PRACTICAL

ELECTRONICS

JANUARY 1972

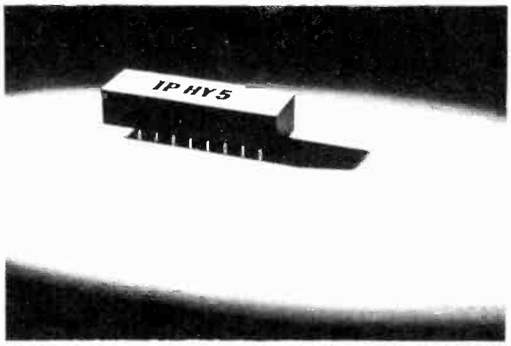
20p

PHOTO-PRINT PROCESS CONTROL for colour and monochrome

ALSO INSIDE:

I.C. AUDIO MIXER

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.

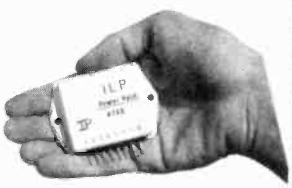
OUTPUT NOISE VOLTAGE
0.5mV.

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.

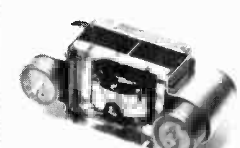
TOTAL DISTORTION less than 1% (typical 0.1%) at all output powers.

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

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 × 2¾in. (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

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.

ONLY £57·75 carr £1·75

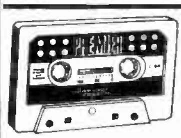
FREE
STEREO HEADPHONES and all leads and plugs supplied with all systems

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 less cartridge	£11·30
Garrard SP25 111 with Goldring G800 cartridge (List £28·35)	£15·50
Garrard AP76 less cartridge	£19·50
Garrard 3500 with Sonotone 9TAHC 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.

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.

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

HI-FI STEREO HEADPHONES

Designed to the highest possible standard. Fitted 2¼in 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

E.M.I. 13×8in. HI-FI SPEAKERS

Fitted two 2¼in tweeters and crossover network. Available with 8 or 15 ohm impedance. Handling capacity 10W. Brand new.

£3·47 P. & P. 40p

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 × 2¾in.

ONLY £16·25 Carr. 40p

"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, 3/16in pencil bit, 25 watt. 240 volt A.C. **£1·50** P. & P. 15p

"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	£1·87
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

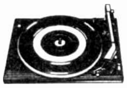
Also see next two pages

HI-FI EQUIPMENT

SAVE UP TO 33⅓% OR MORE

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

RECORD DECKS



B.S.R.

Mini Mono‡	£4·97
C129‡	£6·70
MP60	£10·75
610	£14·65
510	£11·85
310	£9·65
810	£34·47
MP60 T.P.D.1.	£17·65
MP60 T P.D.2	£15·85
610 T.P.D.1.	£20·97
510 T.P.D.1.	£18·75
210 Package*	£9·85
H.T.70	£15·55
H.T. 70 Package	£22·50

THORENS

TD 125	£59·65
TD125AB	£94·25
TX25	£6·70
TD150A II	£34·50
TD150AB II	£40·25
TX11	£3·77

GARRARD

2025 T/C*	£8·50
3500*	£9·75
SP25 III	£10·50
SL65B	£13·45
AP76	£18·90
SL72B	£23·95
SL75B	£26·50
SL95B	£32·95
401	£27·45
ZERO 100A	£44·97
ZERO 100S	£41·97

GOLDRING

GL69/2	£21·25
GL69P/2	£28·50
GL75	£29·97
GL75P	£38·50
LID69/75	£3·40
G99	£21·97

PIONEER

PL12AC	£36·50

‡Mono *Stereo Cartridge
All other models less Cartridge
Carriage 50p extra any model.

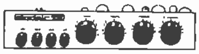
RECORD DECK PACKAGES

Decks supplied ready wired in plinth and cover fitted with cartridge.

Garrard 2025 T/C with Sonotone 9TAHCD	£13·95
Garrard SP25 III with 9TACHD	£15·95
Garrard SP25 III with Goldring G800	£18·95
Garrard AP76 with Goldring G800	£29·95
BSR MP60 Audio Technica AT.55	£21·00
Goldring GL69/2 with Goldring G800	£37·50
Goldring GL75 with Goldring G800	£42·50
Goldring GL75 with Goldring G800E	£46·65

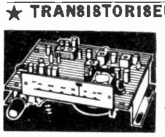
Carriage 50p extra any model.

SINCLAIR EQUIPMENT



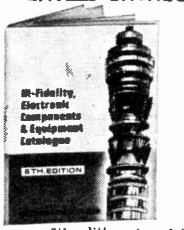
Project 60. Package offers. 2 × Z30 amplifier, stereo 60 pre-amp, PZ5 power supply, **£16·75.** Carr 37½p. Or with PZ6 power supply, **£18·85.** Carr. 37½p. 2 × Z50 amplifier, stereo 60 pre-amp, PZ8 power supply, **£20·25** Carr. 37½p. Transformer for PZ8, **£2·97** extra. Add to any of the above **£4·87** for active filter unit and **£13·90** for pair of Q16 speakers. Project 60 FM Tuner **£20·25.** Carr. 37½p. New Project 605 **£20·97.** Carr. 37p.
All Sinclair products in stock. IC10/IC12 **£2·50.** 2,000 amplifier, **£23·75.** Carr. 37½p. 3000 Amplifier **£31·50.** Carr. 37½p. Neoteric amplifier **£43·95.** Carr. 37½p.

★ TRANSISTORISED FM TUNER ★



6 TRANSISTOR HIGH QUALITY TUNER, SIZE ONLY 6 × 4 × 2½in. 3 I.F. stages. Double tuned discriminator. Ample output to feed most amplifiers. Operates on 9V battery. Coverage 88-108 MHz. Ready built ready for use. Fantastic value for money. **£6·37½,** P. & P. 12½p.
Stereo multiplex adaptors **£4·97½.**

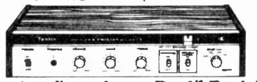
LATEST CATALOGUE



SEND NOW—STILL ONLY 37½p P. & P. 10p

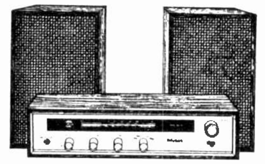
Our new 6th edition gives full details of a comprehensive range of HI-FI EQUIPMENT COMPONENTS, TEST EQUIPMENT and COMMUNICATIONS EQUIPMENT. FREE DISCOUNT COUPONS VALUE 50p.
272 pages, fully illustrated and detailing thousands of items at bargain prices.

TELETON SAQ-206 STEREO AMPLIFIER



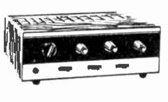
Latest exciting release. Beautifully styled with walnut case. 6 + 6 watts r.m.s. Switched inputs for Mag, Xtal, aux, tape. Incorporates volume, bass, treble, sliding balance, scratch filter and loudness controls. Rec. List £32·50. Our price **£18·50.** Carr. 37p.

TELETON SPECIAL OFFER!



CR10T AM/FM STEREO TUNER AMPLIFIER WITH MATCHING PAIR OF SPEAKER SYSTEMS. Output 4 watts per channel. Excellent reception, AFC, built-in MPX. Cer/XTAL Input. Total List **£50·25.** OUR PRICE **£22·75.** Carr. 62½p.
Also available with Garrard 2025T/C Record Changer, Plinth, cover and stereo cartridge. Ready wired **£36·50.** Carr. £1.

LAFAYETTE LA. 324 STEREO AMPLIFIER



12·5 + 12·5 watt R.M.S. Mag/Cer/Tuner /Tape Inputs. Excellent performance. Compares with amplifiers up to £40.
OUR PRICE **£24.** Carr. 37½p.

TAPE CASSETTES

Top quality in plastic library boxes.

C90	60 min	37½p,	3 for £1·05
C60	90 min	60p,	3 for £1·65
C120	120 min	67½p,	3 for £1·85

Cassette Head Cleaner **56p.** *Post Extra*

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.

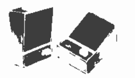
TMK MODEL 117 F.E.T. ELECTRONIC VOLTMETER

Battery operated, 11 meg input. 26 ranges. Large 4½in mirror scale. Size 5¼in × 4½in × 2½in. 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.

230 VOLT A.C. 50 CYCLES RELAYS

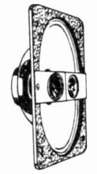
Brand New. 3 sets of changeover contacts at 5 amp rating. **50p** each. P. & P. 10p (100 lots £40). Quantities available.

HOMER INTERCOMS



Ideal for home, office, stores, factories, etc. Supplied complete with batteries, cable and free instructions.
2 Station **£2·97,** P. & P. 15p.
3 Station **£5·25,** P. & P. 15p.
4 Station **£6·62,** P. & P. 17p.

EMI LOUDSPEAKERS

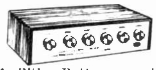


Model 350. 13″ × 8″ with single tweeter/crossover. 20–20,000Hz. 15 watt RMS. Available 8 or 15 ohms. **£7·50** each. P. & P. 37p.
Model 450. 13″ × 8″ with twin tweeters/crossover 55–13,000Hz. 8 watt RMS. Available 8 or 15 ohms. **£3·50** each. P. & P. 25p.

TE 1018 DE-LUXE MONO HIGH IMPEDANCE HEADSET

Sensitive, soft earpads, adjustable headband. Magnetic, impedance 2,600 ohms.
£1·97. P. & P. 15p.

MP7 MIXER PREAMPLIFIER

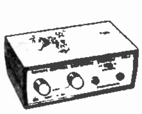


5 microphone inputs each with individual gain controls enabling complete mixing facilities. Battery operated. 9½″ × 5″ × 3″. Inputs Mics: 3 × 3mV 50K; 2 × 3mV 600 ohms. Phono meg. 4mV 50K. Phono ceramic 100mV 1 meg. Output 520mV 100K. **£8·97.** P. & P. 20p.

HOISDEN DH-02S STEREO HEADPHONES

Wonderful value and excellent performance combined. Adjustable headband. 8 ohms impedance. 20–12,000 cps. Complete with lead and stereo jack plug. ONLY **£2·37½.** P. & P. 12½p.

1021 STEREO LISTENING STATION



For balancing and gain selection of loudspeakers with additional facility for stereo headphone switching. 2 gain controls, speaker on-off slide switch, stereo headphone sockets. 6″ × 4″ × 2¼″. **£2·25.** P. & P. 15p.

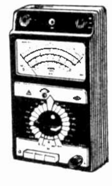
SH628 STEREO HEADSET

Outstanding value. Soft earpads. Adjustable head band. 8–16 ohms. 20–20,000Hz. Complete with cable and stereo jack plug. **£1·87.** P. & P. 15p.

SPECIAL PURCHASE

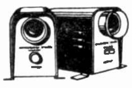
Brand new 18″ 100 watt speakers. Made by Fane. 18″ 100 watt rms. 35 cps bass resonance.
Limited stock only.
£13·95 Each Carr. 50p

U4312 MULTIMETER



Extremely sturdy instrument for general electrical use. 667 o.p.v.
0/·3/1·5/7·5/30/60/150/300/600/900 VDC and 75mV.
0/·3/1·5/7·5/30/60/150/300/600/900 VAC.
0/300uA/1·5/6/15/60/150/600MA/1·5/6 AMP. D.C.
0/1·5/6/15/60/150/600MA/1·5/6 AMP. AC.
0/200 Ω/3K/30K Ω.
Accuracy DC 1%, AC 1·5%. Knife edge pointer, mirror scale. Complete with sturdy metal carrying case, leads and instructions. **£9·50** plus P. & P. 25p.

PRS-2 PHOTO ELECTRIC RELAY SYSTEM



Inexpensive warning or counting system consisting of an enciter and relay unit. Relay unit has variable sensitivity control and switch for intermittent alarm operation. Enciter unit has removable infra red filter and A.C. outlet socket to operate bells, counters, etc. 240V A.C. Complete with cables and instructions. **£9·97.** P. & P. 25p.

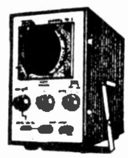
UNR-30 RECEIVER

4 Bands covering 550KHz–30MHz. B.F.O. Built in Speaker 220/240V a.c. Brand new with instructions. **£15·75.** Carr. 37½p.

LAFAYETTE HA-600 RECEIVER

General coverage 150–400KHz, 550KHz–30MHz. FET front end, 2 mech. filters, product detector, variable B.F.O., noise limiter, S Meter, Bandspread. RF Gain. 15in × 9½in × 8¼in. 18lb. 220/240V a.c. or 12V d.c. Brand new with instructions **£45.** Carr. 50p.

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.

TE-16A Transistorised Signal Generator.

5 ranges 400 kHz–30 mHz. An inexpensive instrument for the handyman. Operates on 9v battery. Wide, easy to read scale. 800 kHz modulation. 5¼ × 5¼ × 3½. Complete with instructions and leads. **£7·97½.** P. & P. 20p.

RUSSIAN CI-16 DOUBLE BEAM OSCILLOSCOPES

5MHz Pass Band. Separate Y1, Y2 amplifiers. Calibrated trigger sweep from 0·2μsec to 100msec/cm. Supplied complete with all accessories and instructions. **£87.** Carr. paid

POWER RHEOSTATS

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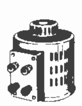

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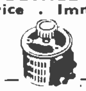

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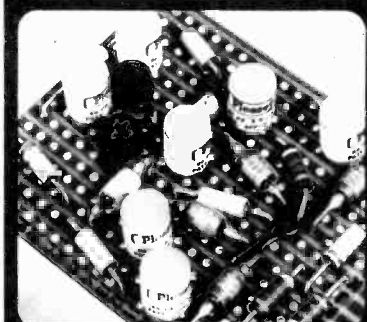

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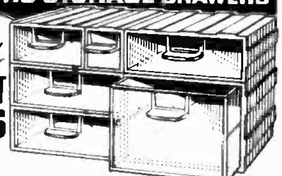

