	TO5	0·90	0·85	0·80
L741C	TO5	0·80	0·75	0·65
L741C	DIL	0·70	0.65	0·60
LM741CN	DIL	0·70	0·65	0·60
SN72709P	DIL	0·45	0·40	0·35

MULLARD TTL

	£p
FJH101	0·87½
FJH121	0·87½
FJH141	0·87½
FJH161	0·87½
FJH171	0·91
FJH221	0·87½
FJJ101	1·87½
FJJ121	1·87½
FJJ141	3·12½
FJJ191	1·87½
FJJ251	3·12½
FJK101	2·25
FJY101	0·80

MULLARD DTL

	£p
FCH101	0·87½
FCH121	1·05
FCH201	1·32½
FCH231	1·50
FCJ101	1·62½
FCJ111	1·55
FCJ201	1·80
FCJ211	2·75
FCK101	4·37½
FCY101	1·05

GENERAL ELECTRIC

	£p
PA222	2·70
PA230	1·31
PA234	0·88
PA237	1·11
PA239	2·21
PA246	1·54
PA264	1·76
PA265	1·93
PA424	1·99
PA436	1·76
PA494	2·10

PLESSEY

	£p
SL403D	1·50
SL611C	1·70
SL621C	2·60
SL701C	1·45
SL702C	1·25

DATA SHEETS 17½p

TOSHIBA

	£p
TH9013P 20 WATT AMP	£4·57
TH9014P PRE-AMP	£1·50

DATA SHEETS £0·12½

MULLARD LINEAR

	£p
TAA241	1·30
242	4·00
263	0·70
293	0·80
300	2·00
310	1·30
320	0·65
350	2·10
435	0·73
521	0·57
522	1·13
530	4·95
570	2·60
811	4·45
TAB101	0·97½
TAD100	1·97½
TAD110	1·97½

SGS

TAA661B £1·32 TAA700 £3·50

TAA621 £2·03 TBA651 £1·69

All TTL IC's may be mixed to qualify for quantity discounts.

8 Pin TO-5 I.C. Holders, £0·20
10 Pin TO-5 I.C. Holders, £0·25
12 Pin TO-5 I.C. Holders, £0·40
8 Pin Dual-in-Line I.C. Holders £0·20
14 Pin Dual-in-Line I.C. Holders, £0·20
16 Pin Dual-in-Line I.C. Holders, £0·25

TTL LOGICS

	1–11 £p	12–24 £p		1–11 £p	12–24 £p
SN7400	0·20	0·18	SN7403	0·20	0·18
SN7401	0·20	0·18	SN7404	0·20	0·18
SN7402	0·20	0·18	SN7405	0·20	0·18

	1–11 £p	12–24 £p		1–11 £p	12–24 £p
SN7406	0·80	0·75	SN7493	0·87	0·84
SN7407	0·20	0·18	SN7494	0·87	0·84
SN7408	0·20	0·18	SN7495	0·87	0·84
SN7409	0·20	0·18	SN7496	0·87	0·84
SN7410	0·20	0·18	SN7497	6·40	6·00
SN7411	0·23	0·21	SN74100	1·65	1·58
SN7412	0·48	0·46	SN74104	1·52	1·40
SN7413	0·40	0·38	SN74105	1·52	1·40
SN7416	0·84	0·78	SN74107	0·52	0·49
SN7417	0·84	0·78	SN74110	0·80	0·75
SN7420	0·20	0·18	SN74111	1·57	1·45
SN7423	0·51	0·47	SN74118	1·30	1·25
SN7425	0·48	0·45	SN74119	1·92	1·80
SN7427	0·48	0·45	SN74121	0·50	0·47
SN7428	0·80	0·75	SN74122	1·44	1·35
SN7430	0·23	0·15	SN74123	2·85	2·70
SN7432	0·48	0·42	SN74145	1·80	1·75
SN7433	0·80	0·75	SN74150	3·52	3·40
SN7437	0·64	0·60	SN74151	1·40	1·35
SN7438	0·64	0·60	SN74153	1·40	1·35
SN7440	0·23	0·21	SN74154	2·20	2·10
SN7441AN	0·87	0·83	SN74155	1·68	1·60
SN7442	0·85	0·81	SN74156	1·68	1·60
SN7443	2·86	2·70	SN74157	1·92	1·82
SN7444	2·86	2·70	SN74160	1·80	1·75
SN7445	2·50	2·40	SN74161	2·60	2·55
SN7446	1·00	0·95	SN74162	4·26	4·10
SN7447	1·00	0·95	SN74163	4·26	4·10
SN7448	1·00	0·95	SN74164	2·20	2·10
SN7449	1·00	0·95	SN74165	2·25	2·15
SN7450	0·20	0·18	SN74166	4·45	4·20
SN7451	0·20	0·18	SN74167	6·40	6·10
SN7453	0·20	0·18	SN74170	4·38	4·18
SN7454	0·20	0·18	SN74174	2·40	2·30
SN7460	0·20	0·18	SN74175	1·68	1·60
SN7470	0·40	0·38	SN74176	2·64	2·55
SN7472	0·32	0·30	SN74177	2·64	2·55
SN7473	0·43	0·41	SN74180	2·13	2·05
SN7474	0·43	0·41	SN74181	9·33	9·00
SN7475	0·45	0·44	SN74182	2·03	1·95
SN7476	0·45	0·44	SN74184	4·80	4·60
SN7480	0·70	0·65	SN74185	4·80	4·60
SN7481	1·40	1·38	SN74190	1·80	1·70
SN7482	0·87	0·82	SN74191	1·80	1·70
SN7483	0·87	0·82	SN74192	1·75	1·65
SN7484	2·00	1·85	SN74193	1·75	1·65
SN7485	3·62	3·40	SN74194	2·67	2·55
SN7486	0·33	0·30	SN74195	2·25	2·10
SN7490	0·87	0·84	SN74196	2·64	2·55
SN7491AN	1·21	1·10	SN74198	5·95	5·65
SN7492	0·87	0·84	SN74199	5·95	5·65

SGS EA 1000

3 watt Audio Amplifier Module £2·63
Data Sheets 10p each

RCA

Type	1-24 £p	25-99 £p	Type	1-24 £p	25-99 £p
CA3000	1·80	1·60	CA3033A	4·26	3·80
CA3000V1	1·80	1·60	CA3035	1·23	1·10
CA3001	2·69	2·40	CA3035V1	1·23	1·10
CA3001V1	2·69	2·40	CA3036	0·73	0·65
CA3002	1·80	1·60	CA3037	1·65	1·47
CA3002V1	1·80	1·60	CA3037A	2·53	2·25
CA3004	1·80	1·60	CA3038	2·53	2·25
CA3005	1·17	1·05	CA3038A	3·40	3·03
CA3006	2·80	2·50	CA3039	0·84	0·75
CA3007	2·63	2·34	CA3040	2·40	2·14
CA3008	1·80	1·60	CA3041	1·09	0·97
CA3008A	2·96	2·64	CA3042	1·09	0·97
CA3010	1·37	1·23	CA3043	1·37	1·23
CA3010A	2·53	2·25	CA3044	1·20	1·07
CA3011	0·74	0·65	CA3044V1	1·20	1·07
CA3011PRE			CA3045	1·23	1·09
	0·74	0·65	CA3046	0·69	0·60
CA3012	0·89	0·79	CA3047	1·37	1·23
CA3012V1	0·89	0·79	CA3047A	2·53	2·25
CA3013	1·05	0·94	CA3048	2·04	1·81
CA3014	1·24	1·10	CA3049	1·60	1·43
CA3014V1	1·24	1·10	CA3050	1·84	1·64
CA3015	2·09	1·86	CA3051	1·34	1·20
CA3015A	3·40	3·03	CA3052	1·65	1·47
CA3016	2·46	2·19	CA3053	0·46	0·41
CA3016A	3·73	3·33	CA3054	1·09	0·97
CA3018	0·84	0·75	CA3055	1·69	1·51
CA3018A	1·10	0·99	CA3056	1·20	1·07
CA3019	0·84	0·75	CA3056A	3·19	2·85
CA3020	1·26	1·13	CA3059	1·65	1·46
CA3020A	1·60	1·43	CA3060	4·91	4·37
CA3021	1·56	1·39	CA3062	2·55	2·27
CA3021V1	1·56	1·39	CA3064	1·20	1·07
CA3022	1·30	1·16	CA3065	1·20	1·07
CA3023	1·26	1·13	CA3066	2·11	1·88
CA3026	1·00	0·90	CA3067	2·18	1·94
CA3026PRE			CA3068	2·43	2·16
	1·00	0·90	CA3070	1·70	1·51
CA3028A	0·74	0·65	CA3071	1·62	1·44
CA3028B	1·05	0·94	CA3072	1·66	1·48
CA3029	0·87	0·77	CA3075	1·13	1·00
CA3029A	1·65	1·47	CA3076	1·30	1·16
CA3030	1·37	1·23	CA3078	3·19	2·85
CA3030A	2·53	2·25	CA3080	0·79	0·70
CA3033	2·53	2·25	CA3090Q	3·46	3·09

LARGEST STOCKS WIDEST RANGE

SEMICONDUCTORS & COMPONENTS

BRAND NEW GUARANTEED

TRANSISTORS

Type	Price
2G301	20p
2G302	20p
2G303	20p
2G306	42½p
2G308	30p
2G309	30p
2G371	15p
2G374	20p
2G381	22½p
2N404	22½p
2N696	20p
2N697	20p
2N698	25p
2N706	12½p
2N706A	12½p
2N708	15p
2N709	62½p
2N718	25p
2N726	30p
2N727	30p
2N914	17½p
2N916	17½p
2N918	30p
2N929	22½p
2N930	27½p
2N1090	22½p
2N1091	22½p
2N1131	25p
2N1132	25p
2N1302	17½p
2N1303	17½p
2N1304	22½p
2N1305	22½p
2N1306	25p
2N1307	25p
2N1308	30p
2N1309	30p
2N1507	17½p
2N1613	25p
2N1631	35p
2N1632	30p
2N1637	30p
2N1638	27½p
2N1671B	£1
2N1711	25p
2N1889	32½p
2N1893	37½p
2N2147	82½p
2N2148	57½p
2N2160	57½p
2N2193	40p
2N2193A	42½p
2N2194A	30p
2N2217	27½p
2N2218	23p
2N2219	23p
2N2220	25p
2N2221	25p
2N2222	30p
2N2287	£1·07½
2N2297	30p
2N2368	17½p
2N2369	17½p
2N2369A	17½p
2N2410	42½p
2N2483	27½p
2N2484	32½p
2N2539	22½p
2N2540	22½p
2N2613	35p
2N2614	30p
2N2646	52½p
2N2696	32½p
2N2711	25p
2N2712	25p
2N2713	27½p
2N2714	30p
2N2865	62½p
2N2904	30p
2N2904A	32½p
2N2905	37½p
2N2905A	40p
2N2906	25p
2N2906A	27½p
2N2907	30p
2N2923	15p
2N2924	15p
2N2925	15p
2N2926	
,, Green	14p
,, Yellow	12½p
,, Orange	12½p
2N3011	30p
2N3014	32½p
2N3053	18p
2N3054	46p
2N3055	62p
2N3133	30p
2N3134	30p
2N3135	25p
2N3136	25p
2N3390	25p
2N3391	20p
2N3391A	30p
2N3392	17½p
2N3393	15p
2N3394	15p
2N3402	22½p
2N3403	22½p
2N3404	32½p

Type	Price
2N3405	45p
2N3414	22½p
2N3415	22½p
2N3416	37½p
2N3417	37½p
2N3570	£1·25
2N3572	97½p
2N3605	27½p
2N3606	27½p
2N3607	22½p
2N3702	11p
2N3703	10p
2N3704	11p
2N3705	10p
2N3706	9p
2N3707	11p
2N3708	7p
2N3709	9p
2N3710	9p
2N3711	12p
2N3715	£1·23
2N3716	£1·30
2N3791	£2·06
2N3819	35p
2N3823	97½p
2N3854	27½p
2N3854A	27½p
2N3855	27½p
2N3855A	30p
2N3856	30p
2N3856A	35p
2N3858	25p
2N3858A	30p
2N3859	27½p
2N3859A	32½p
2N3860	30p
2N3866	£1·50
2N3877	40p
2N3877A	40p
2N3900	37½p
2N3900A	40p
2N3901	97½p
2N3903	35p
2N3904	35p
2N3905	37½p
2N3906	37½p
2N4058	17½p
2N4059	10p
2N4060	12½p
2N4061	12½p
2N4062	12½p
2N4244	47½p
2N4285	17½p
2N4286	17½p
2N4287	17½p
2N4288	17½p
2N4289	17½p
2N4290	17½p
2N4291	17½p
2N4292	12½p
2N4303	47½p
2N5027	52½p
2N5028	57½p
2N5029	47½p
2N5030	42½p
2N5172	12½p
2N5174	52½p
2N5175	52½p
2N5176	45p
2N5232A	30p
2N5245	45p
2N5246	42½p
2N5249	67½p
2N5265	£3·25
2N5266	£2·75
2N5267	£2·62½
2N5305	37½p
2N5306	40p
2N5307	37½p
2N5308	37½p
2N5309	62½p
2N5310	42½p
2N5354	27½p
2N5355	27½p
2N5356	32½p
2N5365	47½p
2N5366	32½p
2N5367	57½p
2N5457	37½p
28005	75p
28020	£2
28102	50p
28103	25p
28104	25p
28501	32½p
28502	35p
28503	27½p
3N128	70p
3N139	£1·27½
3N140	77½p
3N141	72½p
3N142	55p
3N143	67½p
3N152	87½p
R.C.A.:—	
40050	55p
40244	22½p
40251	87½p
40309	32½p
40310	45p

Type	Price
40311	35p
40312	47½p
40314	37½p
40320	47½p
40323	32½p
40324	47½p
40326	37½p
40329	30p
40344	27½p
40347	57½p
40348	52½p
40360	42½p
40361	47½p
40362	57½p
40370	32½p
40406	57½p
40407	40p
40408	52½p
40410	62½p
40467A	57½p
40468A	35p
40600	57½p
40673	85p
AC107	30p
AC126	20p
AC127	25p
AC128	20p
AC154	22½p
AC176	25p
AC187	62½p
AC188	37½p
ACY17	27½p
ACY18	25p
ACY19	25p
ACY20	25p
ACY21	25p
ACY22	20p
ACY28	20p
ACY40	20p
ACY41	25p
ACY44	40p
AD140	52½p
AD149	57½p
AD150	62½p
AD161	37½p
AD162	37½p
AF106	42½p
AF114	25p
AF115	25p
AF116	25p
AF117	25p
AF118	62½p
AF119	20p
AF124	22½p
AF125	20p
AF126	20p
AF127	17½p
AF139	37½p
AF178	42½p
AF179	72½p
AF180	52½p
AF181	42½p
AF239	42½p
AF279	47½p
AF280	62½p
AFZ11	32½p
ASY26	25p
ASY27	37½p
ASY28	27½p
ASY29	27½p
ASY36	25p
ASY50	25p
ASY51	32½p
ASY54	25p
ASY86	32½p
ASZ21	42½p
AU103	£1·25
BC107	10p
BC108	10p
BC109	10p
BC113	15p
BC115	15p
BC116A	15p
BC118	10p
BC121	20p
BC122	20p
BC125	20p
BC126	20p
BC140	37½p
BC147	10p
BC148	10p
BC149	12p
BC152	17½p
BC157	20p
BC158	11p
BC159	12p
BC160	62½p
BC167	11p
BC168B	10p
BC168C	11p
BC169B	11p
BC169C	12p
BC170	12½p
BC171	15p

Type	Price
BC172	15p
BC175	22½p
BC182	10p
BC183	9p
BC184	11p
BC212L	13p
BCY30	27½p
BCY31	30p
BCY32	50p
BCY33	25p
BCY34	30p
BCY38	40p
BCY39	60p
BCY40	50p
BCY42	15p
BCY43	15p
BCY54	32½p
BCY58	22½p
BCY59	22½p
BCY60	97½p
BCY70	20p
BCY71	25p
BCY72	17½p
BCZ10	27½p
BCZ11	42½p
BD116	£1·12½
BD121	65p
BD123	82½p
BD124	60p
BD131	75p
BD132	85p
BDY10	£1·37½
BDY11	£1·62½
BDY17	£1·50
BDY18	£1·75
BDY19	£1·97½
BDY20	£1·12½
BDY38	97½p
BDY60	£1·25
BDY61	£1·25
BDY62	£1
BF115	25p
BF117	47½p
BF163	37½p
BF167	18p
BF173	19p
BF177	30p
BF178	30p
BF179	30p
BF180	35p
BF181	32½p
BF184	25p
BF185	42½p
BF194	17½p
BF195	15p
BF196	42½p
BF197	42½p
BF198	42½p
BF200	52½p
BF224	14p
BF225	19p
BF237	23p
BF238	23p
BF244	25p
BFW58	27½p
BFW59	25p
BFW60	25p
BFW61	47½p
BFX12	22½p
BFX13	22½p
BFX29	30p
BFX30	30p
BFX43	37½p
BFX44	37½p
BFX68	67½p
BFX84	25p
BFX85	32½p
BFX86	25p
BFX87	27½p
BFX88	25p
BFX89	62½p
BFX93A	70p
BFY10	32½p
BFY11	42½p
BFY17	22½p
BFY18	32½p
BFY19	32½p
BFY20	£1·60
BFY21	42½p
BFY24	45p
BFY25	20p
BFY26	20p
BFY29	50p
BFY30	50p
BFY41	50p
BFY43	62½p
BFY50	23p
BFY51	20p
BFY52	23p
BFY53	17½p
BFY56A	57½p
BFY75	30p
BFY76	42½p
BFY77	57½p
BFY90	67½p
BPX25	£1·85
BPX29	£1·80
BPY10	£1·45
BRY39	47½p
BSW41	42½p

Type	Price
BSW70	27½p
BSX19	17½p
BSX20	17½p
BSX21	37½p
BSX26	45p
BSX27	47½p
BSX28	32½p
BSX60	82½p
BSX61	62½p
BSX76	22½p
BSX77	27½p
BSX78	27½p
BSX78	27½p
BSY10	27½p
BSY11	27½p
BSY24	15p
BSY25	15p
BSY26	17½p
BSY27	17½p
BSY28	17½p
BSY29	17½p
BSY32	25p
BSY36	25p
BSY37	25p
BSY38	22½p
BSY39	22½p
BSY51	32½p
BSY52	32½p
BSY53	37½p
BSY54	40p
BSY56	90p
BSY78	47½p
BSY79	45p
BSY82	52½p
BSY90	57½p
BSY95A	12½p
C111	75p
C424	27½p
C425	55p
C426	40p
C428	37½p
C744	30p
D13T1	62½p
D16P1	37½p
D16P2	40p
D16P3	37½p
D16P4	40p
D40N1	75p
GET102	30p
GET113	20p
GET114	20p
GET118	20p
GET119	20p
GET120	52½p
GET873	12½p
GET880	30p
GET887	20p
GET889	22½p
GET890	22½p
GET896	22½p
GET897	22½p
GET898	22½p
MJ400	£1·07½
MJ420	£1·12½
MJ421	£1·12½
MJ430	£1·02½
MJ440	95p
MJ480	97½p
MJ481	£1·25
MJ490	£1
MJ491	£1·37½
MJ1800	£2·17½
MJE340	62½p
MJE520	60p
MJE521	78p
MJE2955	£1·37½
MJE3055	87½p
MPF102	42½p
MPF103	37½p
MPF104	37½p
MPF105	37½p
MPS3638	32½p
NKT0013	47½p
NKT124	42½p
NKT125	27½p
NKT126	27½p
NKT128	27½p
NKT135	27½p
NKT137	32½p
NKT210	30p
NKT211	30p
NKT212	30p
NKT213	30p
NKT214	22½p
NKT215	22½p
NKT216	37½p
NKT217	42½p
NKT219	30p
NKT223	27½p
NKT224	25p
NKT225	22½p
NKT229	30p
NKT237	35p

Type	Price
NKT238	25p
NKT240	27½p
NKT241	27½p
NKT242	20p
NKT243	62½p
NKT244	17½p
NKT245	20p
NKT261	20p
NKT262	30p
NKT264	20p
NKT271	20p
NKT272	20p
NKT274	20p
NKT275	20p
NKT281	27½p
NKT401	87½p
NKT402	90p
NKT403	75p
NKT404	62½p
NKT405	75p
NKT406	62½p
NKT451	62½p
NKT452	62½p
NKT453	47½p
NKT603F	32½p
NKT613F	32½p
NKT674F	30p
NKT677F	30p
NKT713	25p
NKT781	30p
NKT10419	30p
NKT10439	37½p
NKT10519	32½p
NKT20329	47½p
NKT20339	37½p
NKT80111	77½p
NTK80112	97½p
NKT80113	£1·12½
NKT80211	92½p
NKT80212	92½p
NKT80213	92½p
NKT80214	92½p
NKT80215	92½p
NKT80216	92½p
OC20	75p
OC22	50p
OC23	60p
OC24	60p
OC25	50p
OC26	27½p
OC28	62½p
OC29	62½p
OC35	50p
OC36	62½p
OC41	22½p
OC42	25p
OC44	20p
OC45	12½p
OC46	15p
OC70	15p
OC71	12½p
OC72	12½p
OC74	32½p
OC75	22½p
OC76	22½p
OC77	30p
OC81	20p
OC81D	22½p
OC83	25p
OC84	25p
OC139	32½p
OC140	32½p
OC170	30p
OC171	30p
OC200	40p
OC201	60p
OC202	75p
OC203	42½p
OC204	42½p
OC205	90p
OC207	75p
OCP71	42½p
ORP12	50p
ORP61	50p
P346A	22½p
TIP29A	50p
TIP30A	60p
TIP31A	62½p
TIP32A	75p
TIP33A	£1·05
TIP34A	£2·05
TI834	62½p
TI843	40p
TI844	10p
TI845	27p
TI846	11p
TI847	11p
TI848	12½p
TI849	12½p
TI850	17½p
TI851	12½p
TI852	12½p
TI853	22½p
TI860	22½p
TI861	25p
TI862	27½p

Matching charge (audio transistors only), 13p extra per pair.
Post & Packing 12½p per order. Europe 25p. Commonwealth (Air) Letter 65p (Min.). Parcel £1·69 (Min.).
Prices subject to alteration without prior notice.

D.C. PANEL METERS

MR38 SERIES—FACE SIZE 42 × 42mm. ALL PRICES FOR 1–9 PIECES. 50μA, £2·00; 100μA, £1·87½; 200μA, £1·75; 500μA, £1·50; 50-0-50μA, £1·87½; 100-0-100μA, £1·75; 500-0-500μA, £1·60; 1mA, £1·60; 5mA, £1·60; 10mA, £1·60; 50mA, £1·60; 100mA, £1·60; 500mA, £1·60; 1A, £1·60; 5A, £1·60; 10V, £1·60; 20V, £1·60; 50V, £1·60; 300V, £1·60; 500V, £1·60.

SILICON RECTIFIERS

PIV	50	100	200	400	600	800	1000	1200
1A	8p	9p	10p	11p	12p	15p	20p	—
3A	15p	—	—	22½p	—	30p	—	—
6A	—	—	25p	30p	32½p	35p	50p	—
10A	—	52½p	57½p	65p	77½p	87½p	97½p	£1·25
15A	—	57½p	62½p	77½p	90p	97½p	£1·20	£1·57½

1A and 3A are plastic encapsulation.

DIODES & RECTIFIERS

IN914	7p	18940	5p	BAX13	12½p	BYZ13	25p
IN916	7p	AA119	10p	BAX16	12½p	OA5	17½p
IN4007	20p	AA129	10p	BAY18	17½p	OA9	10p
IN4148	7p	AAZ13	10p	BAY31	7½p	OA10	22½p
IN5145	£2·37½	AAZ15	12½p	BAY38	25p	OA47	8p
IS44	9p	AAZ17	12½p	BY100	17½p	OA70	7p
IS113	15p	BA100	15p	BY103	22½p	OA73	10p
IS120	15p	BA102	22½p	BY122	37½p	OA79	7p
IS121	14p	BA110	32½p	BY126	15p	OA81	8p
IS130	8p	BA115	7½p	BY127	17½p	OA85	10p
IS131	10p	BA141	32½p	BY164	52½p	OA90	7p
IS132	12p	BA142	32½p	BYX10	22½p	OA91	7p
IS920	7p	BA144	12½p	BYZ10	35p	OA95	7p
IS922	8p	BA145	20p	BYZ11	32½p	OA200	10p
IS923	12p	BA154	12½p	BYZ12	30p	TIV307	50p

MAINS TRANSFORMERS

1 amp Charger. Sec. 0-3·5-9-18V (P. & P. 22½p.)	£1·12
2 amp Charger. Sec. 0-3·5-9-18V (P. & P. 22½p.)	£1·44
1 amp (Douglas) MT103 Sec. tappings from 6V to 50V	£1·92
2 amp (Douglas) MT104 Sec. tappings from 6V to 50V	£2·54
Post and packing 25p.	
6 amp (Douglas) MT107 Sec. tappings from 6V to 50V	£6·25
Post and packing 37½p.	