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100	0·25	0·33	0·53	0·58	0·63	1·40
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200	0·05	0·09	0·06	0·14	0·20	0·24	1·00
400	0·06	0·13	0·07	0·20	0·27	0·37	1·25
600	0·07	0·16	0·10	0·23	0·34	0·45	1·85
800	0·10	0·17	0·13	0·25	0·37	0·55	2·00
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T5	8	2G382T	OC82
T6	8	2G344B	OC44
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U5	60 200mA sub-min. Sil. diodes	0·50
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U8	50 Sil. planar diodes 250mA, OA/200/202	0·50
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Q34	7 Sil. NPN trans. 2N2369, 500MHZ	0·50
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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).
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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
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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
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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
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1N645	0·25	ACY17	0·30	BF195	0·15	MAT100	0·25	OC46	0·27
1N725A	0·20	ACY18	0·25	BF196	0·15	MAT101	0·30	OC57	0·60
1N914	0·07	ACY19	0·25	BF197	0·15	MAT120	0·25	OC58	0·60
1N4007	0·20	ACY20	0·20	BF861	0·28	MAT121	0·30	OC59	0·65
1S021	0·20	ACY21	0·20	BFS98	0·28	MJE520	0·87	OC66	0·50
1S113	0·15	ACY22	0·10	BFX12	0·20	MJE2955	1·37	OC70	0·12
1S130	0·18	ACY27	0·25	BFX13	0·25	MJE3055	0·87	OC71	0·12
1S131	0·18	ACY28	0·17	BFX29	0·25	NKT128	0·35	OC72	0·20
1S202	0·23	ACY39	0·50	BFX30	0·25	NKT129	0·30	OC73	0·30
2G240	1·97	ACY40	0·15	BFX35	0·98	NKT211	0·25	OC74	0·30
2G301	0·20	ACY41	0·15	BFX63	0·50	NKT213	0·25	OC75	0·25
2G302	0·22	ACY44	0·25	BFX84	0·25	NKT214	0·15	OC76	0·25
2G306	0·30	AD140	0·50	BFX85	0·30	NKT216	0·37	OC77	0·40
2G371	0·22	AD149	0·50	BFX86	0·25	NKT217	0·35	OC78	0·20
2G381	0·25	AD161	0·37	BFX87	0·25	NKT218	1·13	OC79	0·22
2G414	0·30	AD162	0·37	BFX88	0·20	NKT219	0·38	OC81	0·20
2G417	0·22	AF106	0·30	BFY10	1·00	NKT222	0·20	OC81D	0·20
2N214	0·48	AF114	0·25	BFY11	1·25	NKT224	0·22	OC81M	0·20
2N247	0·25	AF115	0·25	BFY17	0·25	NKT251	0·24	OC81DM	0·18
2N250	0·50	AF116	0·25	BYF18	0·25	NKT271	0·25	OC81Z	0·40
2N404	0·20	AF117	0·25	BFY19	0·25	NKT272	0·25	OC82	0·25
2N697	0·15	AF118	0·62	BFY24	0·45	NKT273	0·15	OC82D	0·20
2N698	0·40	AF119	0·20	BFY44	1·00	NKT274	0·20	OC83	0·25
2N706	0·10	AF124	0·25	BFY50	0·22	NKT275	0·25	OC84	0·25
2N706A	0·12	AF125	0·20	BFY51	0·20	NKT277	0·20	OC114	0·38
2N708	0·15	AF126	0·17	BFY52	0·22	NKT278	0·25	OC122	0·60
2N709	0·63	AF127	0·17	BFY53	0·17	NKT301	0·40	OC123	0·65
2N711	0·37	AF139	0·30	BFY64	0·42	NKT304	0·75	OC139	0·25
2N987	0·53	AF178	0·55	BFY90	0·65	NKT403	0·75	OC140	0·35
2N1090	0·30	AF179	0·65	BSX27	0·50	NKT404	0·55	OC141	0·60
2N1091	0·33	AF180	0·52	BSX60	0·93	NKT678	0·30	OC169	0·20
2N1131	0·25	AF181	0·42	BSX76	0·15	NKT713	0·25	OC170	0·25
2N1132	0·25	AF186	0·40	BSY26	0·18	NKT773	0·25	OC171	0·30
2N1302	0·18	AFY19	1·13	BSY27	0·17	NKT777	0·38	OC200	0·40
2N1303	0·18	AFZ11	0·60	BSY51	0·50	O78B	0·38	OC201	0·70
2N1304	0·22	AFZ12	1·00	BSY95A	0·12	OA5	0·20	OC202	0·80
2N1305	0·22	ASY26	0·25	BSY95	0·12	OA6	0·12	OC203	0·40
2N1306	0·25	ASY27	0·32	BT102/500R		OA47	0·10	OC204	0·40
2N1307	0·25	ASY28	0·25		0·75	OA70	0·10	OC205	0·75
2N1308	0·25	ASY29	0·30	BTY42	0·92	OA71	0·10	OC206	0·90
2N1309	0·25	ASY36	0·25	BTY79/100R		OA73	0·10	OC207	0·90
2N1420	0·93	ASY50	0·17		0·75	OA74	0·10	OC460	0·20
2N1507	0·28	ASY51	0·40	BTY79/400R		OA79	0·10	OC470	0·30
2N1526	0·38	ASY53	0·20		1·25	OA81	0·08	OCP71	0·97
2N1909	2·25	ASY55	0·20	BY100	0·15	OA85	0·12	ORP12	0·50
2N2147	0·75	ASY62	0·25	BY126	0·15	OA86	0·15	ORP60	0·40
2N2148	0·60	ASY86	0·33	BY127	0·17	OA90	0·08	ORP61	0·42
2N2160	0·60	ASZ21	0·42	BY182	0·85	OA91	0·07	S19T	0·30
2N2218	0·20	ASZ23	0·75	BY213	0·25	OA95	0·07	SAC40	0·25
2N2219	0·20	AUY10	0·98	BYZ10	0·35	OA200	0·07	SFT308	0·38
2N2287	1·03	AU101	1·50	BYZ11	0·32	OA202	0·10	ST722	0·88
2N2297	0·20	BC107	0·10	BYZ12	0·30	OA210	0·25	ST7231	0·63
2N2369A	0·15	BC108	0·10	BYZ13	0·25	OA211	0·30	SX68	0·20
2N2444-P on A		BC109	0·10	BYZ15	1·00	OAZ200	0·55	SX631	0·30
2N2613	0·28	BC113	0·15	BYZ16	0·62	OAZ201	0·50	SX635	0·40
2N2646	0·45	BC115	0·20	BYZ88C3V3		OAZ202	0·42	SX640	0·50
2N2712	0·25	BC116	0·25		0·15	OAZ203	0·42	SX641	0·55
2N2784	0·50	BC116A	0·30	C111	0·65	OAZ204	0·30	SX642	0·60
2N2846	0·75	BC118	0·25	CRS1/05	0·25	OAZ205	0·42	SX644	0·75
2N2848	0·42	BC121	0·20	CRS1/40	0·47	OAZ206	0·42	SX645	0·75
2N2904	0·20	BC122	0·20	CS4B	2·50	OAZ207	0·47	V15/30P	0·50
2N2904A	0·25	BC125	0·68	CS10B	3·18	OAZ208	0·32	V30/201P	0·75
2N2906	0·20	BC126	0·65	DD000	0·15	OAZ209	0·32	V60/201	0·56
2N2907	0·23	BC140	0·55	DD003	0·15	OAZ210	0·32	V60/201P	0·75
2N2924	0·23	BC147	0·15	DD006	0·18	OAZ211	0·32	XA101	0·10
2N2925	0·15	BC148	0·13	DD007	0·40	OAZ222	0·45	XA102	0·18
2N2926	0·10	BC149	0·15	DD008	0·38	OAZ223	0·45	XA151	0·15
2N3054	0·50	BC157	0·15	GD3	0·33	OAZ224	0·45	XA152	0·15
2N3055	0·75	BC158	0·12	GD4	0·05	OAZ241	0·22	XA161	0·25
2N3702	0·10	BC160	0·63	GD5	0·33	OAZ242	0·23	XA162	0·25
2N3705	0·10	BC169	0·13	GD8	0·25	OAZ244	0·22	XB101	0·43
2N3706	0·23	BCY31	0·35	GD12	0·05	OAZ246	0·23	XB102	0·10
2N3707	0·12	BCY32	0·55	GET102	0·30	OAZ290	0·36	XB103	0·25
2N3709	0·10	BCY33	0·25	GET103	0·22	OC16	0·50	XB113	0·12
2N3710	0·10	BCY34	0·30	GET113	0·20	OC16T	0·38	XB121	0·43
2N3711	0·10	BCY38	0·40	GET114	0·15	OC19	0·37	ZR24	0·63
2N3819	0·35	BCY39	1·00	GET115	0·45	OC20	0·85	ZS170	0·10
2N3820	0·60	BCY40	0·50	GET116	0·50	OC22	0·50	ZS271	0·18
2N3823	0·75	BCY42	0·25	GET120	0·25	OC23	0·60	ZT21	0·25
2N5027	0·53	BCY70	0·15	GET872	0·30	OC24	0·60	ZT43	0·25
2N5088	0·33	BCY71	0·20	GET875	0·25	OC25	0·37	ZTX107	0·15
2S005	1·00	BCZ10	0·35	GET880	0·37	OC26	0·25	ZTX108	0·12
2S178	P on A	BCZ11	0·50	GET881	0·25	OC28	0·60	ZTX300	0·12
2S301	0·50	BD121	0·65	GET882	0·25	OC29	0·60	ZTX304	0·25
2S304	0·75	BD123	0·80	GET885	0·25	OC30	0·40	ZTX500	0·16
2S501	0·37	BD124	0·75	GEX44	0·08	OC35	0·50	ZTX503	0·17
2S703	0·62	BDY11	1·62	GEX45/1	0·10	OC36	0·60	ZTX531	0·25
AA129	0·20	BF115	0·25	GEX941	0·15	OC41	0·25		
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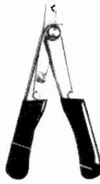

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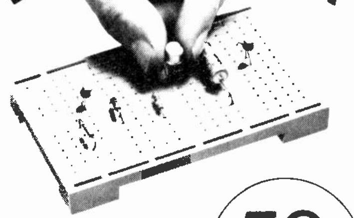

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VOL. 8 No. 1
January 1972

PRACTICAL ELECTRONICS

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TRADE WINDS

For some time it has been clear that certain sections of the U.K. electronics industry will face a difficult, if not threatening, situation due to overseas competitors, chiefly Japan, in the coming years. For the home producers of television receivers, it seems the danger is quite imminent.

Shut out of the American market by recently imposed tariffs and debarred from Germany and Italy by the terms of the licensing agreement which allows them to manufacture television receivers for the PAL system, the Japanese look now to the large U.K. market as a main outlet for their huge output of colour receivers. And with 20in models likely to retail at £100 against home products costing around £180, it is too much to expect patriotism to win against price. Anyhow precedents have already been provided by the watch and camera trades, and imported radio, audio, and measuring equipments are now taking over sections of the home electronics market.

There is, unfortunately, the possibility of an even more serious threat to the electronics industry in the next decade. The danger of an unimpeded flow of cheap products is not merely the worry of that part of the industry catering for the consumer market. Producers of industrial equipment may well have to face intense overseas competition in the coming years. Japan, for example, is reported to be making phenomenal progress in industrial electronics. She has already taken over the U.S.A. market for desk calculators; and as the largest ship building country in the world, she can be expected to exploit this situation fully, and to offer in time vessels fully equipped with communications, radar, and navigational equipment, as complete going concerns. This kind of development in world trade could be a serious blow to the capital equipment section of the U.K. electronics industry—the very section which has so far been the major exporter, in terms of value, of the whole U.K. electronics industry.

Can any measures be taken to avert the more serious consequences of this "cut price" competition from countries operating under quite different social and economic systems to our own? British industrialists no doubt look with envy to the U.S. and would welcome a similar initiative from our government. But tariffs and trade protection arouse no enthusiasm among customers at large. More likely our industry's chief hope rests in the continuing expansion of world requirements for electronic products of all kinds. But frequent "priming of the pump" by the introduction of technical innovations that lead to further new and commercially valuable applications for electronic techniques seems now, more than ever, an imperative operation for the industry.

F.E.B.

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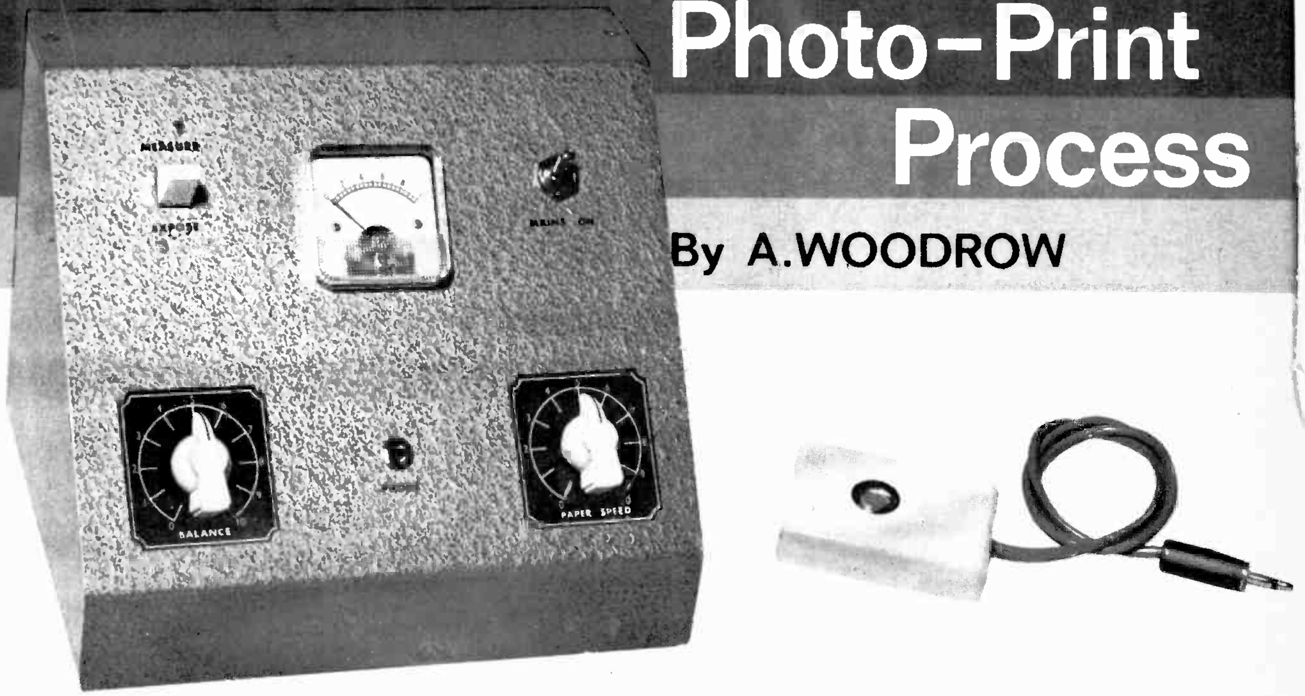


Photo-Print Process

By A. WOODROW

MANY amateur photographers like to do their own processing, and an increasing number are attempting colour printing. One of the more tedious tasks of processing is the printing of a roll of negatives. When printing monochrome, each negative requires that a test strip be made to determine the correct exposure needed, the test then being assessed and a final print then made.

When a roll of 36 negatives is being printed, the amount of time and wasted materials involved can be quite considerable. When colour negatives are used, the problem is multiplied by the necessity of obtaining the correct colour balance as well as density. It is possible to waste a complete printing session without obtaining a single satisfactory colour print.

The unit to be described is designed to take most of the trial-and-error out of printing; in fact, prints are made almost automatically in the case of monochrome. The work involved in colour printing is a little greater than for black and white, but it is still possible to make a successful print at the first attempt.

THREE FUNCTIONS

An exposure meter first assesses the negative, and the information obtained is transferred to a timer, which switches the enlarger lamp on for the required time to give a correctly exposed print. The exposure meter is also used for the comparison of a colour negative with a "standard" negative to obtain the correct colour balance.

One of the most important factors in successful photographic processing is consistency of conditions; temperatures, strength of solution, etc. must be constant if good results are to be obtained. One such factor which is often overlooked is mains voltage. If an enlarger lamp is operated at low mains, its light will be more yellow than at nominal voltage, as well as giving a reduced light output. Conversely, a lamp operated at high voltage gives a bluer light.

The change in light output is serious enough in monochrome printing, but the additional variation in colour can cause chaos in colour printing; a change of two or three volts is sufficient to cause a noticeable shift in colour. With this in mind, the control unit includes a stabiliser unit to hold the lamp voltage constant against variations of mains.

The control unit thus has three parts, intended to be used together, although any one or two sections could be constructed and used independently of the others. The unit will automatically assess and expose negatives over the range one second to one minute, and the stabiliser holds the lamp voltage constant for mains inputs between 220–250V. For nominal mains voltages other than 240V, the stabiliser will operate over a correspondingly lower range.

EXPOSURE METER

If a light source of known brightness is projected through a negative, the amount of light allowed to pass by the negative is a measure of the density of it, and thus of the exposure required to make a print. In this case, the light source is the enlarger lamp, and the amount of light passed by the negative is measured at the enlarger baseboard by a light dependent resistor.

This device, as its name implies, varies its resistance according to the amount of light falling on its sensitive surface. When the device is placed on the baseboard, its resistance depends on the amount of light transmitted by the negative, and thus on the required exposure.

A light dependent resistor, however, has no "memory"; when the illumination is removed, the information gained from the measurement is lost.