Various other Transformers ranging from ¼A to 5A in stock.

TRIACS

SC41A	£1	SC35D	£1·10½
SC41B	£1·10	SC36D	£1
SC41D	£1·20	SC40D	£1·50
SC50D	£2·05	SC45D	£1·62½
40430	97½p	SC46D	£1·42½
40486	95p	40429	90p
40512	£1·45	40432	£1·37½

BRIDGE RECTIFIERS

A.	PIV		A.	PIV	
1	100	47½p	4	50	60p
1·4	140	52½p	4	100	70p
2	50	55p	4	400	95p
2	200	70p	6	50	62½p
2	400	80p	6	200	87½p
			6	400	£1·12½

Economy Range Triacs

TC4/10 (Pressfit) 4 amp 100 PIV	65p
TC4/20 (Pressfit) 4 amp 200 PIV	75p
TC4/40 (Pressfit) 4 amp 400 PIV	87½p
ST2 DIAC	21p

DIACS

MPT20	40p
MPT28	37½p
MPT32	37½p
MPT36	37½p

P.E. SCORPIO IGNITION SYSTEM COMPLETE KIT £10·00 P. & P. 50p

MULLARD SUB-MIN ELECTROLYTIC

C426 range axial lead 6p each

Values (μF/V): 0·64/64; 1/40; 1·6/25; 2·5/16; 2·5/64; 4/10; 4/40; 5/64; 6·4/6·4; 6·4/25; 8/40; 10/16; 10/64; 12·5/25; 16/40; 20/16; 20/64; 25/6·4; 25/25; 32/10; 32/40; 32/64; 40/16; 50/6·4; 50/25; 50/40; 64/10; 80/2·5; 80/16; 80/25; 100/6·4; 125/10; 125/16; 200/6·4; 200/10; 320/6·4.

THYRISTORS

PIV	50	100	200	300	400
1A	25p	27½p	37½p	40p	47½p
4A	47½p	55p	57½p	—	75½p
5A	—	55p	65p	—	75p
7A	—	87½p	92½p	—	£1·12½

TIC47 0·6A 200 PIV 55p

Also 12A 100 PIV, 75p; 2N3525 at £1·27½; 2N4444 £1·91

VEROBOARD

	0·15 Matrix	0·1 Matrix
2½in × 3¾in	17p	23p
2½in × 5in	25p	25p
3¾in × 3¾in	25p	25p
3¾in × 5in	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.

HEAT SINKS

4·8 × 4 × 1in Finned or Two TO-3 Trans., 48p. 4·8 × 2 × 1in Finned, for One TO-3 Trans., 33p. For 80-1, 2½p. For TO-5, 5p Finned. For TO-18, 5p Finned. For TO-18, 5p Finned.

RESISTORS

Carbon Film

½ watt 5%, 1p.	¼W & ½W are
¼ watt 5%, 1p.	E24 series.
½ watt 5%, 2p.	½W, 1W, & 2W
½ w M/O 2%, 4p.	are E12 series.
1 watt 10%, 2½p.	½ watt 2%, 4p.
2 watt 10%, 6p.	

MULLARD C280 M/FOIL CAPACITORS

0·01, 0·022, 0·033, 0·047, 3p; 0·068, 0·1, 4p each.
0·15, 0·22, 0·33, 5p each.

0·47	9p
0·68	11p
1μF	14p
1·5μF	21p
2·2μF	25p

WIRE-WOUND RESISTORS

2·5 watt 5% (up to 270 ohms only), 7p.
5 watt 5% (up to 8·2kΩ only), 9p.
10 watt 5% (up to 25kΩ only), 10p.

POTENTIOMETERS

Carbon:
Log. and Lin., less switch, 16p.
Log. and Lin., with switch, 25p.
Wire-wound Pots (3W), 38p.
Twin Ganged Stereo Pots, Log. and Lin., 40p.

PRESETS (CARBON)

0·1 Watt	6p
0·2 Watt	6p
0·3 Watt	7½p

THERMISTORS

R53 (STC) £1·27½
K151 (Ik) 12½p VA1077 20p
VA3705 87½p
Mullard Thermistors also in stock. Please inquire.

CALLERS WELCOME
Tel. 01-452 0161/2/3
Telex 21492

A. MARSHALL & SON

Send 15p for Comprehensive Price Lists

28 CRICKLEWOOD BROADWAY, LONDON, N.W.2

MON-FRI 9-5.30
SAT 9-5

BLACK LIGHT

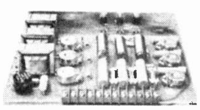
THE OUT OF SIGHT LIGHT

This kit consists of a high-pressure mercury discharge lamp enclosed in a deep blue-violet outer bulb. This absorbs all visible light given by the discharge but transmits the long-wave ultra-violet rays.
The unit performs in a similar fashion to the fluorescent tube type units in use in some discotheques but instead uses a 3-pin B.C. lamp fitted into a high intensity spot-fitting with fully adjustable swivel bearing. The reflector is also fully adjustable and the unit may be mounted in any position and focused as desired.
White shirts and dresses glow "Whiter than white". Paint scenes on walls, etc., with our special fluorescent paint, focus the black-light from across the room and switch-on. The pictures glow brilliantly as if by magic!
Full kit includes lamp, reflector, control-gear, generous samples of five different colours of fluorescent paint and full instructions.
Price **£25** carr. paid. S.A.E. with all inquiries.

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 7½in × 4½in × 2in approx.
Complete assembly and wiring manual **25p**, refundable on purchase of kit. Price: **£10·50** plus 50p P. & P. S.A.E. with all enquiries.

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. S.A.E. with all inquiries.

DABAR ELECTRONIC PRODUCTS
98a LICHFIELD STREET, WALSALL, STAFFS WS1 1UZ
WALSALL 34365
MAIL ORDER ONLY

COMPONENT FACTORS

ALL GOODS BRAND NEW AND GUARANTEED
BARGAIN PRICES DELIVERY BY RETURN

P.O. BOX No. 18 LUTON, BEDS. LU1 ISU

NEW PRICE REDUCTIONS

CERAMIC

1PF	500V	2p
270PF	50V	2p
0·0047	30V	2p
0·01	30V	3p
0·01	350V	2p
0·022	30V	2p
0·047	30V	2p
0·1 Disc	100V	3p
1·5-8PF Trimmer		2p
3–30PF		4p

Electrolytic Mullard C426 Range

1MFD	40V	4p
4MFD	40V	4p
8MFD	40V	4p
10MFD	16V	4p
16MFD	40V	4p
32MFD	10V	4p
40MFD	16V	4p
50MFD	6·4V	4p
200MFD	6·4V	4p

Large range of Tantalum, Polycarbonate and Polyester capacitors available.

Miniature Ceramic Lemco All 750V ± 10%

3PF, 5PF, 10PF, 20PF, 25PF, 40PF, 75PF, 100PF, 120PF, 180PF, 220PF.
Price: **2½p** each or 10 for **20p** (same value).

HUNTS M.E.F. RANGE

16MFD	350V	10p
100MFD	50V	10p
500MFD	50V	12p
1000MFD	12V	12p
2500MFD	6V	10p
2500MFD	12V	12p

DIODES

EB383	10p
HSD1395	1p
OA5	20p
OA47	5p
1N5054 (1kV)	10p
1N4009	2p
OA202 equiv.	5p

TUNNEL DIODES

1N3717	£1
TD715	50p
TD716	40p
TD717	50p
TD719	50p

ZENER DIODES

3V3	BZY88C	10p
3V9	BZY88C	10p
4V3	BZY88C	10p
5V1	MZ5·1T5	10p
5V6	1N752A	15p
6V8	BZY96C	15p
7V5	BZY96C	15p
13V	BZY94C	15p
20V	BZX22	12p
24V	BZY88C	12p
39V	1N5259	15p

INTEGRATED CIRCUITS

μL914	25p
MC790P	60p
MC849P	35p
MC1013P	75p
MC1023P	£2
MC1027P	£2
SN7400N	15p
SN7401N	15p
SN7410N: FJH121	15p
SN7430N	15p
SN7440N	25p
SN7470N	30p
SN7493N	80p
FJH111	12p
FJH131	20p
FJH151	12p
FJH221	20p
FJJ121	30p

TRANSISTORS

2N708	10p
2N709	25p
2N1671B (UJ)	80p
2N1303	10p
2N2904	25p
2N3820 (FET)	50p
2N3866	80p
BC108	10p
BCY30	20p
BCY70	10p
BFY51	10p
BFX87	15p
BSX21	12p
BSX60	50p
C111	30p
C407	20p
C426	12p
E100 (FET)	50p
ME1120	10p
P346A	8p
V405A	10p

Miscellaneous

Mains Transformer 32-0-32 at 150mA **50p**

Mains Transformer 150V at 20mA 8V at 650mA **75p**

¾ Black Knob with Silver Disc ¼in hole **5p**

Miniature ¼W Carbon Pots Def. Specification 500Ω, 1K, 2K5, 5K, 10K, 100K **30p**

P.V.C. Wire 14/0076 100yd **50p**

Miniature RF chokes 0·22, 1, 1·5, 2·2, 12, 15, 22μH **8p each**

Neon lamp A230. 5 for **20p**

CAPACITORS SILVER MICA

5PF	10%	500V	5p
10PF	5%	350V	8p
22PF	5%	350V	10p
27PF	5%	350V	10p
33PF	5%	350V	10p
47PF	5%	350V	10p
75PF	5%	350V	10p
82PF	1%	500V	5p
270PF	5%	350V	10p
380PF	5%	350V	8p
390PF	1%	500V	5p
500PF	5%	200V	18p
820PF	1%	500V	5p
2000PF	5%	200V	40p
4700PF	5%	50V	30p

SPECIAL OFFER ¼W 5% Resistors 250 for £1. Your selection but subject to 20 different values, maximum, in range 10Ω-1MΩ.

TERMS: Cash or Cheque with order. Post and packing free on orders above £5. For smaller orders please add 10p. DISCOUNT: orders above £10—10%, above £20—15%. All goods advertised are top grade professional components and subject to a money refund guarantee if not satisfied. We have many components not advertised, and enquiries are welcome, but must enclose a S.A.E. for reply. Price list 5p. Data sheets 5p. Trade enquiries welcome.

TRANSFORMERS

DOUGLAS GUARANTEED

12 or 24 Volts

Output V. & Amps.		Ref. No.	Price	P. & P.
12V×2	250 mA×2	MT111 CS*†	£0·83	6p
12V×2	500 mA×2	MT213 CT*†	£0·97	12p
12V×2	1A×2	MT 71 AT‡	£1·48	23p
12V×2	2A×2	MT 18 AT	£2·23	30p
12V×2	3A×2	MT 70 AT	£2·30	30p
12V×2	4A×2	MT 108 AT	£2·92	31p
12V×2	5A×2	MT 72 AT	£3·16	28p

30 volts. All tapped at 0-12-15-20-24-30V

Output Amps.	Ref. No.	Price £	P.P.	Output Amps.	Ref. No.	Price £	P.P.
500 mA	MT 112 CT‡	1·12	14p	3A	MT 20 AT	2·64	30p
1A	MT 79 AT‡	1·55	28p	4A	MT 21 AT	3·10	40p
2A	MT 3 AT	2·23	28p	5A	MT 51 AT	4·31	38p

50 volts. All tapped at 0-19-25-33-40-50V

Output Amps.	Ref. No.	Price £	P.P.	Output Amps.	Ref. No.	Price £	P.P.
500 mA	MT 102 AT‡	1·45	22p	3A	MT 105 AT	3·91	39p
1A	MT 103 AT	2·00	30p	4A	MT 106 AT	5·06	39p
2A	MT 104 AT	3·10	30p	6A	MT 107 AT	7·47	39p

60 Volts. All tapped at 0-24-30-40-48-60V

Output Amps.	Ref. No.	Price £	P.P.	Output Amps.	Ref. No.	Price £	P.P.
500 mA	MT 124 AT‡	1·46	21p	2A	MT 127 AT	3·16	39p
1A	MT 126 AT	2·24	28p	3A	MT 125 AT	4·59	39p

AUTO-WOUND RANGE

Power output	Winding tapped at	Ref. No.	Price	P. & P.
20 VA	0-115-210-240	MT 113 CT	£0·89	23p
75 VA	" "	MT 64 AT	£1·72	28p
150 VA	0-115-200-220-240	MT 4 AT	£2·15	30p
200 VA	" "	MT 65 AT	£3·00	30p

400 V. Output at 50 HZ. Ref. IT3 AT Price P. & P.
C-D Ignition system by R. M. Marston Esq. **£2·25** 27p

EQUIPMENT RANGE

Sec. Output (r.m.s.)		Ref. No.	Price	P. & P.
3-0-3 V.	200 mA	MT 209 CS*†	£0·89	6p
9-0-9 V.	100 mA	MT 13 CS*†	£0·91	5p
12-0-12	50 mA	MT 210 CS*†	£0·91	6p
20-0-20	30 mA	MT 211 CS*†	£0·91	6p
0-20×2	300×2	MT 214 CT*‡	£1·21	12p
0-8-9×2	500 mA×2	MT 207 CT*‡	£1·46	30p
0-15-20×2	500 mA×2	MT 205 AT*‡	£2·12	27p
0-15-27×2	500 mA×2	MT 203 AT*	£2·45	27p
0-15-27×2	1A×2	MT 204 AT*	£3·42	28p
10-12-0-12-20	700 mA (d.c.)	MT 221 AT*	£1·11	24p

AT indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. spills; *with interwinding screen; † untapped 240V Primary; ‡ Primary tapped at 210-240V; other Primaries tapped at 200-220-240V.
Over 200 types in stock through agents or direct. Send for list.

DOUGLAS ELECTRONICS INDUSTRIES LTD., Dept. MO. 51, Thames Street, LOUTH, Lincs.

DRILL CONTROLLER
NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1·50** plus 13p post and insurance. Made up model also available, **£2·25** plus 13p post and p.

MAINS OPERATED CONTACTOR

220/240V. 50 cycle solenoid with laminated core so very silent in operation. Closes 4 circuits each rated at 10 A. Extremely well made by a German Electrical Company. Overall size 2½in × 2in × 2in. **£1** each.

NEED A SPECIAL SWITCH?

Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic push-rod suitable for operating. **5p** each, **45p** doz.

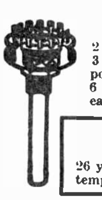
AUTO-ELECTRIC CAR AERIAL

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. **£6** plus 25p post and ins.

MICRO SWITCH

5A changeover contacts, **9p** each. **£1** doz. 15 amp. Model **10p** each or **£1·05** doz.

MINIATURE WAFER SWITCHES



2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **18p** each, **£1·80** dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. **50p** post free.

BLANKET SWITCH

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

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **38p** each or 10 for **£3·42**.

TREASURE TRACER

Complete Kit (except wooden battens) to make the metal detector as the circuit in Practical Wireless August issue. **£2·50** plus 20p post and insurance.

QUICK CUPPA

Mini Immersion Heater, 350W 200/240V. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1·25**, post and insurance 14p. 12V car model also available same price. Jug heater **£1·50** plus P. & P. 14p.

SNAP ACTION SLIDE SWITCH

Rated 5A 240V. Made by Arrow. Type fitted in the handles of electric drills, vacuums, etc. **5p** each, 10 for **45p**.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac XN.3. Price **99p** each, 10 for **£9**.

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.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in dia. by ¼in thick. Rated at 500 MW, wire ended. **43p** with circuit.

IGNITION BOOSTER
as featured in this issue
Send S.A.E. for list of parts

2¼kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2¼kW), switch down for half heat (1⅛kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cutout. Complete kit **£3.75**. Post and ins. 38p.

THE FULL-FI STEREO SIX

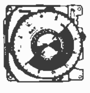
THE AMPLIFIER SENSATION OF THE YEAR

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6W R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. UNREPEATABLE PRICE is **£9** plus 38p post and insurance.

DISTRIBUTION PANELS

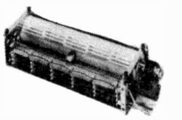
Just what you need for work bench or lab. 4 × 13 amp sockets in metal box to take standard 13 amp fused plugs and on/off switch with neon warning light. Supplied complete with 7 feet of heavy cable. Wired up ready to work, **£2** less plug. **£2·25** with fitted 13 amp plug; **£2·40** with fitted 15 amp plug, plus 23p P. & 1.

THIS MONTH'S SNIP



Smiths 24-hour 2 on/2 off Time Switch—this is the popular model as used in the Autoset and Morphy-Richards time switches. Only needs a case and an output socket. 230V 50 cycle. Contacts switch up to 13A. Price **£2·75**.

TANGENTIAL HEATER UNITS



This heater unit is the very latest type, most efficient, and quiet running, is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1, 2 and 3kW and with thermal safety cut-out. Can be fitted into any metal lined case or cabinet. Only need control switch. **£3·50**. 2kW. Model as above except 2 kilowatts **£2·50**. Don't miss this. Control Switch **35p**, P. & P. 40p.

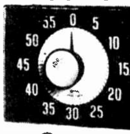
POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), **30p** or 2 for **50p**. Post paid.

COMPUTER TAPE

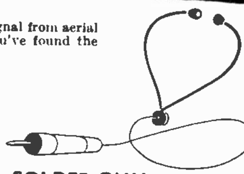
2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide **£1·00** plus 33p post and insurance, with cassette. ½in wide **£1·00** plus 30p post and insurance with cassette. ¼in wide **75p** plus 25p post and insurance with cassette. Spare spools and cassettes—1in **75p**, ½in **75p** each plus 20p post and insurance.

1 HOUR MINUTE TIMER



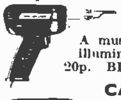
Made by famous Smiths company, these have a large clear dial, size 4¼ × 3¼, which can can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch. **£1·15**.

RADIO STETHOSCOPE



Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything — complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2**—twin stethoset instead of earpiece **75p** extra—post and ins. 20p.

SOLDER GUN

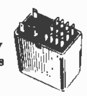


A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt **£3·75** plus post and ins. 20p. BIG JOB 250 watt model **£4·75** plus post and ins. 40p.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* about a year ago. We can supply kit of parts for improved and even more efficient version. Price **£5·25** plus 30p post. When ordering please state whether for positive or negative systems.

Type 25 Relays. These are miniature relays. Size approx. 1⅛in high × 1¼in wide × ⅞in deep. 4 changeover silver/gold contacts. Contact rating lamp 100V d.c. Fitted with a plastic cover. Coil operates approx. 250MW d.c. Available with the following coils:



28Ω for 4V–7·5V	45Ω for 1V–2·5V	52Ω for 4·9V–6V
90Ω for 5·5V–11·5V	130Ω for 10V–15V	530Ω for 17V–36V
1250Ω for 27V–44V	2500Ω for 31V–65V	5800Ω for 27V–44V

75p each. 10 for **£6·75**. Also one with 16,500 ohm coil but this has only 2 heavy duty changeover gold contacts. Price **£1·45**.

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

Veroboard. We are now stocking this in various sizes. Prices as follows:

Inches	0·1	0·15
2½ × 3¾	22p	16p
2½ × 5	24p	24p
3¾ × 5¾	24p	24p
33¾ × 5	27p	27p
17 × 2½	75p	57½p
17 × 5 (plain)	—	75p
17 × 3¾ (plain)	—	52½p
17 × 2½ (plain)	—	37½p
17 × 3¾ (plain)	100p	75p
2½ × 5 (plain)	—	17½p
2½ × 3¾ (plain)	—	15p
Pin intersection tool	47½p	47½p
Spot face cutter	37½p	37½p
Pkt. 50 pins	20p	20p

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15–20W **£1**. Kit B—30–40W **£1**. Kit C—80W **£1·20**. Kit E—65W **£1·20**. Kit F for 8ft 125W tube **£1·75**. Kit MF1 is for 6in, 9in and 12in miniature tubes **£1**. Kit MF2 for 21in 13W. miniature tube **£1**. Postage on Kits A and B 23p for one or two kits then 23p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

0-8 AMMETER

2 in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price **43p** each. 10 for **£3·90**.

Box Sign for Window Display, at home, office or shop, 2ft wide × 14in high × 5in deep. This is an illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stationers.) You will then have a box sign normally costing anything between £10–15. Illumination is by a 2ft fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price **£3** each, plus 65p post, etc.

Motivated Illuminated Box Sign. As previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign written on card then cut this up in strips which could be glued to the one supplied with the box sign. Price **£4·50**, plus 65p post and service.

Geared Motor with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 6 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly. Price **£1·75** plus 25p post, etc.

Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you at about half of the original list price. **30p** per (8oz) can or 12 cans for **£3** post paid. The lubricant is I.C.I. fluon L169.

REED SWITCHES

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

Miniature. 1in long × approximately ⅛in diameter. Will make and break up to ½A up to 300V. Price **13p** each, **£1·20** dozen.

Standard. 2in long × 3/16in diameter. This will break currents of up to 1A, voltage up to 250V. Price **10p** each, **90p** per dozen.

Flat. Flat type, 2in long, just over 1/16in thick, flattened out, so that it can be fitted into a smaller space or a larger quantity may be packed into a square solenoid. Rating 1A 200V. Price **30p** each, **£3** per dozen.

Small ceramic magnets to operate these reed switches **9p** each, **90p** dozen.

Dry Reed Relays. Solenoids on moulded bobbins within magnetic shields—printed circuit or panel mounting.

Ref.	*Coil Resistance*	*Reed Switches*	*Price*
71005	2 K	1 normally open	**25p**
81916	5 K	1 normally open, 1 normally closed	**75p**
05003	4 K	1 normally open	**25p**
62040	1500 & 500 ohms	1 normally open	**35p**

Multiple Reed Relay. Ref. 53001. Contains 13 normally open reeds within a solenoid. Operates on 600mW. Coil resistance 9K ohms. Price **£1·95** each.

Multiple Reed Relay. Ref. 031. 2 normally open 1 normally closed coil resistance 30 ohms. Price **75p**.

J. BULL (ELECTRICAL) LTD.

(Dept. P.E.) 7 Park Street, Croydon CRO 1YD
Callers to 102/3 Tamworth Road, Croydon.