Control Unit

As this information is later needed by the timer, a further element must be added to store the reading, ready for transfer to the timer. A bridge is therefore used for the measurement, and the basic circuit is shown in Fig. 1.

BRIDGE CIRCUIT

The main property of this circuit is that when $R_1 \times R_4 = R_2 \times R_3$ no current will pass through the meter. In this condition, the bridge is balanced. When the equation is not satisfied, a current flows in the meter. This current is of a magnitude dependent on the degree of unbalance and the voltage of the supply, but the point at which balance occurs is independent of applied voltage.

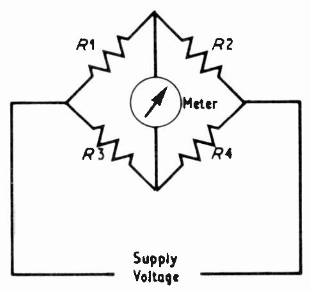


Fig. 1. Basic bridge circuit

Referring now to the main circuit in Fig. 2, the bridge is formed by VR1, VR2 and the light dependent resistor PCC1. Resistors R10, R11 and R15 are also included in the bridge, but serve only to limit the range of the controls, preventing any arm of the bridge from being short-circuited. Potentiometer VR1 forms two arms, either side of its wiper, this control being preset according to the type of printing paper in use.

The supply is 12V a.c., taken from the mains transformer. The output from the bridge is rectified by D3, and then passed to TR4. This transistor is connected as an emitter follower, i.e. a current amplifier, driving ME1, a 1mA meter. Resistor R14 limits the maximum current through the transistor, preventing the meter needle from wrapping itself around the endstop if the unit is switched on with the bridge well out of balance. C3 removes ripple, giving a steady meter reading, and R12 adds a small amount of forward bias to TR4.

The function switch S2 selects either "measure" or "expose" operations. When negative measurement is required, S2c and S2d switch the balance potentiometer into the bridge circuit. Closure of S2b applies voltage to the meter circuit, and also switches on the relay driver transistor TR3 via R8, thus energising the relay RLA and turning on the enlarger lamp for focussing and measurement purposes. The diode D2 prevents voltage surges from damaging TR3 when the relay is de-energised.

TIMER

With the function switch in the "expose" position, S2c and S2d transfer the information regarding the required exposure, contained in VR2, into the timer circuit. As S2b is now open, the relay is de-energised. No supply voltage is yet applied to the timer, as RLA1 and S2e contacts are open-circuit at this stage.

Contacts S2e are now closed to initiate the timing period. Resistors R2, R3 and R4 form a voltage divider, and TR2 has a forward bias derived from the voltage developed across R4. This transistor is thus turned on, its collector volts now being close to the supply of 12V.

The voltage dropped across R5 is applied via R6 to the base of TR3, energising the relay. The enlarger lamp is thus turned on via contacts RLA2, and contacts RLA1 bypass S2e which may now be released, as the supply voltage to the timer is now applied by the relay contacts.

THE NEED FOR AN F.E.T.

The heart of the timer is C1, VR2 and TR1, a field effect transistor. The main property of a field effect transistor in this application is its extremely high input resistance. The highest value of timing resistance which can be used in any timer circuit is determined by the resistance of any circuit connected to it.

If a bipolar transistor were used for TR1, the maximum input resistance obtainable would be only a few megohms. For the timing period to be determined by the timing resistance alone, as is required for accurate peformance, the maximum value of timing resistance must be about one tenth of the input resistance of TR1, i.e. a few hundred kilohms.

As the timing period is proportional to C1 × VR2, and the timing resistance is low, C1 must obviously be high. Large values of capacitance give rise to further problems, as they will have a relatively low leakage resistance, and this can also affect the accuracy of the timer. The field effect transistor, with an input resistance of several hundred megohms, allows a low value to be used for C1, with a large value of VR2.

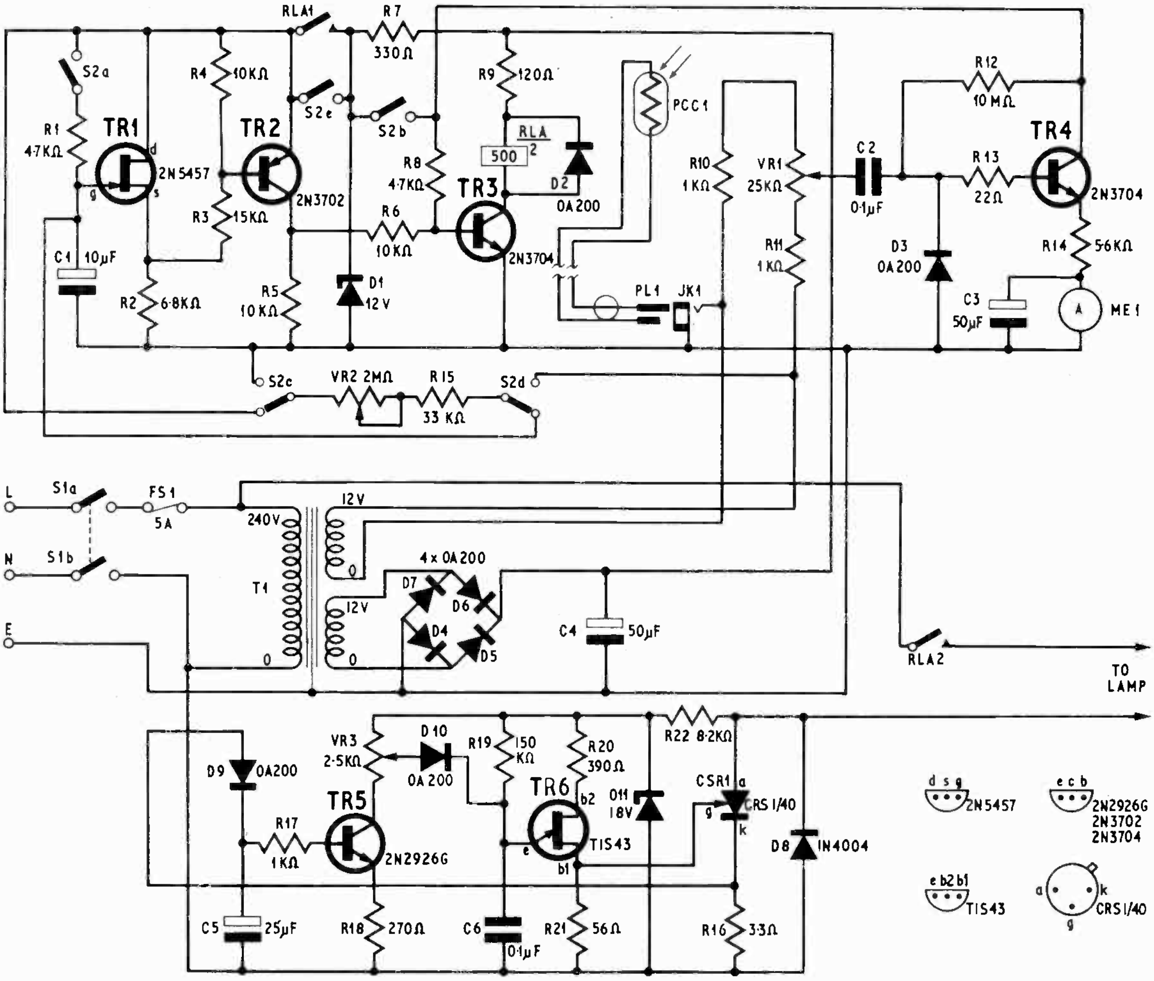


Fig. 2. Complete circuit diagram of the enlarger control unit

THE TIMING OPERATION

Returning to the operation of the complete timer, TR1 has a small bias applied by the voltage drop across R2. Initially C1 is discharged, so the gate of TR1 is at zero volts. When the supply is connected by S2c, C1 begins to charge at a rate determined by the setting of VR2, previously determined by the exposure meter. As the gate voltage approaches the bias voltage of the source, TR1 begins to conduct. The gate voltage thus becomes transferred to the source by the self-biasing action of the source current. Resistor R3 also applies the source voltage to the base of TR2.

When TR1 source voltage, and thus TR2 base voltage, reaches approximately 11V, TR2 switches off, this transistor being a *pnp* type. The collector voltage falls to zero, switching off TR3, and de-energising RLA. The enlarger lamp is turned off, and the supply is removed from the timer by contacts RLA1, S2e having been previously released.

The standing bias, derived from the potential divider R2-R3-R4, is removed from TR1, which now becomes forward biased by the charge remaining on C1. The capacitor is discharged rapidly through the gate-source junction of TR1 and R2, resetting the timer ready for the next timing operation.

THE FUNCTION OF R1

The function of R1 is best explained by considering the circuit without this component. During the measurement operation, VR2 is disconnected from the gate of TR1, leaving C1 in a discharged condition, but voltage is applied to the timer via the contacts of RLA1 which is energised.

When the function switch is changed to "expose", the timer begins a complete timing sequence, as C1 is now charged via the now-connected VR2. The enlarger lamp will thus remain on until a complete timing sequence has elapsed, which is obviously inconvenient if the timer is set for more than a few seconds.

During measurement, R1 is switched in, maintaining C1 in a fully charged condition. When the function switch is changed to the "expose" position, the timer is in the same state as at the end of a timing period, and the lamp is switched off.

The power supply for the exposure meter and timer is conventional. A full-wave bridge rectifier, D4 to D7, is fed from the mains transformer T1, the resulting pulsed d.c. being smoothed by C4. The relay is then supplied via R9, and the remainder of the circuits are fed from a 12V rail stabilised by R7 and the Zener diode D1.

LAMP STABILISER

The basic principle of the stabilised supply to the enlarger lamp is illustrated in Fig. 3a, which shows two cycles of the voltage across the lamp. Only part of each positive half-cycle is applied to the bulb, although the whole of each negative half-cycle is applied.

If the supply is fed to the lamp at point A, the result will be a higher r.m.s. voltage for the complete cycle than if the supply were not allowed to reach the lamp until point B.

Thus, a rise in mains voltage can be counteracted by delaying the point in the positive half-cycle at which the bulb is switched on. Conversely, a drop in mains voltage can be corrected by an earlier switch-on, allowing more of the half-cycle to reach the bulb.

Referring to Fig. 2, each negative half-cycle is fed to the lamp via D8. The positive half-cycles are controlled by the silicon controlled rectifier CSR1.

The silicon controlled rectifier, or thyristor, is an extension of the normal silicon diode. It will under no circumstances conduct when the cathode is positive with respect to the anode, and will also block when forward biased, until a third electrode, the gate, is made positive with respect to the cathode. The thyristor will then conduct until the forward voltage is reduced to zero, even though the gate voltage is removed.

Once the thyristor turns off, it will revert to its blocking state until it is again forward biased and a gate voltage is applied. Thus CSR1 can be switched on at any point during the positive half-cycle as desired, by applying a gate voltage when required. The gate voltage is derived from TR6, a unijunction transistor.

THE UNIJUNCTION TRANSISTOR

The unijunction is a semiconductor device with two bases and an emitter. It acts as a pure resistance of 5 to 10 kilohms with zero emitter voltage. This condition is maintained as the emitter voltage is increased, with only a few microamps of emitter current, until a critical (peak point) level is reached.

At this point, the emitter-base one junction breaks down, allowing a large emitter current to flow. If the emitter voltage is now removed, the device reverts to its original state, with very small emitter current, and once more acts as a resistance between base one and base two.

TRIGGER CIRCUIT

Referring again to Fig. 2, the diode D10, TR5 and the associated circuitry will initially be ignored.

At the beginning of the positive half-cycle, CSR1 is not conducting. D8 is reverse biased, and is also blocking. Thus, the full mains voltage is developed across CSR1, and is applied via R22 to the trigger circuit formed by TR6.

Initially, D11 does not conduct, until the mains voltage reaches 18V, when the Zener will clamp at this voltage. Thereafter, the supply to the trigger circuit will remain at 18V, the surplus voltage being dropped across R22.

As soon as the supply begins to rise, C6 starts to charge via R19. As the supply voltage is stabilised by D11, the capacitor will always charge at the same rate. When the charge on C6 reaches the peak point voltage of the unijunction TR6, the emitter conducts, and C6 discharges through the emitter-base one junction. This current gives a positive voltage across R21, and this voltage is applied to the gate of CSR1, switching it on.

Once the trigger circuit has supplied the gate pulse, it is no longer required until the next positive half-cycle begins. As CSR1 is in parallel with the supply to the trigger circuit, and as this component has a very small voltage drop when conducting, it is apparent that the trigger circuit will be inactive once it has turned on the thyristor, and will remain so during the negative half-cycle, when D8 is conducting.

Resistor R20 is included to stabilise the working conditions of TR6 against temperature variations.

CORRECTION OF FIRING POINT

Transistor TR5 and the associated circuitry gives the correction of thyristor firing point necessary for stabilisation against mains variations. The mains voltage is monitored by R16, in series with the lamp and CSR1.

This resistor develops a voltage across it while CSR1 is conducting, i.e. during the positive half-cycle. As this half-cycle is incomplete, being chopped to provide the correction in the lamp supply, it is obvious that the r.m.s. and average voltages across R16 will not provide a suitable reference. The peak voltage is thus used.

The waveform across R16 is applied via D9 to C5. This capacitor is charged to the peak of the waveform, and will remain at that level unless

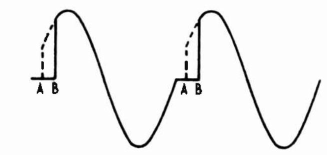


Fig. 3a. Waveform of voltage applied to enlarger lamp

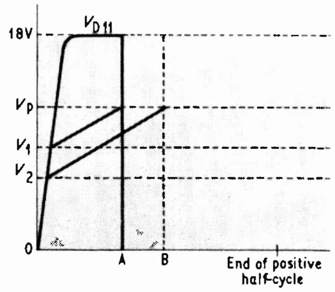


Fig. 3b. Waveforms of lamp stabiliser

allowed to discharge. Three discharge paths are available. C5 cannot discharge back into the supply as it is prevented from doing so by D9.

The second path is into the base of TR5. By the use of a high gain transistor in this position, a relatively high input resistance is achieved, and C5 loses little of its charge this way.

The third possible path is through its own leakage resistance, but the loss this way is also small enough to be ignored. Thus, the voltage across C5 is proportional to the peak voltage of the mains supply. This voltage is amplified by TR5, and a portion of the amplified voltage is tapped off from VR3, being passed by D10 to give a standing charge on C6.

STABILISER OPERATION

Taking the action of the stabiliser unit in its entirety, and referring to Fig. 3b, a voltage proportional to the peak of the mains supply appears across C5. This voltage is amplified by TR5, and tapped off from the slider of VR3, then applied to C6. This gives a voltage on C6 of V_1. C6 is also charged via R19, and its voltage increases until it reaches the peak point voltage of TR6, V_p. The thyristor is then turned on by the pulse across R21, and the remainder of the half-cycle is applied to the enlarger lamp.

If the mains voltage now rises, a larger voltage is developed by C5. This results in a reduced voltage at the collector of TR5, and a lower initial voltage on C6—V_2 in Fig. 2b. Then C6 begins to charge via R19 at the same rate as before; as the starting voltage is lower than previously, C6 takes longer to achieve V_p. The thyristor is thus turned on later in the half-cycle, compensating for the rise of mains voltage.

The peak point voltage of unijunctions varies from sample to sample, and an adjustment is necessary to compensate for this. VR3 is therefore used to adjust the d.c. level fed to C6, this being the only control necessary to set up the stabiliser.

ALTERNATIVE SEMICONDUCTORS

Many of the components are uncritical, and alternatives can be used. This applies particularly to the semiconductors.

TR1 must be an *n*-channel field effect transistor. The 2N5457 (also available under the number MPF103) has been selected because it has a lower range of characteristics compared with other types. Other f.e.t.s will work satisfactorily, but may not give the same range of times—this is not too important, as the only result will be a different setting of the paper speed control when the unit is calibrated.