Great new OFFER from DIOTRAN

TRANSISTORS

BRAND NEW FULLY GUARANTEED DEVICES

AC107	15p	AF115	17p	BC140	35p	BCY31	22p	BF272	80p	EC403	15p	ORP60	40p
AC113	20p	AF116	17p	BC141	35p	BCY32	25p	BF273	30p	GET880	27p	ORP61	40p
AC115	23p	AF117	17p	BC142	45p	BCY33	17p	BF274	30p	MAT100	15p	ST140	12p
AC125	17p	AF118	30p	BC143	40p	BCY34	20p	BF308	35p	MAT101	17p	ST141	17p
AC126	17p	AF124	21p	BC145	45p	BCY70	17p	BF309	37p	MAT120	15p	TIS43	40p
AC127	17p	AF125	20p	BC147	17p	BCY71	30p	BF316	75p	MAT121	17p	UT46	27p
AC128	17p	AF126	20p	BC148	12p	BCY72	15p	BFW10	55p	MPF102	43p	V405A	25p
AC141K	17p	AF127	20p	BC149	17p	BCZ11	20p	BFX29	27p	MPF105	43p	V410A	45p
AC142K	17p	AF139	33p	BC150	17p	BD121	85p	BFX84	20p	OC19	30p	2G301	19p
AC151	15p	AF178	50p	BC151	20p	BD123	85p	BFX85	27p	OC20	50p	2G302	19p
AC154	15p	AF179	50p	BC152	17p	BD124	75p	BFX86	22p	OC22	30p	2G303	19p
AC155	17p	AF180	50p	BC153	27p	BD131	80p	BFX87	25p	OC23	33p	2G304	20p
AC156	17p	AF191	50p	BC154	30p	BD132	80p	BFX88	22p	OC24	45p	2G306	35p
AC157	17p	AF186	45p	BC157	20p	BDY20	£1	BFY50	20p	OC25	25p	2G308	35p
AC165	17p	AF239	37p	BC158	17p	BF115	22p	BFY51	20p	OC26	25p	2G309	35p
AC166	17p	AFZ11	37p	BC159	20p	BF117	45p	BFY52	20p	OC28	40p	2G339	17p
AC167	20p	AFZ12	45p	BC167	13p	BF118	60p	BFY53	17p	OC29	40p	2G339A	15p
AC168	20p	AL102	85p	BC168	13p	BF119	70p	BSX19	15p	OC35	33p	2G344	15p
AC169	14p	AL103	85p	BC169	13p	BF152	35p	BSX20	15p	OC36	40p	2G345	15p
AC176	23p	ASY26	25p	BC170	12p	BF153	35p	BSY25	15p	OC41	20p	2G371	13p
AC177	20p	ASY27	30p	BC171	13p	BF154	35p	BSY26	15p	OC42	22p	2G371B	10p
AC187	30p	ASY28	25p	BC172	13p	BF157	45p	BSY27	15p	OC44	15p	2G374	17p
AC188	30p	ASY29	25p	BC173	13p	BF158	25p	BSY28	15p	OC45	12p	2G377	27p
ACY17	25p	ASY50	25p	BC174	13p	BF159	30p	BSY29	15p	OC70	15p	2G378	15p
ACY18	20p	ASY51	25p	BC175	22p	BF160	30p	BSY38	15p	OC71	9p	2G382	15p
ACY19	22p	ASY52	25p	BC177	17p	BF162	30p	BSY39	15p	OC72	12p	2G401	30p
ACY20	20p	ASY54	25p	BC178	17p	BF163	35p	BSY40	30p	OC74	12p	2G414	30p
ACY21	20p	ASY55	25p	BC179	17p	BF164	35p	BSY41	35p	OC75	15p	2G417	25p
ACY22	19p	ASY56	25p	BC180	20p	BF165	35p	BSY95	12p	OC76	15p	2N388	30p
ACY27	18p	ASY57	25p	BC181	22p	BF167	22p	BSY95A	12p	OC77	25p	2N388A	50p
ACY28	19p	ASY58	25p	BC182	10p	BF173	22p	BU105	£3·90	OC81	15p	2N404	22p
ACY29	30p	ASY58	25p	BC182L	10p	BF176	35p	C111E	60p	OC81D	15p	2N404A	30p
ACY30	25p	ASZ21	40p	BC183	10p	BF177	35p	C400	30p	OC82	15p	2N524	55p
ACY31	25p	BC107	10p	BC183L	10p	BF178	45p	C407	25p	OC82D	15p	2N527	60p
ACY34	18p	BC108	10p	BC184	13p	BF179	50p	C424	17p	OC83	20p	2N696	12p
ACY35	18p	BC109	11p	BC184L	13p	BF180	30p	C425	40p	OC84	20p	2N697	15p
ACY36	30p	BC113	25p	BC186	27p	BF181	30p	C426	30p	OC139	15p	2N698	24p
ACY40	15p	BC114	30p	BC187	27p	BF182	30p	C428	20p	OC140	17p	2N699	55p
ACY41	18p	BC115	30p	BC207	11p	BF183	30p	C441	27p	OC170	15p	2N706	7p
ACY44	35p	BC116	35p	BC209	11p	BF184	25p	C442	35p	OC171	15p	2N706A	8p
AD140	40p	BC117	35p	BC209	11p	BF185	30p	C444	37p	OC200	25p	2N708	12p
AD142	40p	BC118	25p	BC212L	11p	BF188	30p	C450	17p	OC201	27p	1N709	45p
AD149	43p	BC119	45p	BC213L	11p	BF194	23p	C720	12p	OC202	27p	2N711	40p
AD161	35p	BC125	35p	BC213L	11p	BF195	24p	C722	25p	OC203	25p	2N717	42p
AD162	35p	BC126	35p	BC214L	12p	BF196	30p	C740	25p	OC204	25p	2N718	24p
AD161/		BC132	25p	BC225	25p	BF197	35p	C742	17p	OC205	35p	2N718A	50p
162(MP)	63p	BC134	30p	BC226	35p	BF200	45p	C744	17p	OC309	35p	2N726	27p
ADT140	50p	BC135	30p	BC317	12p	BF222	80p	C760	17p	P346A	17p	2N727	27p
ADZ11	£2	BC136	30p	BC318	12p	BF257	35p	C762	17p	P397	45p	2N743	17p
ADZ12	£2·10	BC137	35p	BC319	12p	BF270	25p	C764	60p	OCP71	43p	2N744	17p
AF114	17p	BC139	45p	BCY30	20p	BF271	17p	EC401	15p	ORP12	43p	2N914	17p

2N918	30p	2N2714	25p	2N3704	15p
2N929	22p	2N2904	25p	2N3705	12p
2N930	25p	2N2904A	30p	2N3706	12p
2N1131	20p	2N2905	25p	2N3707	13p
2N1132	22p	2N2905A	30p	2N3708	8p
2N1302	17p	2N2906	25p	2N3709	8p
2N1303	17p	2N2906A	27p	2N3710	10p
2N1304	20p	2N2907	25p	2N3711	10p
2N1305	20p	2N2907A	30p	2N3819	40p
2N1306	22p	2N2923	13p	2N3820	£1
2N1307	22p	2N2924	13p	2N3903	25p
2N1308	27p	2N2925	13p	2N3904	27p
2N1309	27p	2N2926		2N3905	25p
2N1613	17p	(G)	12p	2N3906	27p
2N1711	20p	2N2926(Y)	11p	2N4058	15p
2N1889	35p	2N2926		2N4059	10p
2N1890	45p	(O)	10p	2N4060	12p
2N1893	37p	2N3010	80p	2N4061	12p
2N2160	60p	2N3011	20p	2N4062	12p
2N2147	75p	2N3053	20p	2N5172	12p
2N2148	60p	2N3054	50p	2N5459	43p
2N2192	30p	2N3055	63p	2S034	75p
2N2193	30p	2N3391	17p	2S301	50p
2N2194	27p	2N3391A	20p	2S302A	45p
2N2217	20p	2N3392	17p	2S302	45p
2N2218	25p	2N3393	15p	2S303	60p
2N2219	27p	2N3394	15p	2S304	£1·10
2N2220	22p	2N3395	20p	2S305	£1
2N2221	22p	2N3402	22p	2S306	£1·10
2N2222	27p	2N3403	22p	2S307	£1·10
2N2368	17p	2N3404	32p	2S321	60p
2N2369	15p	2N3405	45p	2S322	50p
2N2369A	15p	2N3414	20p	2S322A	45p
2N2411	50p	2N3415	20p	2S323	60p
2N2412	50p	2N3417	37p	2S324	£1·20
2N2646	55p	2N3525	74p	2S325	£1·20
2N2711	22p	2N3702	12p	2S326	£1·20
2N2712	22p	2N3703	12p	2S327	£1·20

DIODES & RECTIFIERS

AA119	8p	BYZ11	32p	OA81	7p
AA120	8p	BYZ12	30p	OA85	7p
BA116	22p	BYZ13	25p	OA90	6p
BA126	22p	BYZ16	35p	OA91	7p
BY100	15p	BYZ17	35p	OA95	7p
BY101	12p	BYZ18	30p	OA200	6p
BY105	15p	BYZ19	25p	OA202	7p
BY114	12p	OA5	17p	SO10	4p
BY126	15p	OA10	22p	SO19	4p
BY127	17p	OA47	7p	IN914	6p
BY130	15p	OA70	7p	IN916	6p
BYZ10	35p	OA79	8p	IN4148	6p

500,000 SILICON PLANAR TRANSISTORS

NPN-PNP PLASTIC AND METAL CAN TYPES

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

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

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

TYPE STN5. Silicon Planar Transistors npn TO-5 Metal Can. Types similar to: BFY50-51-52 and 2N2192-92.
Price: 500 £9·50; 1,000 £16

TYPE STPL. As above but in pnp and similar to types 2N5354-56, 2N4058-2N4061 and 2N3702-3. Also used as complementary to the above npn devices type STNL.
Price: 500 £7·50; 1,000 £13

TYPE STNK. Silicon Planar Plastic Transistor npn with TO-18 pin circular lead configuration, I.C. 200mA, 300mW and similar to BC107-8-9, BC170, BC173, BC182-184, BC237-8-9 and BC337-8.
Price: 500 £9·50; 1,000 £16

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

200,000 SILICON ALLOY TRANSISTORS

Clearance of *pnp* Silicon Transistors from the 2S300 (TO-5) and 2S320 (SO-2) range and similar to the GC200-20S and BCY30-34 series. Ideal for *Amateur Electronics, Radio Hams and for experimental use in Schools, Colleges and Industry.*

Approximate count by weight:
100 off—**75p** (plus p. & p. 10p)
300 off—**£1·75** (plus p. & p. 15p)
500 off—**£2·50** (plus p. & p. 17½p)
1,000 off—**£4** (plus p. & p. 25p)
10,000 off—**£35** (plus p. & p. 55p)

Large quantities quoted for on request.
EXPORT INQUIRIES WELCOME

DIOTRAN SALES

PO BOX 5, WARE, HERTS

Full Money-Back Guarantee

POSTAGE & PACKING 7p

10 MILLION DIODES

Silicon or Germanium

State which when ordering

200	50p	10,000	£10·00
1,000	£2·00	50,000	£30·00
5,000	£7·00	100,000	£50·00

2,000,000 SILICON PLANAR TRANSISTORS

TO18 P.N.P. & N.P.N. TYPES

State which when ordering

100	£1·50	10,000	£90·00
500	£6·00	50,000	£400.00
1,000	£10·00	100,000	£625·00

LINEAR INTEGRATED CIRCUIT 709/PC S.G.S.

TO-5 can 8 lead. Full specification high gain Operational Amplifier data supplied. *Lowest ever price.*

QUANTITY: **1-9, 10-24, 25-99, 100-999**
PRICE EACH: **37p, 34p, 30p, 25p.**

Build yourself a TRANSISTOR RADIO

NEW! ROAMER 10 WITH VHF INCLUDING AIRCRAFT

10 TRANSISTORS. 9 TUNABLE WAVEBANDS, MW1, MW2, LW, SW1, SW2, SW3, TRAWLER BAND, VHF AND LOCAL STATIONS AND AIRCRAFT BAND.

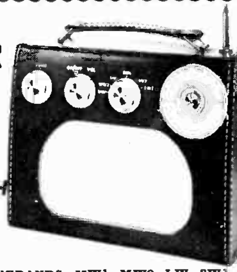
Built-in ferrite rod aerial for MW/LW. Retractable, chrome plated 7 section telescopic aerial, can be angled and rotated for peak short wave and VHF listening. Push-pull output using 600mW transistors. Car Aerial and tape record sockets. Switched earpiece socket complete with earpiece. 10 transistors plus 3 diodes. 5" heavy duty speaker. Air spaced ganged tuning condenser with VHF section. 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).

TOTAL BUILDING COSTS **£8·50** P.P. & INS. 50p (OVERSEAS P. & P. £1)

ROAMER EIGHT Mk. I

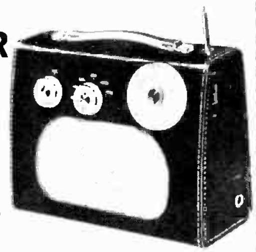
NOW WITH VARIABLE TONE CONTROL



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. Switched earpiece socket complete with earpiece. 8 transistors plus 3 diodes. 5" heavy duty 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).

TOTAL BUILDING COSTS **£6·98** P. P. & INS. 41p (OVERSEAS P. & P. £1)

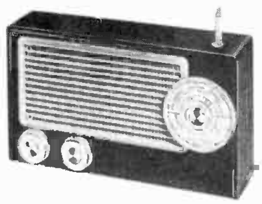
ROAMER SEVEN Mk. IV



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. 5" heavy duty 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 15p (FREE with parts). Earpiece with plug and switched socket for private listening, 30p extra.

TOTAL BUILDING COSTS **£5·98** P. P. & INS. 41p (OVERSEAS P. & P. £1)

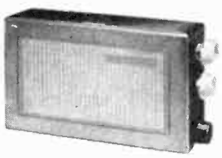
ROAMER SIX



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 × 5½in × 2½in approx. Easy build plans and parts price list 15p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£3·98** P. P. & INS. 26p (OVERSEAS P. & P. £1)

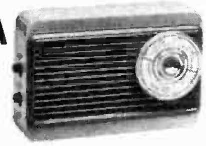
POCKET FIVE



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 5½in × 1¼in × 3½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£2·23** P. P. & INS. 21p (OVERSEAS P. & P. 63p)

TRANSONA FIVE



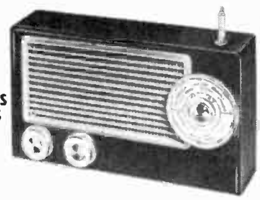
NOW WITH 3in SPEAKER

3 TUNABLE WAVE BANDS: MW, LW AND TRAWLER BAND. 7 stage—5 transistors and 2 diodes, ferrite rod aerial, tuning condenser, volume control, fine tone 3in moving coil speaker. Attractive case with red speaker grille. Size 6½in × 4½in × 1½in. Easy build plans and parts price list 10p (FREE with parts). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£2·50** P. P. & INS. 22p (OVERSEAS P. & P. 63p)

TRANS EIGHT

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 × 5½in × 2½in 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). Earpiece with plug and switched socket for private listening 30p extra.

TOTAL BUILDING COSTS **£4·48** P. P. & INS. 31p (OVERSEAS P. & P. £1)

NEW! "EDU-KIT"

BUILD RADIOS, AMPLIFIERS, ETC., FROM EASY STAGE DIAGRAMS. FIVE UNITS INCLUDING MASTER UNIT TO CONSTRUCT. Components include: Tuning Condenser: 2 Volume Controls: 2 Slider Switches: 4" 2½" Speaker: Terminal Strip: Ferrite Rod Aerial: 3 Plugs and Sockets: Battery Clips: 4 Tag Boards Balanced Armature Unit: 10 Transistors: 4 Diodes: Resistors: Capacitors: Three ⅝in Knobs.

Units once constructed are detachable from Master Unit, enabling them to be stored for future use. Ideal for Schools, Educational Authorities and all those interested in radio construction.

ALL PARTS INCLUDING CASE AND PLANS **£5·50** P.P. & INS. 31p (OVERSEAS P. & P. £1)

FULL AFTER SALES SERVICE

★ Callers side entrance Barratts Shoe Shop

★ Open 10-1, 2.30-4.30 Monday-Friday, 9-12 Saturday

RADIO EXCHANGE LTD

61 HIGH STREET, BEDFORD. Tel. 0234 52367

I enclose £.................. please send items marked

ROAMER TEN	☐	ROAMER SEVEN	☐
ROAMER EIGHT	☐	TRANS EIGHT	☐
TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

Parts price list and plans for..............................

Name ....

Address ....

.... P.E. 38

Practical Electronics Classified Advertisements

RATES: 8p per word (minimum 12 words). Box No. 10p extra. Advertisements must be prepaid and addressed to Classified Advertisement Manager, "Practical Electronics" IPC MAGAZINES LTD., Fleetway House, Farringdon Street, London EC4A 4AD

MISCELLANEOUS

. . . DON'T LOOK

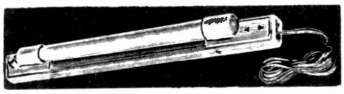
unless you really want to get the benefit from this collection of SUPER electronic projects. Have you ever wanted to build A MACHINE THAT LEARNS? Or perhaps make a TEACHING DEVICE? Maybe you fancy the idea of an ELECTRONIC FANTASY MACHINE? How about a "Thing" capable of REPRODUCING ITSELF? Whatever your electronic turn-of-mind, there's just GOT TO BE LOADS TO INTEREST YOU in the science-fiction-world of BOFFIN. Find out more that interests YOU!

GET YOUR CATALOGUE — SEND JUST 15p NOW!

TO: BOFFIN PROJECTS
4 CUNLIFFE ROAD
STONELEIGH, EWELL
SURREY

Designs by GERRY BROWN and JOHN SALMON and presented on TV.

12 VOLT FLUORESCENT LIGHTS



Beat Power Cuts, 12 ins 8 watt Tube, ideal for Caravan, Tent, Emergency Lighting, etc. Fully Transistorised, Low Battery Drain. With ON/OFF Switch and 12V Socket to run other Lights or 12V Equipment.

Unbeatable at **£3·30**
or in kit form **£2·90** post paid

SALOP ELECTRONICS Callers welcome
23 Wyle Cop
Shrewsbury, Shropshire *S.A.E. for lists*

CLEARING LABORATORY, scopes, V.T.V.M's, V.O.M's, H.S. recorders, transcription turntables, electronic testmeters, calibration units, P.S.U.'s, pulse generators, D.C. null-potentiometers, bridges, spectrum analysers, voltage regulators, sig-gens, M/C relays, components, etc. Lower Beeding 236.

JOHN SAYS . . .

RING MODULATOR by Dewtron is professional, transformerless, 5-transistor, has adjustable F1/F2 rejection. Module **£7.** Unit **£8·90. WAA-WAA** Pedal kit of all parts, including all mechanics and instructions ONLY **£2·95. AUTO RHYTHM** from Dewtron modules. Simple unit for waltz, fox-trot, etc. Costs under **£20** in modules. **SYNTHESISER MODULES** and other miracles! Send 15p for illustrated list. **D.E.W. LTD., 254 Ringwood Road, Ferndown, Dorset**

BRAIN CALCULATOR. Adds, subtracts, divides. Calculates figures, money, sums easily and quickly. Pocket size, with full instructions, **55p.** CAMERA CENTRE, Fleetwood.

HARDWARE FOR CONSTRUCTORS. Screws, nuts, brackets, spacers, etc. S.A.E. list. R. A. MARSH, 29 Shelbourne Road, Stratford-on-Avon, Warwicks.

CIRCUIT BOARD ETCHING KITS, full instructions, **£1·25,** c.w.o. ARVIN SERVICE COMPANY, 12 Cambridge Road, St. Albans, Herts.

MISCELLANEOUS *(continued)*

TOP TRANSISTORS

Brand New and Individually Tested Transistors supplied unmarked, but packed separately for indentification and guaranteed to be within their correct specification or money refunded. All at **9p.** each or **Any 25 transistors for only £1·90**

ACY22	BFY51	OC72	2N3702
BC108	BFY52	OC202	2N3703
BC109	BSY27	ZTX300	2N3705
BC168	OC45	2N706	2N3706
BC169	OC71	2N2926	2N3708

Money back guarantee. P. & P. 10p.
J. M. KING (V)
17 Buckridge, Portpool Lane, London, E.C.1

BUILD IT in a DEWBOX quality cabinet 2in × 2½in × any length. DEW LTD., Ringwood Road, Ferndown, Dorset. S.A.E. for leaflet. Write now—right now.

RECORD T.V. SOUND using our loudspeaker isolating transformer. Provides safe connection to recorder. Instructions included, **70p** + 10p P. & P. CROWBOROUGH ELECTRONICS (P.E.), Eridge Road, Crowborough, Sussex.

PROFESSIONAL CONTROL PANELS
with **FASCIA KIT**

MAKE YOUR OWN PANELS IN PERMANENT, ANODISED, SELF-ADHESIVE ALUMINIUM. NO SPECIAL EQUIPMENT NEEDED. EASY TO FOLLOW INSTRUCTIONS. CHOICE OF SILVER ON BLACK, RED, BLUE, GREEN.
TRIAL KIT **£1·28** Carr. Paid
No. 1 KIT **£1·88** Carr. Paid
No. 2 KIT **£2·39** Carr. Paid
M.P.E. Ltd. (P.E.), BRIDGE ST., CLAY CROSS DERBYS.

DO-IT-YOURSELF . . . . we stock a large range of audio and electronic components at very competitive prices, e.g.: Chassis speakers, cross-over networks, hi-fi speaker kits (Wharfedale and Peerless), BAF sound absorbent, speaker grille fabrics, inductors, resistors, electrolytics (reversible and polarised), transistors, etc. Send for FREE list. (2 × 3p stamps for fabric samples). Mail order ONLY. No callers please.

AUDIOSCAN Dept. P.E.2/72
4, PRINCES SQUARE, HARROGATE, YORKS.

. . . LOTS OF

Suppliers forget to tell you that their metal locators won't function until you've first got a transistor radio with which to beat the locators signal. The BOFFIN TREASURE PROBE, however, comes to your doorstep with PRINTED-CIRCUIT BOARD, all ELECTRONIC COMPONENTS, a ready-drilled box to put it in plus search-coil and earphone. Think of the fun you'll have BEACHCOMBING with the sensitive TREASURE-PROBE, and the expectancy of hearing its LOUD "BEEP" tell you "YOU'RE ON TO SOMETHING" GET YOUR TREASURE-PROBE SEND **£6·95** NOW!

BOFFIN PROJECTS
4 CUNLIFFE ROAD
STONELEIGH EWELL
SURREY

Designed by GERRY BROWN & JOHN SALMON and presented on TV

MISCELLANEOUS *(continued)*

NO NEED TO WORRY ABOUT A TRANSMITTING LICENCE

because this GPO approved transmitter/receiver kit does not use R.F. and you can get one easily. Your transmissions will be virtually SECRET since they won't be heard by conventional means. Actually it's TWO KITS IN ONE because you get all the printed-circuit boards and components for both the transmitter AND receiver. You're going to find this project REALLY FUN-TO-BUILD with the EASY-TO-FOLLOW instructions. An extremely flexible design with quite an AMAZING RANGE—has obvious applications for SCHOOL PROJECTS, LANGUAGE LABORATORIES, SCOUT CAMPS etc.

GET YOURS! SEND **£5·20** NOW

TO: 'BOFFIN PROJECTS'
DEPT. KE2010
4 CUNLIFFE ROAD
STONELEIGH, EWELL, SURREY

HOLIDAYS FOR BOYS. 14/16 years, Summer 1972. Tuition and practical work in electronics (and tape recording), engineering (Karting), photography. 11 days in Norfolk—**£16.** Write for free brochure. INTER-SCHOOL CHRISTIAN FELLOWSHIP, c/o 1, Hubbard Road, London, SE27 9PJ.

AUTOMATIC CHORD SELECTOR. Add Automatic chords to your organ. S.A.E. for details to MOLLOY, 5 Elm Road, Tokers Green, Reading, Berks.

BITE THAT MUSIC. GET YOUR MOLARS INTO THE MELODY. HEAR THROUGH YOUR TEETH WITH THE INCREDIBLE ADASTRANT. SIMPLE TO USE. WORKS FROM EARPHONE OF WIRELESS, ETC. CLEAN TEETH AND SKIN TO AND WITH MUSIC. PRICE **£1·00.**

SEND TO **DENTOSONICS LTD.**
590 ROMAN ROAD, BOW
LONDON, E.3

FASCIA PANELS, hi-fi equipment, etc., etched aluminium to individual specifications, S.A.E. details. R. MARSH, 29 Shelbourne Road, Stratford on Avon, Warwicks.

ASSORTED TAG STRIPS — MARVELLOUS SELECTION. 100 FOR **50p.** P. & P. 10p.
CRYSTAL MICROPHONES WITH MUTING SWITCH, CAN BE MOUNTED ON DESK OR FLOOR STAND. **£1·50** POST FREE.
MAIL ORDER ONLY
XEROZA RADIO
1 EAST STREET • BISHOP'S TAWTON • DEVON

SYNTHESISER MODULES

Send S.A.E. for details of voltage-controlled modules for synthesiser construction to:

D.E.W. Ltd.
254 Ringwood Road, Ferndown, Dorset

FOR SALE *(continued)*

SERVICE SHEETS

RECEIVERS AND COMPONENTS

ART WORK

Brand New to spec. Fully guaranteed.
Numerical Indicator 3015F. 7 segment display 0–9DP 5V 8mA bar **£1·89.** Fits DIL 16 pin sockets **29p.** 7447 driver **£1·25. Numicator** 190V side 0–9 leads **£1·25. Light Emitting Diode** visible red 2V 20mA **67p. BC107 9p. BC108 9p. BC109 9p.** Fet 2N3819 **31p.** TI843 unijunct **35p.** BC177/8 **11p.** BCY70/72 **16p.** BFY50/51/52/53 **18p.** 2N2926 oy **10p.** 2N3053 **19p.** 2N3055 **59p. I.C. Photo Detector** Darlington amp. **55p.** TI843 **67p.** OCP71 **75p.** ORP12 **49p. 1A Rectifiers** 100V **8p.** 400V **10p.** 50V **bridge 34p.** 1N914 **7p.** OA91 **7p. Zeners** 400mW. 5, 6, 9, 12, 18V **13p.**
Integrated Circuits, 74NTTL series, data 11p. 7400, 1, 2, 3, 4, 10, 20, 30, 40, 50, 51, 53, 54 **16p.** 7413, 70, 72, 74 **37p.** 73, 76, 86 **45p.** 75, 121 **57p.** 7490, 92, 93 **75p.** 41, 141, 42, 95 **95p.** 81, 82 **£1·25.**
Op Amps 8 lead, TO5, 709 **36p.** 710 **45p.** 741 **49p:** PA237 2W amp **£1·47.** 703 rf. if. **55p. S.C.R.** 3A 400V **67p.**
Transformer 6V 1A **80p.** Signal Injector af. rf. **£2. Eagle** audio cat. **10p.** P. & P. Mail order only. C.W.O. P. & P. 8p. Overseas 50p. Data sheets 7p.
S.A.E. **P.O. BOX 29. BRACKNELL, BERKS.**

WITWORTH TRANSFORMERS

TV Line out-put transformers

Manufacturers of the largest range in the country. All makes supplied.

Free catalogue.

Modern

BAIRD, BUSH, GEC, PHILIPS

Replacement types ex-stock.

For "By-return" service, contact London

01-948 3702

Tidman Mail Order Ltd., Dept. PE,
236 Sandycombe Road,
Richmond, Surrey.