TR2 is required to be a *pnp* silicon transistor, and any such component will work satisfactorily. Similarly, TR3 and TR4 are merely required to be *npn* silicon types, the only limitation being that TR3 must be able to handle the relay current—100mA at most. TR5 is a high gain *npn* silicon transistor—BC109 or 2N3711 are two suitable alternatives. TR6 is a unijunction—2N2646, 2N2160 or BEN3000 will work quite happily here. If alternatives are employed, the lead-outs must be checked, as the various types may differ from those specified.

Any Zener diodes of the required ratings are suitable, and D8 may be any silicon diode with a 1A 400V rating, or better. Similarly, CSR1 can be

COMPONENTS . . .

Resistors

R1	4·7k Ω	R13	22 Ω
R2	6·8k Ω	R14	5·6k Ω
R3	15k Ω	R15	33k Ω
R4	10k Ω	R16	3·3 Ω 2·5W (for 150W lamp)
R5	10k Ω		6·8 Ω 2·5W (for 75W lamp)
R6	10k Ω	R17	1k Ω
R7	330 Ω	R18	270 Ω
R8	4·7k Ω	R19	150k Ω
R9	120 Ω	R20	390 Ω
R10	1k Ω	R21	56 Ω
R11	1k Ω	R22	8·2k Ω 5W
R12	10M Ω		

All resistors ± 10%, ¼W unless otherwise specified

Potentiometers

VR1 25k Ω lin
VR2 2M Ω log
VR3 2·5k Ω subminiature skeleton preset

Capacitors

C1 10μF 15V tantalum
C2 0·1μF 250V foil
C3 50μF 6V electrolytic
C4 50μF 25V electrolytic
C5 25μF 6V electrolytic
C6 0·1μF 250V foil

Semiconductors

TR1 2N5457 (*or* MPF103)
TR2 2N3702
TR3 2N3704
TR4 2N3704
TR5 2N2696G
TR6 TIS43
CSR1 CRS1/40

Diodes

D1 12V 400mW Zener
D2-7 OA200 (6 off)
D8 1N4004
D9, 10 OA200 (2 off)
D11 18V 1W Zener

Switches

S1 2-pole on-off, toggle
S2 P.O. type lever switch 4CL/4CN (see text)

Relay

RLA 500 ohm coil, 2 make contacts (one heavy duty)

Transformer

T1 Miniature mains transformer, 2 × 12V secondaries (R.S. Components)

Miscellaneous

PCC1 ORP12
ME1 1mA meter, type MR38P
Veroboard, 5in × 3¾in, 0·15in pitch, copper clad
Case, 8in × 6in × 6in sloping front
FS1 Fuse 5A and fuseholder
2 pointer knobs
3·5mm jack plug and socket
4 rubber feet
Heat sink, TO5
Small plastic box
Audio screened lead

any type of adequate rating, 1A 400V. The rest of the silicon diodes, specified as OA200, may be any small signal types, such as OA202, 1N914, 1N916, SD19.

RELAY AND FUNCTION SWITCH

The specification of the relay and function switch gives the minimum requirements of these components. It may prove difficult to obtain exactly the contacts required.

The relay may have a different coil resistance from the 500 ohm type specified. Any resistance down to 200 ohms can be used in the circuit as it stands: relays down to 150 ohms may be accommodated by reducing R9 to 82 ohms. Two make contacts are needed; most relays will have two or more sets of changeovers, but the unwanted contacts can, of course, be ignored. One set of the contacts at least must be capable of handling 1A at 240V.

The function switch is a P.O. type lever keyswitch. This has three positions; when the lever is pushed in one direction from the centre, the switch locks in this position; this section requires two changeovers and two make contacts. When the lever is pushed in the other direction from centre, the switch is spring-loaded, i.e. it will return to centre when released; this section requires one make contact. As with the relay, any spare contacts can be ignored.

A suitable switch, with four changeovers in each direction, is available from several suppliers, for example Home Radio. The older type of lever keyswitch, with a cylindrical knob is also suitable. As a last resort, the function switch may be separated into two parts; a four changeover wafer switch is used for the "measure" part, and a separate pushbutton of the press-to-make, release-to-break type initiates the timer.

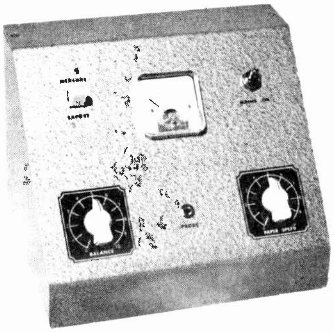
OTHER COMPONENTS

Alternatives to the specified components must not be used in two positions. C1 must be a low leakage capacitor, tantalum being the most suitable type. Paper capacitors are available, but tend to be bulky and expensive. The more familiar aluminium electrolytic should not be used; in fact, the timer will fail to operate with such a component.

This unit requires a transformer with two separate secondaries. Most of the small mains transformers available have a single centre-tapped winding, i.e. 12V-0-12V, but these should not be used. The transformer specified has the necessary secondaries.

The value of R16 must be changed according to the size of the enlarger lamp. A 150W bulb requires 3·3 ohms in this position; 6·8 ohms is used with a 75W lamp.

NEXT MONTH:
Full constructional details and how to use the Photo-Print Process Control Unit



METALS IN ELECTRONIC ENGINEERING

By A. Freeman, B.Sc., A.R.I.C. (The Marconi Company Ltd)

ALTHOUGH, during the last two decades, the development of transistors and printed circuitry has led to considerable economy of space per equivalent circuit function, the requirement for more sophisticated apparatus has meant that electronic capital equipment now in use may occupy about the same volume as did the simpler systems of 20 years ago. Thus, the reduction in the consumption of metal by the electronic capital goods industry, that would have been expected as a result of the economy of space, has not taken place.

There has, however, been an increase in the use of aluminium alloy because of its lightness, workability, and better corrosion resistance than steel. For the chassis or cases in which circuits are built, cadmium plated steel is often used because of the difficulty of making solder joints in aluminium.

RADIO TELESCOPES

Radio astronomy and communication satellites have led to the erection of large steerable reflector "dishes." Such "dishes" are made from aluminium alloy or stainless steel and must be supported so that their profile is accurately maintained, even in gale-force winds.

Thus, there has grown up a heavy constructional industry, ancillary to the electronics side of the business, using the techniques and materials of ship and bridge-building, but with the accuracy of light engineering.

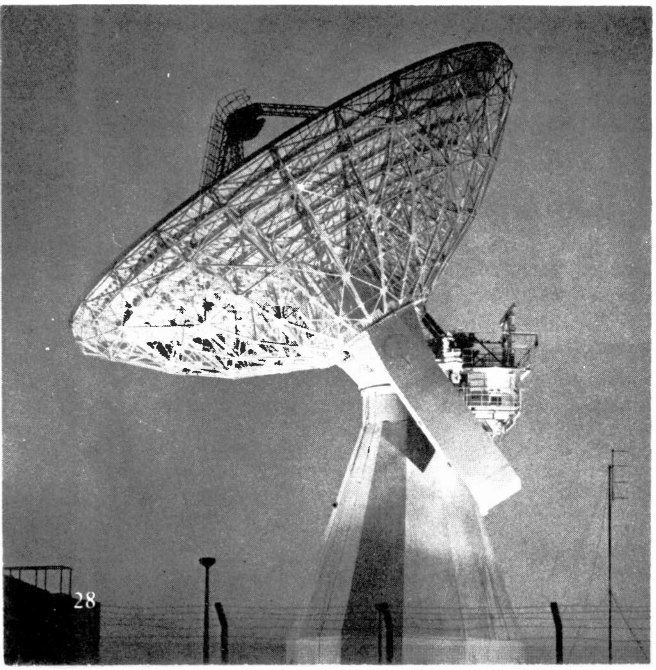
When these devices are erected in climates where winter temperatures are appreciably below freezing point, girders made from ordinary mild steel cannot be used, because at these temperatures they become brittle; comparatively light mechanical shocks can result in fracture. Therefore special steels are used which retain their toughness in very cold conditions.

PRINTED CIRCUITS

Copper is still the most used electrical conductor, not only in the form of wire, but in increasing quantities on printed circuits, where the connections are made by etched foil on an insulating baseboard.

The copper foil for the manufacture of the clad laminates is made by electro-plating polished stainless steel strip and parting the two metals mechanically, which is not difficult because the electro-deposit has only poor adhesion to the polished surface. This method produces foil that is polished on one side and dull on the other.

Cable and Wireless satellite-communication earth terminal at Bahrain with 90ft diameter dish antenna



Erection of the aerial for satellite communications on Ascension Island

The dull side is coated with resin and applied to the surface of the insulating laminate at the same time as fabricating the laminate. The roughness of the dull surface of the copper foil acts as an adhesion key.

Connections are made to the printed circuit either by soldering or, more generally, by sockets containing spring contacts which mate with circuit terminations on the edge of printed-circuit boards. The contacts and the circuit terminations are often gold-plated to prevent tarnishing, which would otherwise lead to poor contact and "noise" in the circuit.

THIN-FILM CIRCUITS

Thin-film devices are similar to printed circuits in that all interconnections are laid down, but they also contain resistors and capacitors as integral parts of the circuit. These devices are made by evaporation techniques. The substrates are glass or ceramic; the metal to be used is evaporated in a vacuum with the metallic vapours passing through a mask to condense in the required pattern on the substrate. The substrate must be kept perfectly clean.

The materials used in this process include gold for the circuit nichrome for resistors, and silicon monoxide as insulation. Capacitors are built up by successive layers of metal and silicon monoxide. As in the case of printed circuits, the manufacture of thin-film devices readily lends itself to automation.

WAVEGUIDES

Brass is used in the manufacture of waveguides, particularly those of large aperture, which are made from sheet as opposed to the smaller drawn tube. In areas where ferrous metals cannot be used because of electro-magnetic fields, brass screws are employed and springs are made in either phosphor-bronze or, for more severe duty, copper-beryllium.

Light alloys are widely used for waveguides, waveguide components and television camera bodies, especially the magnesium alloys N4 and N6 which have good corrosion resistance and good mechanical properties. They are very suitable for machining by methods such as routing, and N4 alloy can be welded without much difficulty.

Satisfactory brazing is really only possible with unalloyed aluminium but this has poor mechanical properties. As there is no perfectly satisfactory solder for use directly on aluminium or its alloys, the problem of the low temperature joining of aluminium alloys is generally overcome by copper-plating the alloy, tinning the areas to be soldered, removing the exposed copper chemically and finally sweating the tinned surfaces together.

When weight conservation is important, as in television camera bodies, magnesium-rich alloys are very attractive, having a density of 1·87 compared with 2·87 for the engineering alloys of aluminium. Unfortunately, these alloys readily corrode if left in an unpainted condition even in mild environments, so they are not suitable for the manufacture of items containing moving parts that cannot be painted.

STAINLESS STEELS

There are two main types of stainless steel, austenitic and martensitic. Austenitic stainless steel is relatively soft, non-magnetic and very resistant to corrosion. This type is often used for domestic items.

Martensitic stainless steel can be hardened, is magnetic and though much more resistant to corrosion than ordinary hard steel is not as resistant to staining as the austenitic type. Table knives are made of martensitic stainless steel.

Both of these types are widely used in the electronics industry but in small quantities. The austenitic steels are particularly useful because of their non-magnetic properties, especially in the fully annealed, or mildly cold-worked condition, when they have the mechanical properties of mild steel.

Some of the special austenitic stainless steels have found use in unusually arduous conditions, e.g. type EN58J is used for equipment that is to be immersed at such a depth in the sea that oxygenation is only very slight. (Oxygenation is necessary for the prevention of corrosion in most stainless steels.)

Development stage of thin-film production

The assembly of an r.f. module for Skynet II on the left. A completed module, with the cross-welds necessary for weight-saving, on the right

WAVEGUIDE COMPONENTS

Waveguide components are often difficult or even impossible to make from the normal rectangular tube. In such cases, recourse is made to electroforming techniques, using stainless steel formers.

When the shape is such that a steel former could not be withdrawn at the end of the electroplating operation, a thermoplastic former of the desired shape is made. After electroforming, it is removed either by melting or by dissolving out with a suitable solvent. Electroforming methods are slow and a single component may take several days to build up to the required thickness for adequate rigidity.

A recent innovation is the production of simple waveguide components, for example, tapers, by metal spraying techniques, zinc or silver-tin being the metals most often used. A thin deposit about 0·010in thick is applied to the mandrel that has previously been treated with a suitable release agent. Before removing the mandrel, the coating is strengthened with resin-glass cloth laminates wet-laid on to the sprayed metal.

In an increasing number of cases it is essential that the dimensions of waveguide components remain constant in spite of varying temperature. This requirement is achieved by the use of alloys having a low coefficient of expansion, such as invar and nilo. The poor electrical conductivity of these alloys is overcome by electroplating with silver of sufficient thickness that all the radio frequency current is confined to the electro-deposit.

SOLDERABILITY

Alloys similar to invar are used for the leads of transistors and miniature valves in order to obtain the satisfactory glass-to-metal seals required by these components. This application gives rise to soldering problems, because these alloys are not solderable using non-corrosive resin-based fluxes.

In most cases the leads are gold-plated in the course of the transistor manufacturing process but, because the gold is readily soluble in soft solder, the joint is in fact made to the low expansion alloy.

The solderability of component leads was once a serious problem. The leads used to be made of copper wire electroplated with tin but, if the time between electroplating and soldering was more than a month, soldering became increasingly difficult, eventually reaching the stage when it was impossible. This trouble has been overcome in recent years by electroplating the copper wire with 70:30 tin/lead alloy which remains solderable for years, even under adverse conditions of storage.

The use of this alloy also overcomes another difficulty experienced when pure tin is used, namely that of the growth of tin whiskers. These are single crystals in the form of fine whiskers that grow out from the tin surface sometimes reaching lengths of 1in. Such whiskers can cause short circuits in equipment. The growth of whiskers is inhibited by the presence of metals that alloy readily with tin, of which lead is the most convenient. A lead content of three per cent or more gives complete immunity.

PRECIOUS METALS

Among the precious metals, silver is used because of its high conductivity, both as an electro-deposit and on contacts as the block metal or in composites such as graphite-silver, sintered from powder.

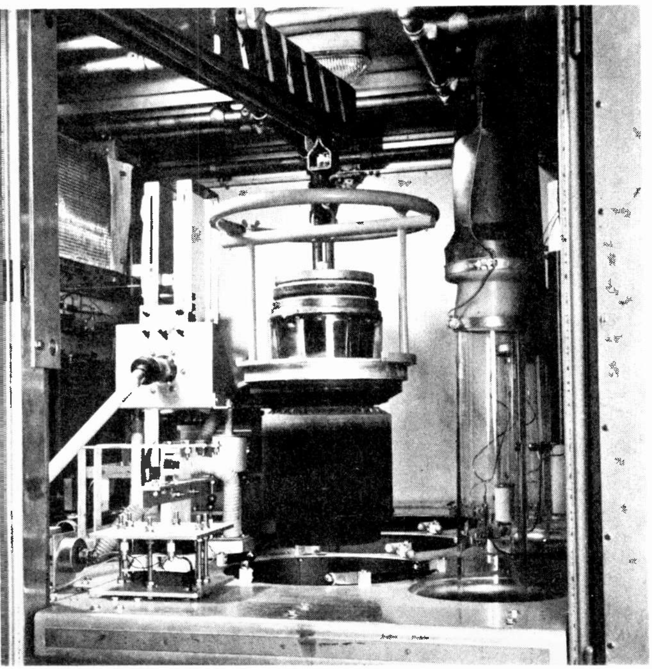
Gold is used as a non-tarnishing finish on copper and silver and in the form of modern "hard" golds, which may contain up to two per cent nickel or cobalt, as wear-resisting finishes for light to medium pressure applications.

Rhodium is used for surfaces subjected to severe wear or as the opposing surface to gold in such bearing surfaces as slip-ring brush combinations, the slip-ring being gold plated whilst the brush is rhodium plated.

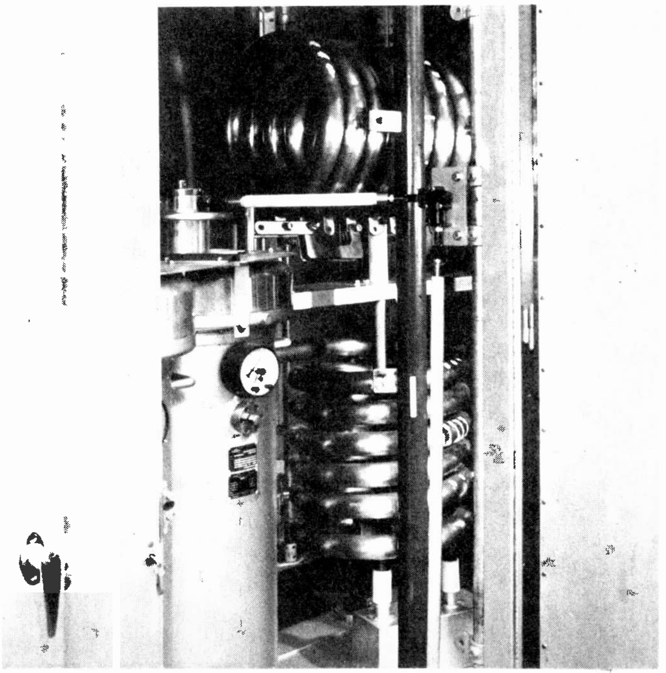
HIGH POWER VALVES

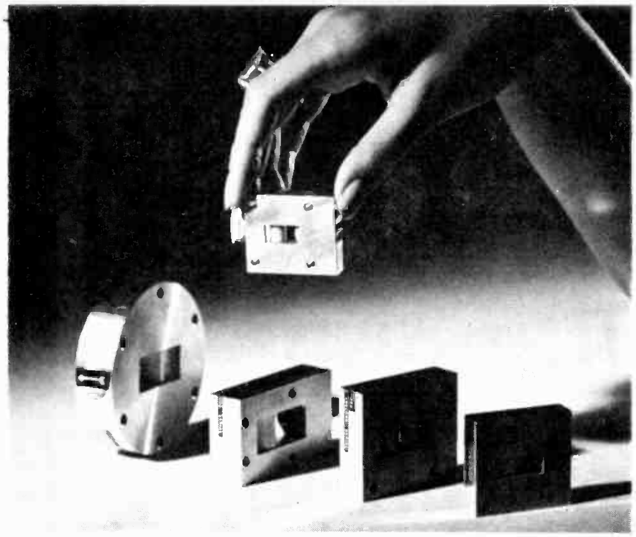
Whilst transistor devices have gone a long way in replacing small valves, the manufacture of large transmitting valves is expanding. The electrodes in these valves are made of high conductivity oxygen-

Removing a high-power valve, weighing about 90lb, from a broadcast transmitter



Gas-filled anode tuning capacitors with anode and output coils of 750kW broadcast transmitter





A series of isolators for use in waveguides

free copper and nickel whilst their supports are of refractory metals such as molybdenum, tantalum or tungsten sheathed in platinum.

All the metals must be of a high purity, in particular being free from gaseous impurities. Valve manufacturers experience great difficulty in obtaining refractory metals of sufficiently high purity.

NEW APPLICATIONS

Investigation into the behaviour of metals and other substances at temperatures well removed from ambience has disclosed properties not normally encountered, some of which are useful for specialised applications. Typical examples are the electrical super-conductivity of certain metals at temperatures near to absolute zero (−273°C). It is possible that continuing research on these lines may have repercussions on the types of metal used throughout the electronics industry.

ACKNOWLEDGEMENT

The author wishes to thank the Technical Director of The Marconi Company Limited for permission to publish this article. ★

Marconi Mark VII colour television camera at the Leeds studios of Yorkshire Television

NEWS BRIEFS

MICRO-COMPUTER DEVELOPMENT

THE US space agency NASA, has selected RCA to develop a test model of a space computer that would be 100 times smaller and lighter than equivalent commercial systems.

The microprocessor could be the forerunner of a system for future manned and unmanned space vehicles such as the Space Shuttle and the Earth Orbiting Space Station.

The shuttle is a reusable craft that will take off like a rocket and land like an aeroplane. The space station would be a permanent orbiting laboratory able to accommodate a contingent of scientists.

Heart of the computer under development by RCA will be 15 large-scale integrated (LSI) arrays—one-eighth-inch square chips each containing up to 600 electronic elements. Although the computer will weigh just 10 pounds, occupy one-half cubic foot and require only 15 watts of power, it will be capable of processing functions equivalent to room-size commercial computers.

CHANNEL SURVEILLANCE SYSTEM

THE first radar station to be ordered for the purpose of monitoring shipping movements in the Channel has been installed for the Department of Trade and Industry at H.M. Coastguard station at St Margaret's Bay, near Dover. A Decca 48 mile HR 729 system with two 16in displays, a 9ft scanner and 25kW transceiver, it will range from Boulogne to Dunkirk and over a similar arc of the Eastern approaches to the Dover Straits.

This is the direct outcome of the Government's concern for the accident rate in the Channel, which led to the National Physical Laboratory with the assistance of Decca, carrying out two major traffic surveys based at Dungeness and St Margaret's Bay, for the Department of Trade and Industry.

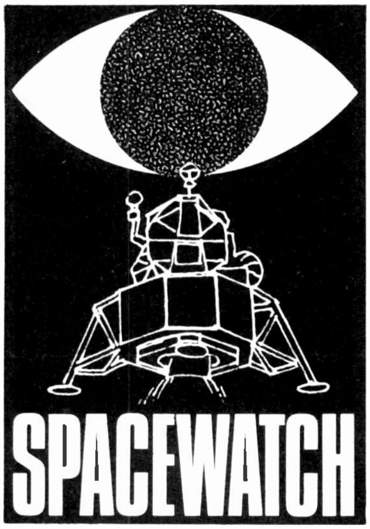
The new radar is the first ever sold to H.M. Coastguard and will also be used for search and rescue of vessels in distress when occasions arise. Its choice follows successful trials at Deal of a smaller Decca radar, which first caught the headlines when, in conditions of thick fog, the Deal Coastguard homed the Ramsgate lifeboat onto a yacht in distress and subsequently conned both back to Ramsgate Harbour.

EVENING LECTURES

A SHORT course of six evening lectures will be held at North Staffordshire Polytechnic, Stoke-on-Trent. Time: 6.30 to 9.0 p.m. All enrolment enquiries should be made to the Polytechnic.

January 12	M. Hughes	General Introduction to D.I.Y. Electronics
January 19	A. Douglas	Electronic Music Synthesis (including ref: to the P.E. Organ)
January 26	F. Hyde	Radio Astronomy (building a simple radio telescope)
February 2	A. J. Dunn	Radio Control of Models
February 9	A. J. Dunn	Electronics for Automobiles
February 16	M. Hughes	Logic Demonstration

All the above are regular contributors to PRACTICAL ELECTRONICS



BY FRANK W. HYDE

WATER ON THE MOON

Till now, the examination of the rocks and dust brought back from the Moon by America and Russia, has indicated that the moon is entirely without water. Doubt is now thrown on these conclusions by Dr J. W. Freeman (chief *Apollo* programme investigator for the instruments) of Rice University, and a statement has been made about his reasons for deciding that there is water in pockets on the Moon.

The effect that this will have on the future of moon stations is very considerable for it would mean that the crew would not have to bring water with them from earth, or manufacture it from chemicals or re-cycling processes.

Dr Freeman and his associate Dr Kent Hills base their statement on the fact that the instruments left on the moon by *Apollos 12* and *14* detected a water cloud that was like a geyser in eruption. The vapour was very diffused and probably amounted to about a quart of water. The eruption was from a crack in the moon's surface and the event was recorded on instruments which are called suprathermal ion detectors.

The largest event that was detected covered an area of 10 square miles, and was in the region of the Sea of Storms. The accuracy of the exact position is not as good as could be hoped since there are only two instruments operating. However, the precise location can be established later.

One other point that supports the contention by Dr Freeman is that the geyser coincided with small moon quakes recorded by the seismographs left on the moon. The advent of cracks is therefore well supported.

Planetary scientists have always held that in the solar system planets all contain carbon dioxide and water in their interiors; with the geyser like eruptions on the moon is the proof of the fact. It will of course require further supporting evidence before acceptance but no doubt this will be dealt with on the remaining two missions.

ROCK HARVEST

The geophysical harvest of the *Apollo 15* mission has been excitedly acclaimed by scientists. It will take a great deal of time to examine fully and analyse the rock and dust samples amounting to about 170lbs. They have a much wider variety of types and some 60 large pieces. The rocks which have been called Genesis are not as hoped the primeval lunar material.

One of the reasons for the choice of the Fra Mauro site on the *Apollo 15* mission was the hope that primitive finds would be made. However, the amount of information that will be obtained from the samples is very important.

HOT MOON

The moon is a hot body with the heat concentrated in the interior or alternatively in pockets of radioactive material. These pockets are perhaps around a hundred miles down from the surface.

This evidence of the heat gradient was obtained from the two probes which were put down to a depth of 6ft into the moon by the *Apollo 15* astronauts. The heat flow measurements showed that the increase in temperature amounted to about one degree farenheit for each increase of one foot in depth.

Compared with the earth this is about one fifth of the escape flow. This would indicate that there are radio-active minerals inside the moon. If the abundance is evenly distributed in the body of the moon then there must be a molten core. Melting temperatures would appear at about 300 miles below the surface. If this is not the case then the radio-active materials must be in pockets at about 100 miles depth.

MOONQUAKES

There are now on the moon three seismic stations which were set up by the crews of *Apollos 12, 14* and *15*. The network has brought an immense amount of new knowledge of day to day happenings on and in the moon which were not even suspected. The happenings were disguised from previous observations because of the rigidity of the shell.

The power of some of the tremors would undoubtedly have made cracks in the earth's surface which is much less rigid than the moon. The major effects take place when the earth and the moon are near to each other each month. The forces that are set up due to the increased tidal pull and the effect of the changing barycentre cause the tremors which are transmitted back to earth. One such record showed that the disturbance originated some 500 miles below the surface which may be even greater than those occurring on earth.

The moon then is a body that is convulsed internally without visible signs on the surface.

CORE SAMPLES

A 8½ft core sample was taken from the moon and this was found to contain some 57 layers of soil. This illustrates about 2,400 million years of the history of the moon. The layers are of varying thickness and range from half an inch to five inches. It is possible that each layer represents a different meteorite impact.

At the bottom of the sample core a 3¼in section was of much coarser material containing some chips up to ¼in diameter. This could be basic rock which was overlaid by the rest of the material.

MYSTERIOUS MINIQUAKES

One of the mysteries of the seismic recordings of the moon are the swarms of minor disturbances quite unrelated to tidal effects.

The majority of the activity on the moon lies in a small area below the Ocean of Storms and this is where the deep tremors are recorded. These may be due to heat from the depths of the moon. The mini swarms however, cannot come from this source.

One suggestion is that they are triggered off by the mascons. These are areas on the moon where there is a specially dense region. These cause an out of balance effect and it may be that this is the answer. Nothing definite can be said about this at the moment. If this should not prove to be the answer then there must be some other activity that has not yet been detected.

The swarms of mini-quakes over a period of two and a half days showed four swarms and thirty events.

SATELLITE TROUBLE

There has been some trouble with the ATS-3 satellite, whose full title is Applications Technology Satellite-3. It is in a synchronous orbit at 70 degrees West longitude 22,300 miles above Colombia.

Fitted on this vehicle is an aerial which should rotate at 100 rev/min. This is necessary to keep it pointed at the earth while the satellite spins. About the middle of July 1971 the aerial began to slow up and fell to 80 rev/min and sometimes stopped altogether and sometimes revolved at other speeds.

It would appear that this is due to the sun which when it is north of the equator heats up the satellite and causes the aerial to seize up. When the sun moves south of the equator all should be well again.

LIE DETECTOR

By O. COCKERELL

Though not to be taken too seriously, this highly sensitive circuit provides a fascinating tool for psychological experimentation. Without any modifications it can be used as an audible pulse monitor.

THE psychogalvanic reflex has long been used by experimental psychologists, policemen, and others, as a "window on the mind". Indeed a whole cult of fringe medicine has sprung up around it: self-styled "scientologists" spend hours questioning each other while holding the electrodes of a resistance meter. Now, thanks to the availability of integrated circuits, the enterprising constructor can make an instrument of much greater sensitivity than was possible until a year or so ago.

WHAT IS MEASURED?

If someone tells a lie they usually blush. This reflex, whose biological origin is not entirely explained, is associated with a number of small but detectable metabolic changes—respiration, heart rate and perspiration being the most easily measured.

Changes in perspiration can be detected almost instantaneously by the simple expedient of measuring the resistance between two electrodes placed on the skin. While one can observe some changes with something no more elaborate than an Avometer, one would be limited to subjects whose skin resistance was within the range of the meter, and one would certainly not be able to observe small changes such as occur with a passing thought in the mind of the subject.

In general a lie detector must register resistance changes as small as one per cent over a period of up to five seconds, the average value of resistance being anything between 10 kilohms and 10 megohms. As one is limited to a few volts at the electrodes (more would cause an unpleasant tingle), it turns out that a versatile instrument must detect current changes of a few nanoamps (amps $\times 10^{-9}$) per second. The instrument should also respond with equal sensitivity when the percentage change is the same, but when the actual current is a thousand times as great.

The block diagram, Fig. 1, shows how the huge range is encompassed in a single instrument without need for adjustment. The skin current is passed through a silicon diode which produces a voltage proportional to the logarithm of the current through it. Thus equal percentage changes of current will produce equal increments of voltage, about 2 millivolts for a 10 per cent change. The amplifier is in fact a differentiator below a few hertz so that an output appears only for a change of input.

HUM AND NOISE

Anyone who has put his finger on the input of a high gain amplifier will tell you that all you get out will be an almighty hum, and possibly some Radio 1 as well! For this reason components are included to provide 12dB per octave roll-off above a few hertz.

THE READOUT

Various readouts are possible, perhaps the simplest being a voltmeter. The present instrument, however, uses a voltage controlled oscillator and a crystal microphone as a speaker, so that a lie registers as a note of rising pitch. This serves two purposes: most people can hear a small percentage change of pitch over a very wide range, so that greater sensitivity than with a meter is possible; and secondly a sort of positive feedback occurs—as the subject hears the accusing little squeak he responds by making it even worse. It is also possible to use an earpiece if the subject is to be kept unaware of his responses.