Valves, Tubes, Condensers, Resistors, Rectifiers and Frame out-put Transformers also stocked.

Callers welcome.

TONE TESTER

IDEAL GIFT

Is a neatly designed solid state continuity tester in a small black aluminium case. Its bleep can be heard from at least 50ft. Ideal for tracing cable faults, etc. It will work into 80,000Ω loop.

USED BY
- HI-FI ENTHUSIASTS
- ELECTRICIANS
- DO-IT-YOURSELF MEN
- TESTERS
- TELEPHONE ENGINEERS
- MOTORISTS

How many times have you found yourself in a situation unable to check a simple thing like a fuse for example?

- PRICE £2·75 including postage and battery. Send P.O. or cheque.

- **HIGHAMS ELECTRONIC COMMUNICATIONS LTD.**
Dept. PE1, 58–60 Redchurch Street, London, E.2

nippiboard

MULTI-PURPOSE PRINTED WIRING BOARD FOR

PE TRANSISTOR CIRCUITS

	SRBP	FIBREGLASS
Photo-print Process Control Unit	4AS	4BS
Rhythmetron (Nov)	2A	2B
Lift Note Generator (Ingenuity) (Nov)	2A	2B
Chart Recorder (Oct)	2A	2B
Engine Temperature Controller (Oct)	1A	1B
Rain or Water Level Alarm (Oct)	1A	1B
Timer with Digital Readout (Sept)	2A	2B

TYPE 1A-15p; 1B-18p; 2A-28p; 2B-34p; 3A-36p; 3B-43p; 4AS-44p; 4BS-52p

ALSO SUITABLE FOR MANY OTHER PROJECTS

FREE NIPPIBOARD TYPE 1A when you buy

SL403D SHORT CIRCUIT PROOF I.C. AMP as specified for **EE RECORD PLAYER**

£1·99 plus 9p post & packing

NIP ELECTRONICS DEPT NB/E

P.O. BOX 11, ST. Albans, Herts, England.

AARVAK ELECTRONICS, 3 channel sound-light convertors: 1,200 watts, **£17;** 3,000 watts, **£25;** Medium Power Strobes **£16.** 74 Bedford Avenue, Barnet, Herts. 01-449 1268.

EX COMPUTER PRINTED CIRCUIT PANELS 2in × 4in packed with semi-conductors and top quality resistors, capacitors, diodes, etc. Our price 10 boards **50p.** P. & P. 7p. With a guaranteed minimum of 35 transistors. Data on transistors included.

SPECIAL BARGAIN PACK. 25 boards for **£1,** P. & P. 18p. With a guaranteed minimum of 85 transistors. Data on transistors included.

PANELS with 2 power transistors similar to OC28 on each board—components 2 boards (4 - OC28) **50p,** P. & P. 6p.

9 OA5, 3 OA10, 3 Pot Cores, 26 Resistors, 14 Capacitors, 3 GET 872, 3 GET 872B, 1 GET 875. All long leaded on panels 13in × 4in. 4 for **£1,** P. & P. 25p.

709C OPERATIONAL AMPLIFIER TO5
8 lead I.C. 1 off **50p.** 50 off **35p.** 100 off **20p.**

250 MIXED RESISTORS 62p
¼ & ½ watt.

150 MIXED HI STABS 62p
¼, ½ & 1 watt 5% & better.

QUARTZ HALOGEN BULBS
With long leads. 12V 55W for car spot lights, projectors, etc. **50p** each. P. & P. 5p.

GPO EXTENSION TELEPHONES
with dial but without bell. **95p** each. P. & P. 30p. **£1·75** for 2. P. & P. 50p.

BARGAIN RELAY OFFER
Single pole change over silver contacts 25V to 50V. 2·5kΩ coil. 8 for **50p.** P. & P. 5p.

KEYTRONICS mail order only
44 EARLS COURT ROAD
LONDON, W.8 01-478 8499

CHROMASONIC electronics
1972 CATALOGUE
10p post free

56 FORTIS GREEN ROAD, LONDON N10 3HN

DRY REED INSERTS

Overall length 1.85" (Body length 1.1"), Diameter 0.14" to switch up to 500 mA at up to 250v D.C. Gold clad contacts. 62½p per doz.; £3·75 per 100; £27·50 per 1,000; £250 per 10,000. All carriage paid.
G.W.M. RADIO LTD.
40/42 Portland Road, Worthing, Sussex 0903 34897

DUAL GATE MOSFET MEM564C, ruggedised 3N140, sim. 40673. For WW Communic. Rx, Stereo FM, etc., ONLY **65p,** UK post 5p. AMATRONIX LTD. 396 Selsdon Road, S. Croydon, Surrey, CR2 0DE.

LOT OFFERS invited for new compts: 950 mag-device relays—420 pots—1,300 capacitors—150 norbits—5,000 resistors—20 transformers, etc. Details Tel Halifax 56499.

CONTACT CLEARWAY ELECTRONICS LTD. for all your Fibre-Optic requirements. Fibre-Optic light sources, Components and custom built displays. Tel: Sandwich 3596 or write: Sandwich Industrial Estate, Sandwich, Kent.

LADDERS

LADDERS. 20ft, **£7.** Order C.O.D. Phone 02-993 5222. HOME SALES (Dept. PEE), Baldwin Road, Stourport, Worcs. Callers welcome.

BATTERY ELIMINATORS

The ideal way of running your TRANSISTOR RADIO, RECORD PLAYER, TAPE RECORDER, AMPLIFIER, etc. Types available: 6v, 9v, 12v, 18v (single output) £2 each. P. & P. 15p. 9v + 9v; 6v + 6v; or 4½v + 4½v (two separate outputs) £2.50 each. P. & P. 15p. Please state output required. All the above units are completely isolated from mains by double wound transformer ensuring 100% safety.
R.C.S. PRODUCTS (RADIO) LTD.
(Dept. P.E.), 31 Oliver Road, London, E.17

OSMABET LTD.

We make transformers amongst other things

MAINS TRANSFORMERS
Prim. 200/240V a.c. TX6, 425–0–425V, 500 Ma, 6·3V 6A CT, 6·3V 6A CT, 0·5–6·3V 3A, **£12·75;** TX1, 425–0–425V, 250Ma, 6·3V 4A CT, 6·3V 4A CT 0–5–6·3V, 3A, **£7·50;** TX2, 250–0–250V, 150mA, 6·3V4A CT, 0–5–6·3V, 3A, **£4·05;** TX5, 300–0–300V, 120mA, 6·3V 2A CT, 6·3V, 2A, 6·3V, 1A, **£4·05;** TX8, 250–0–250V, 65mA, 6·3V, 1·5A, **£2·10;** MT1, 200V, 30mA, 6·3V, 1A, **£1·20;** MT2, 230V, 45mA, 6·3V, 1·5A, **£1·50;** MT2A, 250V, 60mA, 6·3V, 2A, **£1·95;** MT3 Prim. 110/240V, Sec. 250V, 100mA, 6·3V, 2A, **£2·25.**
AUTO TRANSFORMERS
0–110–200–220–240V a.c. up or down fully shrouded fitted insulated terminal blocks. 30W **£1·35;** 50W **£1·80;** 75W **£2·10;** 100W **£2·55;** 150W **£3·15;** 200W **£3·90;** 300W **£5·25;** 400W **£6·30;** 500W **£7·50;** 600W **£8·25;** 750W **£9·75;** 1,000W **£12·75;** 1,500W **£18;** 2,000W **£24·75;** 3,000W **£33;** 4,000W **£45.**
LOW VOLTAGE TRANSFORMERS
Prim. 200/240V a.c., 6·3V, 1·5A, **85p;** 3A, **£1·13;** 6A CT, **£1·80;** 12V, 1·5A, **£1·13;** 3A CT, **£1·80;** 6A CT, **£2·70;** 18V, 1·5A CT, **£1·80;** 24V, 1·5A CT, **£1·80;** 3A CT, **£2·70;** 5A, **£3·75;** 8A, **£6;** 12A, **£9;** 40V, 3A CT, **£3·45.**
MIDGET RECTIFIER TRANSFORMERS
For FW rect., size 1¾ × 2 × 1½in, Prim. 200/240V a.c. output, PPT2 12–0–12V, 0·25A, PPT3 20–0–20V, 0·15A, **£1·20** each; ditto, size 2 × 2½ × 1¾in MTV1 9–0–9V, 1A, **98p;** MTV2 12–0–12V, 1A, MTV3 20–0–20V, 0·75A, **£1·20** each.
O/P TRANSFORMERS FOR POWER AMPLIFIERS
P.P. sec. tapped 3–7·5–15 ohms, A–A 6·6kΩ, 30W (KT66, etc.), **£4·05;** 50W, 3kΩ, A–A, **£6·75;** 100W, 3kΩ, A–A, EL34 (KT88, etc.) **£11·40** with and to 400W.
LOUDSPEAKERS FOR POWER AMPLIFIERS
New, famous makes, 15W with tweeter, **£4·75;** 25W, **£5·60;** 35W, **£7·20;** 50W, **£10·00;** 100W, **£21·50;** E.M.I. 13½ × 8in 10W, 3 or 8 or 15 ohms, **£2·25.** Ditto with two tweeters and Xover, **£4·00;** Horn Tweeters 2–16kHz 10W 8 or 16 ohms, **£1·50.** HI-FI, 8 × 5in 8Ω, **£1·85;** 10 · 6in 3 or 8 15Ω, **£2·10.**
MANUAL OF POWER AMPLIFIERS
Covering valve amplifiers of 30 to 400 watts, with price list of transformers and chokes specified. **25p.**
LOUDSPEAKERS
2in 35Ω, 2½in 8 or 80Ω, 2½in 25Ω, 3in 30Ω, **60p** each; 3½in 3Ω, 4in 15Ω, 5 × 3in 3 or 8 or 15 or 25Ω, **90p** each; 6 × 4in 3 or 8Ω; 7 × 4in 3Ω; 8 × 2½in 3Ω; 6½in 3Ω, **£1·08;** 8 × 5in 3 or 15 or 25Ω, **£1·35;** 8in 3Ω, **£1·85;** 10in 3 or 15Ω, **£2·25.**
SPEAKER AUTO MATCHING TRANSFORMER 12W
3 to 8 or 15 ohms, up or down, **75p.** P. & P. 15p.
100 WATT POWER AMPLIFIER
4 inputs, variable tone controls, mixing controls, response 25-20kHz, for a.c. 200/250V, new and guaranteed. S.A.E. details. **£39.**
BULK TAPE ERASERS
Instant erasure, tape spools and cassettes, demagnetizes tape heads, a.c. 200/250V, **£2·40** plus 24p P. & P.
AIRCRAFT BAND CONVERTERS
Covers entire aircraft band, 110–135MHz, fully tunable, works in proximity of any a.m. receiver, with battery, instructions, **£4·25** plus 25p P. & P.
PRINTED CIRCUIT ETCHING KITS
Comprehensive outfit with solutions and equipment to make your own P.C. boards, instructions, **£1·35,** p.p. 20p.
TAPE RECORDER MOTORS
A variety of uses, fans, models, blowers, etc., 230V a.c., **75p** each.
CONDENSERS
Paper: 0·01/2kV, **12½p;** 0·22/800V a.c. **25p;** 0·47/700V, **15p;** 40/150V, **25p;** 4/500V **25p.** Electrolytics: 6,000/15V, **10p;** 10,000/16V, **40p;** 100 × 60/450V **25p;** 350 × 50/325V, **25p;** 100 × 400/275V, **25p;** 6500/64V, **50p.**
P.E. SCORPIO IGNITION SYSTEM
As specified, Transformer on Mullard Pot Core **£3·45;** Eddystone Diecast Box **£1·85,** 0·47 mfd 1,000V **25p.**
Carriage extra on all orders, etc., etc.

S.A.E. INQUIRIES-LISTS. MAIL ORDER ONLY
46 Kenilworth Road, Edgware, Middx. HA8 8YG
Tel. 01-958 9314

TRANSISTORS 2p EACH

SPECIAL BULK PURCHASE
New unmarked, assorted gain transistors.
NPN-PNP-TO 5 and TO 18 similar to: BFY.50, 51, 52, 53. BCY.30, 31, 32, 33. BFX.88. 2N.3702. 2N.3703. 2N.3704-11. 2N.706.
In packs of 50 (units of 10) state types required.
PRICE £1 PER PACK
CWO—Under £2 add 10p P. & P.
Special offer while stocks last
DIODE IN.914 at 3p each
BACON ELECTRONICS
133 High St., HURSTPIERPOINT, Sussex
TEL. 2554-5

Published approximately on the 15th of each month by IPC Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. Printed in England by Chapel River Press, Andover, Hants. Sole Agents for Australia and New Zealand – Gordon & Gotch (A/sia) Ltd.: South Africa – Central News Agency Ltd.: Rhodesia and Zambia—Kingstons Ltd.: East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage): For one year to any part of the world £2·65 (£2.13.0.).