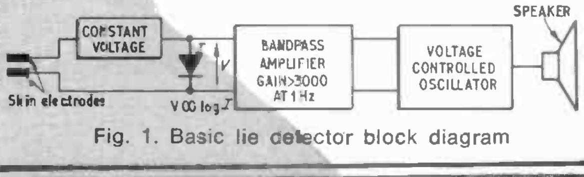


Fig. 1. Basic lie detector block diagram

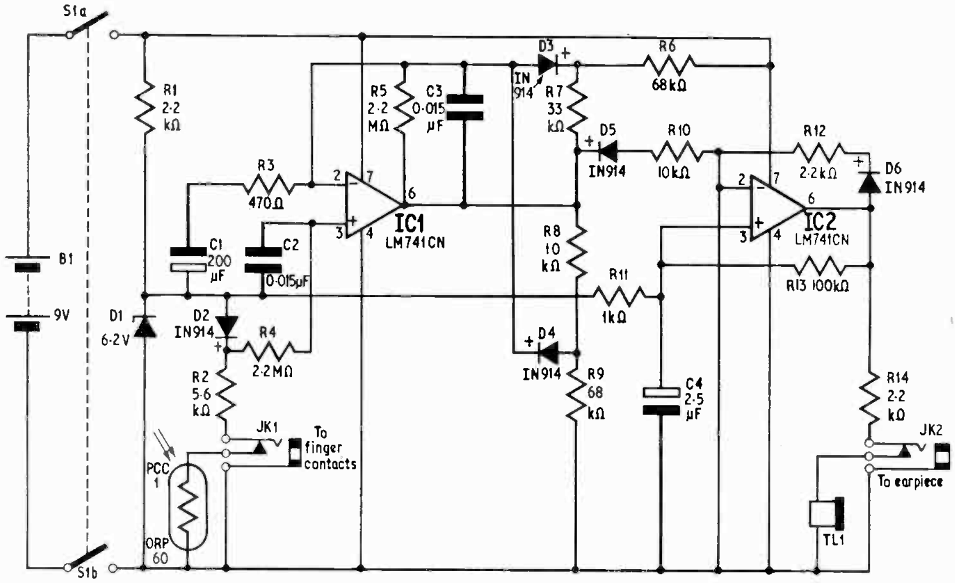


Fig. 2. Circuit diagram of lie detector

PULSE MONITOR

A bonus offered by the circuit comes in the form of a pulse monitor. If a photoconductive cell is used in place of the finger electrodes, and the subject's fingertip placed over it, his heartbeat can be heard in the form of frequency modulation of the output tone. The way it works is that the light passing through the finger is modulated in intensity by the blood pulsing through it.

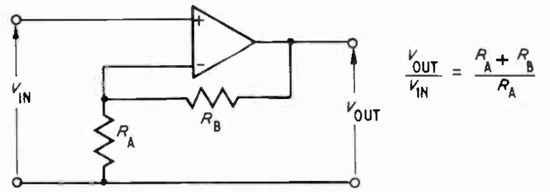
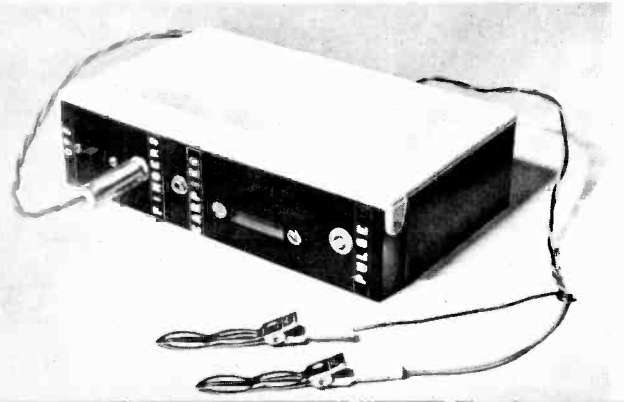


Fig. 3. Non-inverting operational amplifier configuration

THE 741 OPERATIONAL AMPLIFIER

If you have never used an operational amplifier before, or if you have fiddled for hours trying to get an earlier type to behave, only to find that it has succumbed to your ministrations and given up the ghost—take heart! The 741 is virtually indestructible. You can short the outputs to ground or to either supply and it doesn't mind. Even if you connect the battery the wrong way round the battery will be the first casualty (but don't try this with anything bigger than a PP3).



If you are not quite sure what an "op.amp." does it is simply this: the output goes positive if the "+" input is positive of the "−" input, and goes negative if the opposite is true. The input currents are tiny, usually less than a tenth of a microamp, and the output resistance is low, a few hundred ohms. The open loop gain—that is without feedback—is tens of thousands as long as the inputs are not allowed to get a sniff of the output in high impedance circuits.

CIRCUIT DETAILS

Fig. 2 shows the complete circuit diagram. An integrated circuit, IC1, is used as an amplifier in the standard non-inverting configuration. Fig. 3 shows this in simplified form. The gain is simply

$$\frac{R_A + R_B}{R_A} \text{ or if } R_B \gg R_A, \text{ simply } \frac{R_B}{R_A}.$$

In the actual circuit R_B is 2·2 megohms and R_A is 470 ohms so the gain is about 4,000 at around 1Hz. The capacitor C1 starts reducing the gain below 1Hz, and C2 and C3 reduce it above 3–4Hz.

COMPONENTS . . .

Resistors
R1 2·2k Ω
R2 5·6k Ω
R3 470 Ω
R4 2·2M Ω
R5 2·2M Ω
R6 68k Ω
R7 33k Ω
R8 10k Ω
R9 68k Ω
R10 10k Ω
R11 1k Ω
R12 2·2k Ω
R13 100k Ω
R14 2·2k Ω
All ±5%, ¼W carbon

Light Dependent Resistor
PCC1 ORP60 *or* U1100 Miniature CdS photocell

Capacitors
C1 200μF elect. 4V
C2 0·015μF
C3 0·015μF
C4 2·5μF elect. 64V

Integrated Circuits
IC1, IC2 LM741CN, SN72741 *or* 741-OPA (8-lead D.I.P.) (2 off)

Diodes
D1 6·2V 400mW Zener
D2 to D6 IN914 *or* any small silicon signal diode (5 off)

Speaker
TL1 Crystal mic. insert

Switch
S1 Double pole changeover slide switch

Jack plugs and sockets
JK1 3·5mm Jack socket with break contact, and plug
JK2 2·5mm Jack socket with break contact, and plug

Miscellaneous
Crystal earpiece (optional)
Plastic box 6in × 4in
B1 9V Battery PP3
Sprung hair clips
Veroboard 0·1in matrix, 5·7in × 2·8in with copper strips
Battery connector
Capacitor clip (for mounting TL1)

The diodes D3 and D4 together with R6 to R9 reduce the gain as the output swings above zero and below −2 volts. These voltages are with reference to the positive end of the Zener. Their purpose is to reduce the time taken to recover from a very large input swing.

VOLTAGE CONTROLLED OSCILLATOR

Fig. 4 shows the essential components of the voltage controlled oscillator. The 100 kilohm and 1 kilohm resistors apply positive feedback so that small voltages at the input cause the output to swing to its limits (about +2 and −4 volts, with respect to the positive end of the Zener). One hundredth of the output appears at the "+" input by potential divider action.

Assuming the output has just switched to its upper (+2V) limit, diode D_F will be forward biased and the "+" input will be at +20 millivolts. Capacitor C_T will charge up through D_F and R_F until its voltage reaches the 20 millivolts on the "+" input when the output swings rapidly to −4 volts, taking the "+" input to −40 millivolts. Diode D_F is now reverse biased and C_T can only discharge through R_T at a rate dependent on the input voltage V_C, which is assumed to be at a negative potential. As soon as the "−" input reaches −40 millivolts, the output switches to +2 volts and the cycle starts again.

Thus the output is a series of pulses of almost constant width but of repetition frequency determined by V_C.

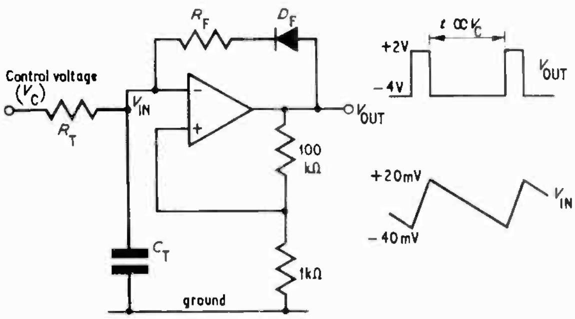


Fig. 4. Voltage controlled oscillator circuit

THE SKIN ELECTRODES

The finger clips or skin electrodes are the only items unlikely to be found in the average constructor's inventory—they are in fact sprung hair curlers. Get the nickel-plated type rather than the aluminium ones which are difficult to solder. I got mine from Woolworths.

MANHATTEN LAYOUT

Layout of components and cuts in the copper strips are shown in Fig. 5. The form of Veroboard layout used will probably seem wasteful at first

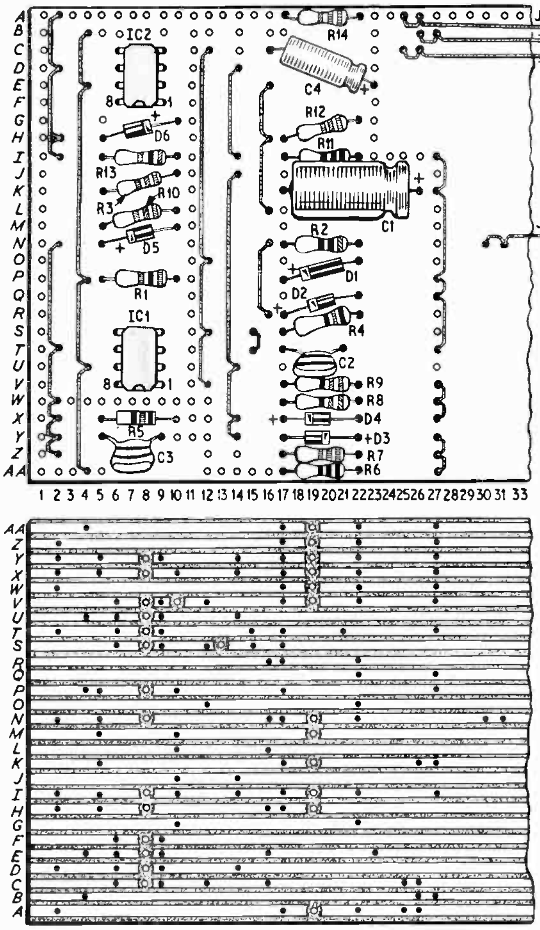


Fig. 5. Component assembly and wiring details of Veroboard panel (Note that the copper strip should be cut at 19T)

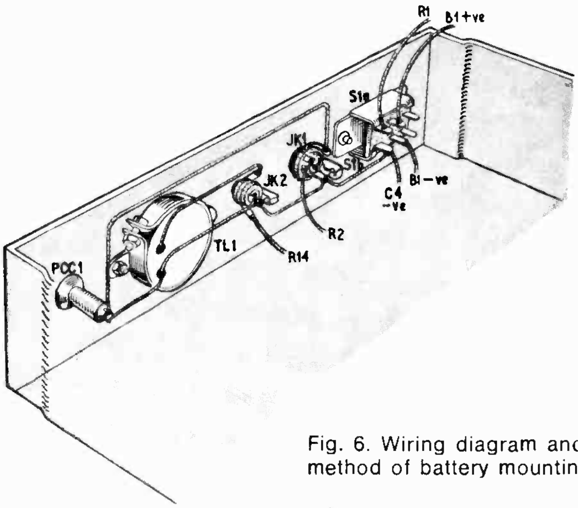
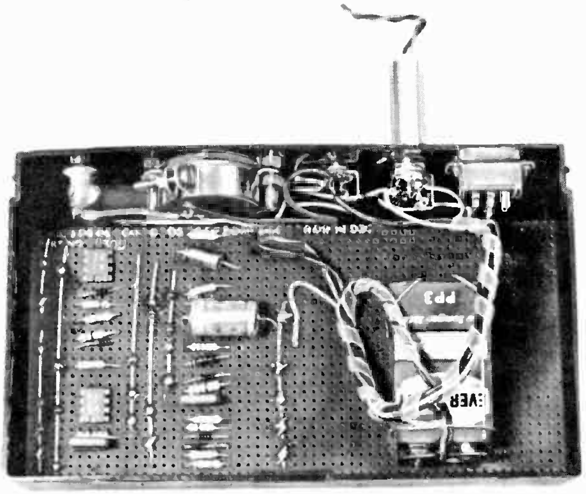


Fig. 6. Wiring diagram and method of battery mounting



glance, but it has the advantage of being easy to implement and to check. All components are more or less parallel to the copper strips, while component side links run at right angles (like the streets of Manhatten). The battery slides into three 20 s.w.g. straps on the board which prevent it from moving about, but allow it to be replaced (see Fig. 6).

Apart from the battery clips only four wires connect to the board—input, output and positive and negative supplies. The negative supply is the common rail for input and output.

The miniature jacks used for input and output are of the type which break a connection when the plug is inserted.

WARMING UP TIME

When you first turn the machine on, the large electrolytic, C1, may take a minute or so to polarise—that is, as well as taking a few seconds to charge up, and it can take considerably longer for the leakage current to reduce to its proper value. The pitch of the oscillations should fall to a very low value, certainly less than a hundred hertz, before asking questions. A simple test to establish that the device is "in range" is to get the subject to take several deep breaths, this should elicit a full scale response.

OPERATION

Put the finger clips on the subject with soothing reassurances that he won't get electric shocks. Then proceed to shock him by proving that the gadget works. A simple demonstration is to ask him to think of a number, say between one and five, and then ask him about each number in turn. He must of course say no to each number so that he must lie once. Present the numbers in random order otherwise the reaction as his number approaches might be confused with the previous one.

WARNING

Don't try to operate the gadget from a mains supply, or battery eliminator, even small leakage currents can be felt, and larger ones could be dangerous. ★

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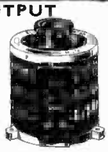

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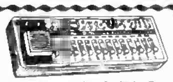
7	6, 12, 20V at 20A	£6·88	55p
8	24V at 10A	£5·23	35p
9	4, 6, 24, 32V at 12A	£7·15	45p



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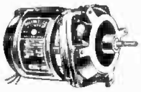

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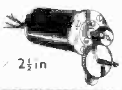

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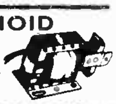

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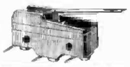

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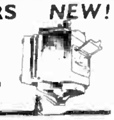

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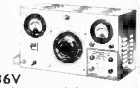

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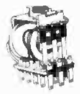

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'KEY SWITCH' 230 VOLT A.C. RELAYS
One set c/o contacts rated at 7·5 amps. Boxed. PRICE: **40p.** P. & P. 5p. (100 lots **£32** including P. & P.

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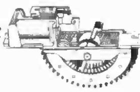

NEW **4 Bank 25 Way** 24V d.c. operation. **£5·88,** P. & P. 12p. **6 Bank 25 Way** 24V d.c. **£6·50,** P. & P. 12p. **8 Bank 25 Way,** 24V d.c. operation. **£7·62** plus 22p. P. & P.

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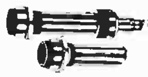

Precision engineered light source with adjustable lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP12 or similar cell. Both units are single hole fixing. Price per pair **£2·75.** P & P. **18p.**

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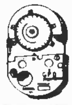
Kit includes ORP.12 Photocell, Relay Transistor Circuit. For 6 or 12V D.C. operation. **Price £1·25** plus 12p P. & P. **ORP. 12 and Circuit 63p post paid.**

VENNER Electric Time Switch



200/250V Ex GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 15A **£13·25,** 20A **£3·75.** P. & P. 20p. Also available with solar dial ON dusk, OFF dawn. Price as above.

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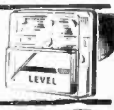

Approximately 300 micro amp basic, as fitted to Tape Recorders, etc. Strip type dual coloured dial. **50p + 8p** P. & P.

230 VOLT A.C. SOLENOID OPERATED FLUID VALVE

Adjustable flow control, all metal construction. Will handle hot or cold liquids, water, oil, paraffin, etc. ¾" inlet/outlet. PRICE: **£1·50,** P. & P. 20p.