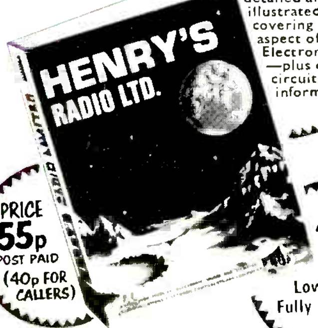
HENRY'S RADIO LIMITED

ENGLAND'S LEADING ELECTRONIC CENTRES

HENRY'S RADIO

HI-FI · ELECTRONIC COMPONENTS · TEST · P.A. · DISCOTHEQUE · LIGHTING · MAIL ORDER

10th EDITION CATALOGUE



350 pages fully detailed and illustrated covering every aspect of Electronics—plus data, circuits and information

PRICE 55p POST PAID (40p FOR CALLERS)

10,000 Stock lines at Special Low Prices and Fully Guaranteed

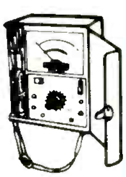
PLUS! FIVE 10p VOUCHERS FOR USE WITH PURCHASES

Send to this address—**Henry's Radio Ltd. (Dept. PE), 3 Albemarle Way, London, E.C.1**—for catalogue by post only. All other mail and callers to "303", see below.

A NEW HENRY'S CATALOGUE IS A MUST FOR ELECTRONICS TODAY!

HOME EQUIPMENT

AF105 50k/V multimeter (illus.). Price **£8·50**, p.p. 20p. Leather case **£1·42**.
200H 20k/V. Price **£3·87**, p.p. 20p. Case **62p**.
500 30k/V multimeter. Price **£8·87**, p.p. 20p. Leather case **£1·50**.
THL33 2k/V. Price **£4·12**, p.p. 15p. Leather case **£1·15**.
TE65 Valve voltmeter. Price **£17·50**, p.p. 40p.
SE250B Pocket pencil signal injector. Price **£1·75**, p.p. 15p.



SE500 Pocket pencil signal tracer. Price **£1·50**, p.p. 15p.
TE20D RF generator. Price **£15**, p.p. 40p.
TE22D Matching audio generator. Price **£17**, p.p. 40p.
TE15 Grid dip meter. Price **£12·50**, p.p. 40p.
TO3 Scope 3in tube. Price **£35·50**, p.p. 50p.
TE22 Audio Generator. Price **£17**, p.p. 40p.
C1-5 Pulse Scope. **£39·00**, p.p. 50p.
U4341 A.C./D.C. Multitester and transistor tester. A.C. and D.C. current. In steel case. Price **£10·50**, p.p. 15p.
TMK500 30kV Multitester. Price **£8·87**, p.p. 13p. Leather case **£1·98**.
LARGEST RANGE of Panel Meters, Edge Meters and Test Equipment of every sort. Full details in latest catalogue—see above.
Carriage, etc., 50p each; 75p per pair for kits

LOW COST HI-FI SPEAKERS

E.M.I. Size 13¼in × 8¼in and Ceramic Magnet
TYPE 150 6 watt, 3, 8 or 15 ohms **£2·12**. Post 22p.
TYPE 150TC Twin cone version **£2·75**. Post 22p.
TYPE 450 10 watt with twin tweeters and crossover, 3, 8 or 15 ohms. **£3·90**. Post 25p.
TYPE 390 20 watt with tweeter and crossover, 8 and 15 ohms. **£7·50**. Post 28p.

POLISHED CABINETS For 150, 150TC and 450 **£4·50**. Post 30p.

SPEAKER KITS

WHARFEDALE 4–8 ohms		**PEERLESS** 8 ohm Systems	
Unit 3. 8in 15W	£10·50	20–2. 8in 30W	£11·25
Unit 4. 12in 25W	£14·25	20–3. 8in 40W	£16·75
Unit 5. 12in 35W	£20·25	4–30/12. 12in 40W	£22·75
GOODMANS DIN 20 KIT 20W, 4 ohm.			£11·75

Carriage, etc., 50p each; 75p per pair for kits.

STEREO HEADPHONES

With stereo jack. Post 15p

Dulci SH650D	£2·25
Rotel RH600	£4·67
Akai ASE9S	£5·50
Eagle SE30	£5·97
Koss K711	£7·97
Pioneer SE30	£9·45
Koss PRO4A	£15·50

HI-FI TO SUIT EVERY POCKET

SAVE UP TO 40% ON LIST PRICES
PLUS FREE BIB GROOV-KLEEN Value £1·99.

ROTA 1500 5 + 5 watts. Garrard 2025TC with 9TAHC diamond ceramic. Plinth/Cover. SDL1 Compact Speakers. Size 15" × 10½" × 7".
SAVE £27 **£47·75** Carr. £2

TELETON "206" Garrard SP25 Mk. III, Goldring G800 Series Cart., Plinth/Cover. New 15 watt Quality SDL1 Bookshelf Speaker Systems, all leads, etc.
SAVE £30 **£54·95** Carr. £2

TELETON F2000 Med. Wave, Stereo FM Tuner Amplifier, Garrard 2025TC, 9TAHC Diam., Plinth/Cover. New 15 watt Speaker Systems as above, all leads, etc.
SAVE £36 **£59·95** Carr. £2

or with 2 × SA125 Speakers **£48·95** Carr. £2

ROTA 2200 10 + 10 watt. Garrard SP25 III/G800H. Plinth/Cover. New 15 watt SDL2 Twin Speaker Systems, all leads, etc.
SAVE £32 **£62·50** Carr. £2

Low prices plus 12 months' guarantee and demonstrations

FREE—Latest Special Price Stock List and Stereo Systems, Ref. 16/17.

FREE BROCHURES

★ P.A., DISCO and LIGHTING No. 18
★ TRANSISTORS, I.C.'s No. 36

20 WATT I.C. AMPLIFIER

Toshiba 20 watt Power Amplifier, **£4·57**
Toshiba Pre-Amplifier I.C., **£1·50**
Data and suggested circuits No. 42, **10p**
SL403D 3 watt I.C. with 8 page data and circuits, **£1·50**
IC12 6 watt I.C., **£2·50**

TEXAS PRE-AMPLIFIERS AND 1-100W AMPLIFIERS

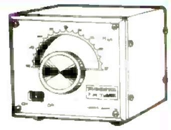
Circuits, layouts and data, **£1·25**. Post paid.

NIXIE TUBES

(post 15p per order)

XN3 or XN13 0–9 side view with data sheet, **85p** each.
GN4 end view 0–9 with socket and data, **£1·75**
All I.C.'s for Digital Clocks in stock. HENRY'S CLOCK CIRCUIT No. 29/2, **15p**

BUILD THIS VHF FM TUNER



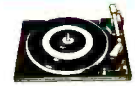
5 MULLARD TRANSISTORS 300kc/s BAND-WIDTH PRINTED CIRCUIT, HIGH FIDELITY REPRODUCTION. MONO AND STEREO.
A popular VHF FM Tuner for quality and reception of mono and stereo. There is no doubt about it—VHF FM gives the REAL sound. All parts sold separately.
Free Leaflet No. 3 & 7. **TOTAL £6·97**, p.p. 20p. Cabinet **100p**. Decoder Kit **£5·97**. Tuning meter **£1·75**.
Mains unit (optional) Model PS900 **£2·47**.
Mains unit for Tuner and Decoder PS1200 **£2·62**.

HIGH QUALITY SILICON AMPLIFIERS AND PRE-AMPS

Self-powered Silicon–FET Pre-Amplifiers. Push-button selectors, tape record/play, adjustable levels, drive up to 4 × PA25 or 2 × PA50 per channel.
FET 9/4 Mono or single channel. All facilities plus microphone. Mixing. Price **£12·50**.
FET 154 Stereo with all facilities, magnetic cart. input, etc. Price **£16·50**.
SILICON POWER AMPLIFIERS RMS OUTPUT
PA25 25 watts into 8 ohms, **£7·50**. PA50 50 watts into 4 ohms, **£9·50**. MU442 Power Supply for 1 or 2 PA25's or 1 only PA50, **£6**. Post 20p.
FREE BROCHURE NO. 25 ON REQUEST.
NO SOLDERING—ALL UNITS INTERCONNECTING.
ON DEMONSTRATION AT "356".

TERRIFIC SAVINGS!

GARRARD - BSR - THORENS GOLDRING - PIONEER CONNOISSEUR



CHASSIS (P) (less cartridge)		ASSEMBLED (P) (less cartridge, with cover)		ASSEMBLED (with cart. P and C)	
*SP25 Mk. III	£11·30	MP60 (TDIP)	£17·65	2025TC/9TAHCD	£13·95
†AP76	£19·97	HT70 PC	£24·00	SP25/3-G800H	£18·95
●MP60	£11·30	PL12AC	£36·50	AP76-G800	£29·95
●MP610	£15·15	GL72/PC	£36·95		
●HT70	£16·60	GL75 PC	£43·75		
GL72	£22·95	TD150AB/TXII	£45·50		
GL75	£28·97	BD2	£32·25		
DUAL 1215	£39·00				

CHASSIS WITH CARTRIDGE		(P) SPECIAL PRICE WITH CARTRIDGE—ADD
*2025TC/9TAHCD	£9·50	All magnetic—Recommended Y940 (=AD76K) £3·25; AT66 £4·95; G850 £4·25; AT21 £9·60; G800 or G800H £6·55; M44.7 or C £7·45; 909X £7·32
*3000/9TAHCD	£9·98	
TEAK PLINTH WITH COVER (State deck) *P1/T1 Std.	£3·00	
*BN1 Deluxe	£8·00	
†P4/T4 Std.	£4·25	
†BN4 Deluxe	£8·00	
●P6/T6 Std.	£3·00	
●BSR Deluxe	£6·25	

Post, etc.: Chassis 50p, with Plinth/Cover 70p, Plinth/Cover 30p, Carts. 15p.

300mW TRANSISTOR AMPLIFIER MODEL 4-300

Fully assembled 4TR Amplifier. Size 5½ × 1⅞ × ⅞in, 1–10mV adjustable sensitivity. Output 3–8 ohms. Fitted Vol. control. 9 volt operated. Thousands of uses plus low cost. **£1·75** p.p. 15p (or 2 for **£3·25** p.p. 15p).

SINCLAIR PROJECT 60 PACKAGE DEALS —SAVE POUNDS

2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply, **£16·75**, Carr. 40p. Or with PZ6 power supply **£18·25**. Carr. 40p, 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply **£20·25**. Carr. 40p. Transformer for PZ8 **£2·45** extra. New! Project "605" stereo system **£21·50**. Any of the above with Active Filter unit add **£4·75** or with pair O16 speakers add **£16**. Also new FM Tuner **£20·25**. 2000 Amplifier **£23·75**, p.p. 50p. 3000 Amplifier **£31·50**. Also IC12 **£2·50**.

"BANDSPREAD" PORTABLE TO BUILD

Printed circuit all transistor design using Mullard RF/IF Module. Medium and Long Wave bands plus Medium Wave Bandspread for extra selectivity. Also slow motion geared tuning, 600mW push–pull output, fibre glass PVC covered cabinet, car aerial. Attractive appearance and performance.
TOTAL COST TO BUILD **£7·98**, p.p. 32p (Batt. 22p). All parts sold separately—Leaflet No. 2.
"7T" PORTABLE (as previously advertised) **£6·98**, p.p. 35p from stock—Leaflet No. 1.

MORE OF EVERYTHING AT LOW PRICES ALWAYS FROM HENRY'S

*Components in stock for most published designs—send large SAE with list for parts quote for your circuit.

Electronic Components, Audio and Test Gear Centre	*High Fidelity Sales & Demonstrations Centre*	*P.A., Disco & Lighting Centre*	*Mail Orders, Special Bargain Shop, Industrial Sales*
356 EDGWARE ROAD, LONDON, W.2. Tel: 01-402 4736	**354 EDGWARE ROAD, LONDON, W.2. Tel: 01-402 5854**	**309 EDGWARE ROAD, LONDON, W.2. Tel: 01-723 6963**	**303 EDGWARE ROAD, LONDON, W.2. Tel: 01-723 1008/9**

"309", "354" & "356" OPEN SIX FULL DAYS A WEEK 9 am to 6 pm MONDAY TO SATURDAY