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STATE OF THE INDUSTRY

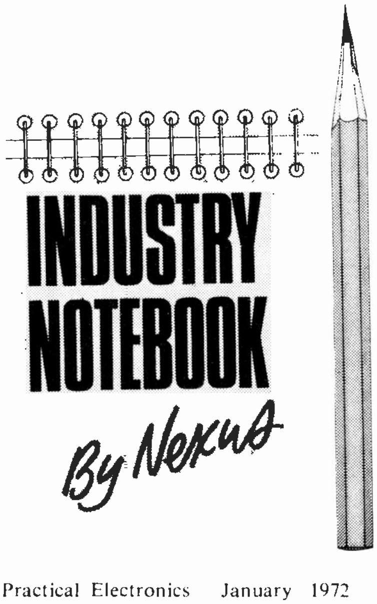
Official statistics necessarily trail events. It takes time for companies to make their returns to the Department of Trade and Industry and more time to analyse and collate them. So we had to wait until November 3 before getting the 1971 first half results on how the capital equipment sector is making out in these troubled times.

The figures were not as bad as some had feared. Compared with the first half of 1970 total output was up 5 per cent at £336·6 million. Radar was a bright feature, up 28 per cent, but slumps in broadcast equipment (−20 per cent), navigational aids (−11 per cent), and radio communications equipment (−10 per cent) eliminated the gains. Control equipment put on 22 per cent and nucleonic instruments a cracking 25 per cent, although the latter is such a small segment of the industry that the gain had little effect on the overall totals. Exports were down from 40 per cent to 36 per cent. Surprisingly, employment remained constant, this year being 150,000 people at the end of both the first and second quarters.

The red light is seen in the forward order book. The figure at June 30, 1970, was £648 million. On the same date in 1971 the figure had slumped to £572 million. The conclusion must be that the great days of 15 per cent growth every year are all but over.

LEANER AND TOUGHER

Squaring up to the commercial facts of life is no easy matter. Some people throw in the sponge as did RCA with computers. Since then the U.S. General Electric has pulled out of microcircuits. After an investment of £20 million and four years of struggle.



Others persist by seeking economies and building better management structures. Plessey recently underwent a complete reorganisation converting a cumbersome operation into "businesses", each accountable directly to the main Plessey board.

Some details of how Mullard tackled their problem have been revealed by commercial director Jack Akerman. Mullard now has four divisions each responsible for a market sector. They are Consumer, Computer, Communications, and Instrumentation and Control. The general manager of each division looks after his market sector not only from the sales point of view but also the Mullard manufacturing plant producing goods for his market area. Each is charged with making a profitable return on the capital employed which totals some £90 million right across the board.

Everyone is expected to work for the benefit of the whole company—not just for his own division. Akerman regards the organisational change as a platform for growth in the '70s. Results after 6 months showed a reduction in stocks of over 10 per cent while providing a better service to the customer, reduction in the commercial staff and better morale.

SLIMMING DOWN

Another example of slimming down to better meet the future as well as today's problems is to be seen in SGS whose U.K. operations are based on a marketing unit at Aylesbury and a substantial manufacturing plant at Falkirk. Fears that the Falkirk plant would be closed entirely were recently allayed by a lightning visit from Milan by Giancarlo Maimone, newly appointed managing director, who had discussions with local MP Harry Ewing and union representatives. The outcome was that Falkirk appears to be saved, for the time being at least, but with a labour force pruned from a peak of 1,100 down to some 500–600.

The marketing team at Aylesbury has also been streamlined and it is possible that a joint marketing team with ATES (a company associated with SGS through the Italian holding company IRI) will be set up. Other SGS plants in Italy, France, Germany and Singapore are all reported to be working well under capacity. Mr Maimone has some tough decisions ahead in relation to cut-backs elsewhere but, for the moment, SGS men in the U.K. are optimistic. "At least we now have a clean situation on which to build", was the opinion of marketing manager Roy Hood.

TELECOMMUNICATIONS BOOM

One sector of the industry which is flourishing is telecommunications which, with the introduction of PCM and electronic exchanges, is getting more and more electronic in character. The TXE 2 electronic exchange is now firmly established. Since the first was commissioned in Ambergate, Derbyshire, in 1966, some 150 have been installed and they are now coming into service at a rate of more than two every week.

The big TXE 4 with up to 40,000 lines (TXE 2 has only 2,000 lines) has now been finally ordered by the Post Office from Standard Telephones and Cables. The development of TXE 4 has not been without problems but these have now been resolved. First contract is worth £15 million and the first installation will be made in London at the beginning of 1975. Soon afterwards, TXE 4's will be in service in Manchester and Birmingham.

The TXE 2 has been a big success for Plessey who have supplied the bulk of them to the Post Office and have also been successful in selling them overseas.

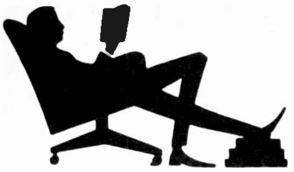
But the biggest telecommunications boom area of all is data communications. Fifteen countries in Europe have now come together in sponsoring a year's study by PA International Management Consultants in London on the data communications requirements of Europe for the next 15 years. The study is planned to show future customer requirements, anticipated data traffic flow with Europe, and between Europe and other continents, and future developments in data processing systems.

BRITAIN IN SPACE

The biggest rocket to get airborne (but only just) on Guy Fawkes day was *Europa 11* launched from Kouro in Equatorial French Guiana. Regrettably, it was the biggest flop of the year.

A few days earlier the British technology satellite *Prospero* (formerly *X3*) was successfully launched in orbit by a *Black Arrow* from Woomera and has been functioning well.

Prospero's success, however, will not compensate us in prestige for the loss of *Europa 11*. We pulled out of the European Launcher Development Organisation (ELDO) in 1968. It was a controversial move which did not endear us to our continental partners. The *Blue Streak* rocket used on November 5 was sold to ELDO. One crumb of comfort was that Marconi's navigational guidance system was not at fault.



BOOK REVIEWS

THE ARLINGTON DICTIONARY OF ELECTRONICS

Published by Arlington Books
171 pages, 8½in × 7½in. Price £3

THIS new book of American origin is well produced and attractively presented. The range of material covered is enormous, ranging from simple circuit theory to microwave engineering and quantum physics. Also included is some advanced maths including vector calculus. Digital computer fundamentals are also dealt with. Diagrams, though not profuse, are clear and well explained and the definitions are succinct and, wherever possible, assume only elementary knowledge.

My main criticism is not of this book itself but of the whole philosophy of presenting technical information in dictionary format. It is difficult to imagine when this type of book would be of use. In text books obscure terms are usually given lengthy explanations whilst a lay reader encountering technical terms would be unlikely to learn much from this type of book.

However, if this type of book appeals to you I can recommend it as an addition to library or personal book collection.

S.R.L.

110 INTEGRATED CIRCUIT PROJECTS FOR THE HOME CONSTRUCTOR

By R. M. Marston
Published by Iliffe
128 pages, 8½in × 5⅜in. Price £1·20

IN cramming 110 circuits into as many pages Mr. Marston has undoubtedly achieved quite a feat. The integrated circuits described range from the CA3018, which is simply four transistors on one chip, to the PA246 five watt amplifier. There is also a section describing 35 RTL digital i.c. projects.

The general procedure used is that a description of the internal circuit of the i.c. is presented, then several projects are described so that the reader becomes familiar with the function of the unit. Many of the projects are useful and interesting and it is almost certain that everyone will find something of use in this book.

The presentation of the information is, however, not all that good. Each new project does not have a heading so one has to resort to the index to find a particular circuit. All the i.c.s, apart from the digital, are represented with the operational amplifier symbol of a triangle. For i.c.s such as the CA3018 this makes it very difficult to read circuit diagrams, and on some diagrams output signals seem to come out of inputs.

At one new penny per circuit the book is certainly good value but a little more care in presentation would have helped.

R.S.

QUESTIONS AND ANSWERS ON RADIO AND TELEVISION (3rd edition)

By H. W. Hellyer
Published by Newnes-Butterworth
172 pages, 6¾in × 4¾in. Price 60p

THIS book is clearly aimed at people who would like to know how television and radio systems operate, but whose knowledge of electronics is slight. It takes the reader through the main principles of electronics and then goes on to explain, in simple terms, the basic features of electronic devices, including the valve and the transistor. Some of the important circuits in radio and television are then described with many circuit diagrams to illustrate practical considerations. The final chapters deal with the functions of the television receiver, including tuning, synchronising and picture linearity control. Colour reception is not dealt with in any detail.

The sections on basic electronics are lengthy and, on the whole, they provide a useful introduction to the subject for a beginner. However, in a book with this title, I think that some of the questions and answers on semiconductor manufacture would have been better replaced by explanation of some practical points, such as the methods of correct biasing for transistors. The description of the field effect transistor, which is anyway complicated by the use of the term "depletion layer" without definition, seems superfluous to this kind of book.

Apart from these criticisms the book provides a lot of useful information on radio and television and would give the interested beginner plenty of food for thought.

S.R.L.

RADIO AND TELEVISION YEAR BOOK 1971/72

Edited by Eric Ickinger
Published by IPC Electrical-Electronic Year Books Ltd
224 pages, 8⅝in × 5½in. Price £1

A COMPLETE guide to radio and television broadcast stations, transmitting at v.h.f. and u.h.f. in the U.K., precedes the up-dated cataloguing of commercial equipment under classifications: monochrome television, colour television, radiograms, record players, table radios, portable radios, car radios, tape recorders, unit audio.

The format follows the usual style as a buyer's guide giving descriptions, brief specifications, and prices (November 1971). Some illustrations are also included.

HI FI YEAR BOOK 1972

Edited by Colin Sproxton
Published by IPC Electrical-Electronic Year Books Ltd
376 pages, 8¾in × 6in. Price £1·25

AMONG the preceding articles in this latest Hi Fi Year Book is an interesting outline of the Dolby noise reduction system that is now being increasingly incorporated in commercial equipment. Also included are: Hi Fi from FM radio; a short review of eighteen of the best recordings over the past year or so: the meaning and importance of pick-up parameters; a glossary of terms associated with microphones; a list of common abbreviations and meanings.

The equipment descriptions and prices are updated but do not include all new items that took their bow at the 1971 Audio Fair (see our Audio Fair report in this issue). A complete list is given in the centre of this book of September 1971 list prices and new purchase tax rates.

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. 7in × 4in 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.

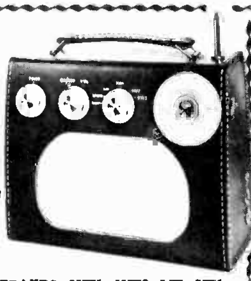
Easy to follow instructions and diagrams. Parts price list and easy build plans 30p (FREE with parts).

TOTAL BUILDING COSTS **£8·50**

P.P. & INS. 50p (OVERSEAS P. & P. £1)

ROAMER EIGHT Mk. I

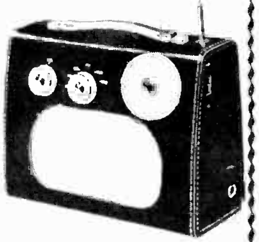
NOW WITH VARIABLE TONE CONTROL



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. 7in × 4in 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)

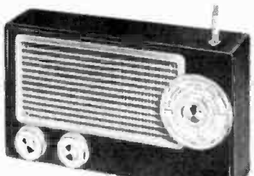
ROAMER SEVEN Mk. IV



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. 7in × 4in P.M. 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.

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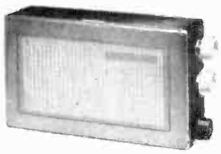
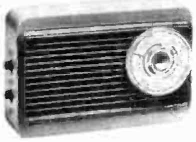
POCKET FIVE



3 TUNABLE WAVEBANDS: MW, LW, TRAWLER BAND WITH EXTENDED MW BAND FOR EASIER TUNING OF LUXEMBOURG, ETC. 7 stages—5 transistors and 2 diodes, supersensitive ferrite rod aerial, fine tone moving coil speaker. Attractive black and gold case. Size 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



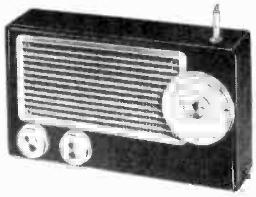
NOW WITH 3in SPEAKER

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.

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TRANSONA FIVE	☐	ROAMER SIX	☐
POCKET FIVE	☐	EDU-KIT	☐

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Address ....

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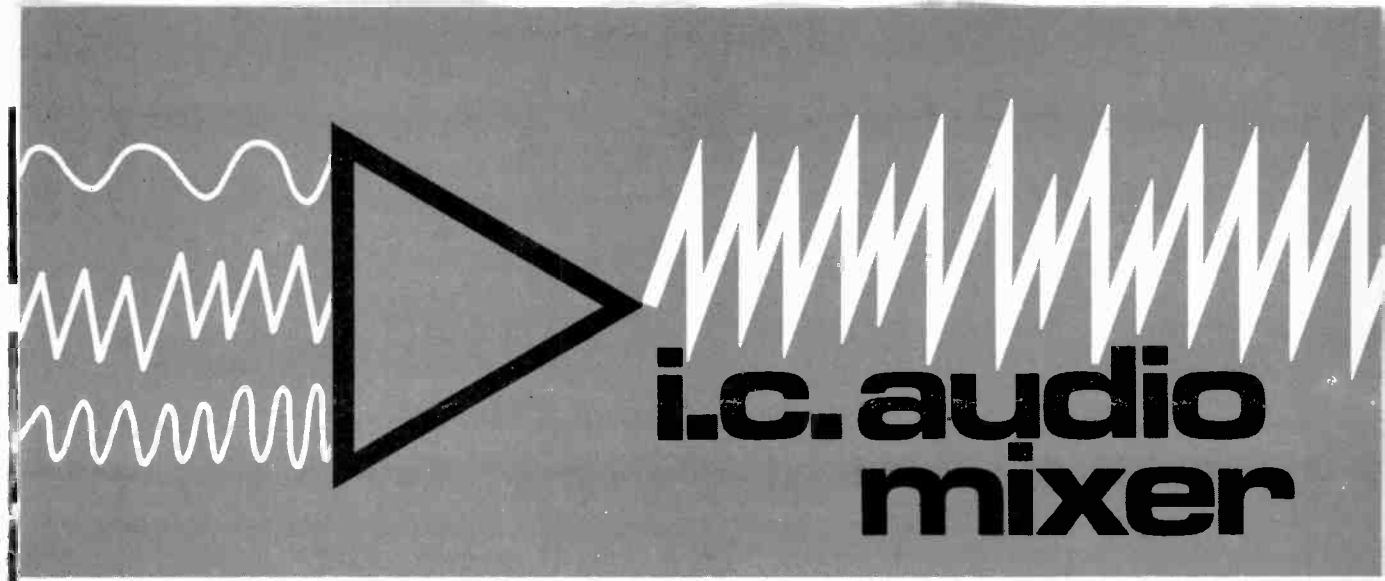


i.c. audio mixer

Combines Mic or Tuner inputs into a single channel

By M. J. Bunce

THIS article describes a simple three channel, audio mixer using an integrated circuit pre-amplifier. It has a substantially flat frequency response in the audio range, and is designed for use with both domestic and semi-professional tape recorders, particularly with regard to cine sound-track recording.

The mixer can also be used by pop groups, using impedance matching transformers if low output impedance transducers are used, such as dynamic or ribbon microphones.

CIRCUIT DESCRIPTION

The circuit of the mixer itself is given in Fig. 1. The input lines to the pre-amplifier are blocked to d.c. by capacitors C1, C2 and C3. This is necessary to prevent crackling and hiss caused by current flowing through the potentiometer wiper circuits.

The pre-amplifier is an integrated circuit operational amplifier contained in a standard eight-lead TO5 package. Such amplifiers are beginning to appear quite cheaply on the surplus market.

The circuit described was designed around an S.G.S. μA709, which has an open loop gain in the order of 50,000 at frequencies up to around 1MHz.

The gain of the amplifier for a single channel is given by:

$$G = \frac{R_F}{R_I}$$

where R_F is the value of feedback resistance R5 in ohms and R_I is the value of input resistance. In this case:

$$\text{Gain } G = \frac{1{,}000{,}000}{100{,}000} = 10$$

Thus the amplifier has an overall gain of ten.

CAPACITOR ROLES

To prevent the amplifier from amplifying stray radiation, picked up by the external connecting leads, the input is shunted by a resistor/capacitor network, consisting of R6 and C4. Similarly, generation of radio frequency parasitic oscillations within

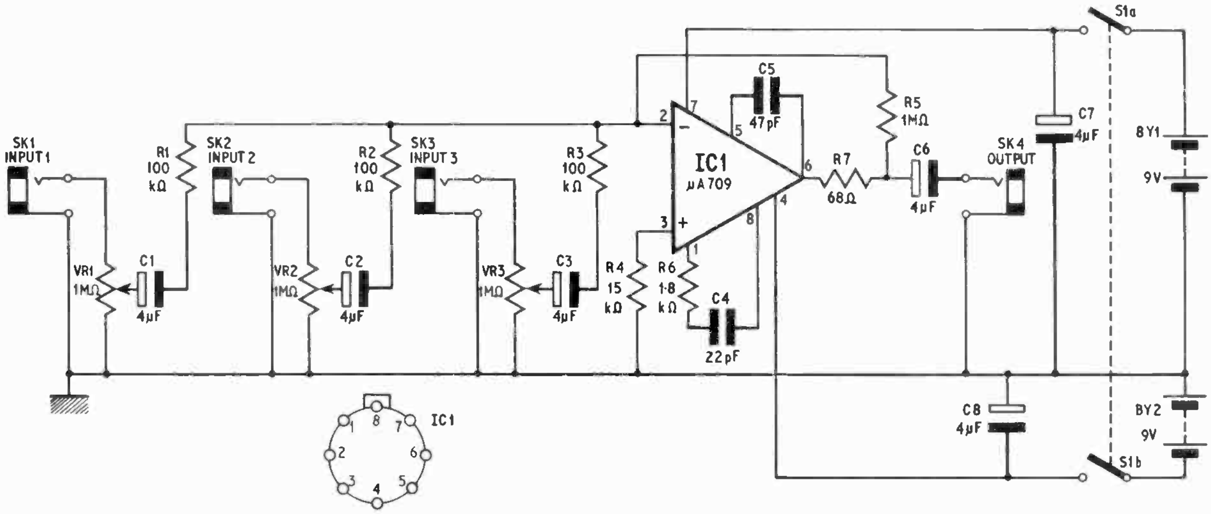


Fig. 1. Circuit diagram of audio mixer

I.C. AUDIO MIXER

COMPONENTS . . .

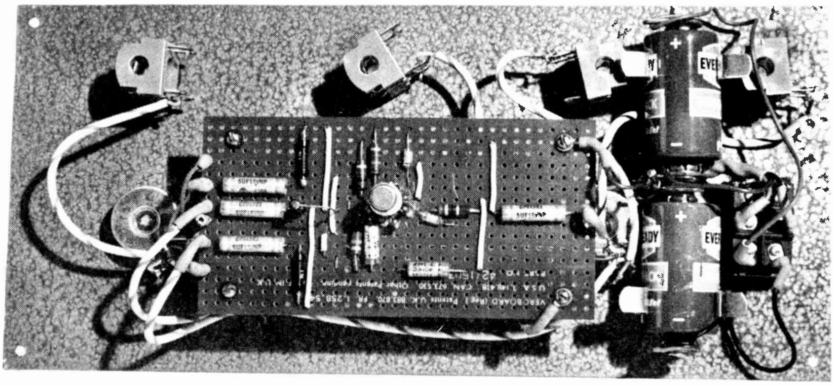
Resistors
R1 100k Ω
R2 100k Ω
R3 100k Ω
R4 15k Ω
R5 1M Ω
R6 1·8k Ω
R7 68 Ω
All ±10%, ¼W carbon

Potentiometers
VR1 1M Ω carbon log.
VR2 1M Ω carbon log.
VR3 1M Ω carbon log.

Capacitors
C1 4μF elect. 15V
C2 4μF elect. 15V
C3 4μF elect. 15V
C4 22pF polystyrene
C5 47pF polystyrene
C6 4μF elect. 15V
C7 4μF elect. 25V
C8 4μF elect. 25V

Integrated Circuit
IC1 μA 709 (S.G.S.) *or* equivalent

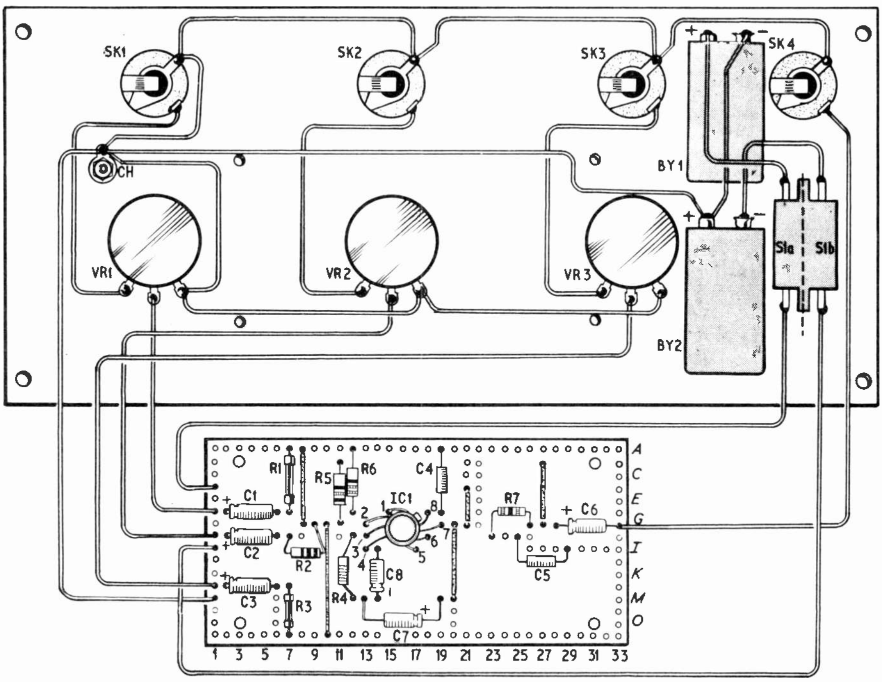
Sockets
SK1–SK4 Standard type jack sockets (4 off)



Switch
S1 Double pole on/off switch

Batteries
BY1, BY2 9 volts type PP9 (2 off)

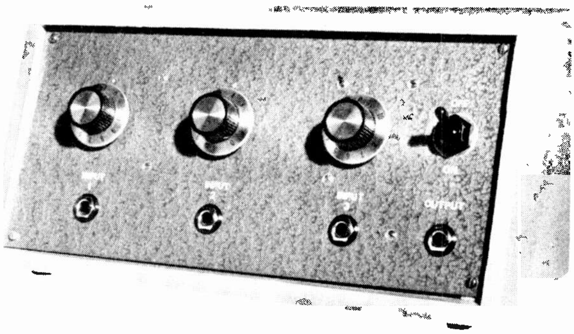
Miscellaneous
Aluminium panel 16 s.w.g. 11in × 5in
Skirted control knobs numbered 0–10 over 300 degrees
Veroboard 5in × 2½in 0·15in matrix
Hardboard and wood as required



MAKE BREAKS TO COPPER AT:

4A	4P	9F	17F	30C
4B	5F	11H	18M	30N
4C	5H	14G	22G	30O
4N	5L	14H	30A	30P
4O	8H	16I	30B	32G

Fig. 2. Component layout and interwiring of mixer



the amplifier is suppressed by capacitor C5 at the amplifier output.

The values of these components determines the upper frequency response limit of the amplifier; its lower limit is determined by the values of the input capacitors C1, C2 and C3, and also the output capacitor C6. For this mixer application, a fairly sharp roll-off is required above 25kHz.

Any d.c. component in the amplifier output (e.g. that due to offset or drift within the i.c.) is blocked by capacitor C6, which also protects the amplifier against short-circuit fault conditions at the input stages of the equipment to which it is connected. It may seem at first that using the component values specified voltage offsets might easily occur. In practice, however, although offsets of up to ± 1V can occur at the output of the amplifier, this is of no consequence since the output is d.c. blocked, and the output voltage swing never exceeds $\pm 0{\cdot}5$V.

INPUT INTERACTION

It would also appear that the inputs might interact (i.e. turning one input to minimum would cause a drop in gain of the remaining inputs). This is also not true, since the input of the i.c. is a virtual earth, and the inputs do not therefore have any effect whatsoever on each other.

As the power requirements of the amplifier are small, it was decided to use two 9V batteries, particularly as the amplifier requires a centre-tapped supply. The design of a suitable power unit for such a circuit could be disproportionately costly and complex. Besides, for the particular application of this mixer, portability is useful.

Earthing is not critical, although the fewer the number of separate earths, the better.

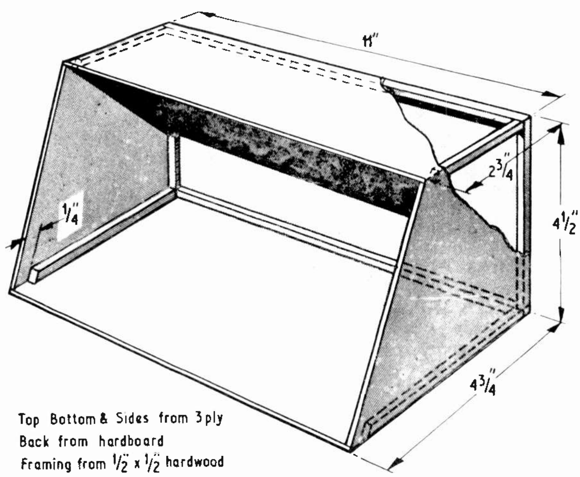


Fig. 3. Case assembly details

CONSTRUCTION

The unit is built around the front panel, thus avoiding numerous trailing wires, so that it may be fitted into the case as a complete module. Component assembly details on the front panel are shown in Fig. 2.

The electronic components are all mounted on a piece of Veroboard which is spaced from the panel by four 6BA spacers. The integrated circuit package is mounted on an i.c. socket to obviate the risk of damage when soldering the leads.

The layout of the components on the panel is not critical, however all unused whole copper strips should be electrically bonded to earth to avoid pick-up of extraneous signals.

When laying out the front panel (see photograph), consideration was given to the ergonomic aspects of the design, particularly as the cine sound track operator could well be working outdoors in cold weather. As he could be wearing gloves under such conditions, plenty of room was left between the control knobs, which are of skirted type.

The case is of thin plywood, angled to provide a comfortable degree of rake to the front panel. Since each individual constructor may wish to design his own case to suit his requirements, only a simple perspective view of the prototype case is included (Fig. 3).

HUM SUPPRESSION

The inside of the case is lined with aluminium foil to prevent pick-up of external interference such as mains hum. The foil is earthed to the front panel at the chassis solder tag CH (Fig. 2).

The screws fitted to the front panel are all countersunk, with the exception of the four case securing screws, as this improves neatness and avoids any risk of fouling the skirt of at least one of the potentiometer knobs.

USING THE MIXER

In setting up the mixer each number on the control knobs represents a gain increase or decrease of approximately 1dB with the input and feedback resistance values given in Fig. 1.

For amplifier gain variations the input resistors R1, R2 and R3 can be changed either singly or totally to suit individual requirements. Thus, with the 1 Megohm feedback resistance given and input resistors in channels 1, 2 and 3 having values of 1 Megohm, 100 kilohms and 10 kilohms respectively, these will provide suitable gains for an f.m. tuner, crystal microphone and dynamic or ribbon microphone providing the latter two are fitted with impedance matching transformers.

No master gain control is fitted since for its particular design application the tape-recorder input gain control is satisfactory. Monitoring is carried out in the normal way using the recorder facility. ★

ELECTRONORAMA

Mowing by Moonlight

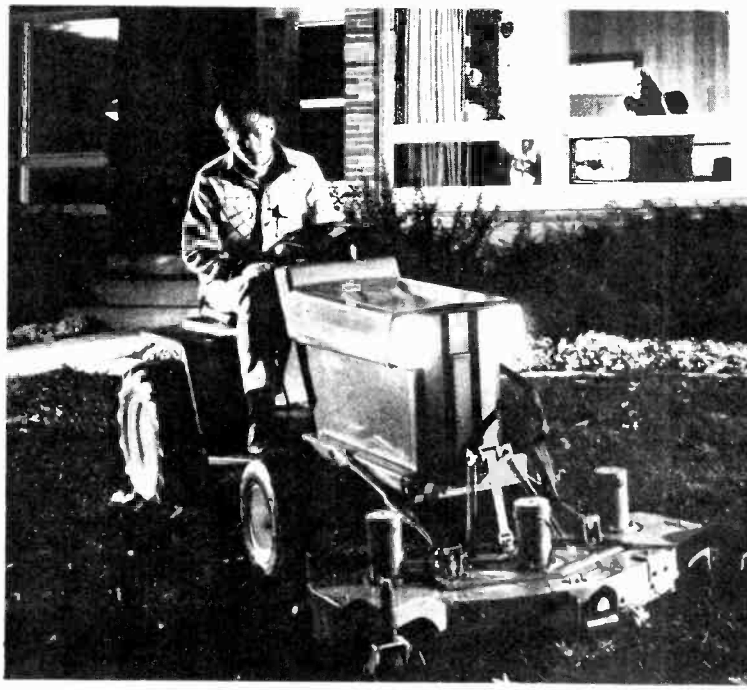
RICH, insomniac Americans can now while away the midnight hours by mowing the lawn, without fear of disturbing their neighbours.

The Elec-Trac is a quiet and compact electric tractor developed by General Electric for use in the garden. It can mow, till, blow away snow, or provide a mobile power source for electrical equipment.

A programmed starting system prevents the operator from applying too much speed too soon and when the controls are set to "full forward" a built-in safety circuit automatically accelerates the vehicle smoothly to the desired speed.

Six long-life batteries will provide eight to ten years of life under normal conditions.

The company predicts a great future for after dark lawn care. They say, "We know that from three years of testing at night that quiet mowing in the cool of the evening or early morning is a real pleasure."



Electronic Cash Register

TO MEET the need for faster check-out in supermarkets and stores, a new electronic system has been designed to replace the slow and cumbersome cash register. Pitney-Bowes call the new system "SPICE" (Sales Point Information Computing Equipment), and the unit which the customer sees is closer to a computer terminal than a cash register.

By connecting all the units to a central in-store controller, all information concerning sales can be recorded on magnetic tape. This can later be processed by a computer and any facts and figures which are needed can be extracted for use by the store manager. As well as accurately recording sales, the terminals may be used to get immediate notification of a customer's credit standing. The terminals can also be used as calculators to work out quantity prices or discounts.

An optional extra to SPICE is "PEPPER" (Photo-Electric Portable Probe/Reader) which eliminates the need for the sales clerk to ring up the prices. All sales items are individually marked with specal tickets, on which the price is coded into a row of bars. The electronic "pen" is quickly passed over the ticket, instantly displaying price, item number, and department number on the terminal register. Speed and elimination of human error make this very attractive to both customer and seller.

For small stores or places where access to a central computer is not feasible, a self-contained system known as "SALT" (Stand Alone Terminal) is available which can be programmed to provide on-the-spot point-of-sale information.

A .... ELECTRONI

A Sight for Sore Ears

WHEN noise exceeds a certain level it is not only annoying, it can be positively dangerous! In an attempt to lessen the risk to hearing for people who live or work in noisy environments, the Noise Abatement Society is now marketing two new pieces of equipment: a survey meter which lights a lamp if sound exceeds the danger level and ear defenders for protection when it does.

Eye Movements Control Wheelchair

FOR patients who have lost the use of both arms and legs, this wheelchair offers new hope. The only actions needed to start, steer or stop the wheelchair are movements of the eyes. The sight-guide steering mechanism used in the chair was developed originally for NASA, the U.S. space agency, which is seeking ways of freeing the hands of pilots and astronauts for other in-flight duties.

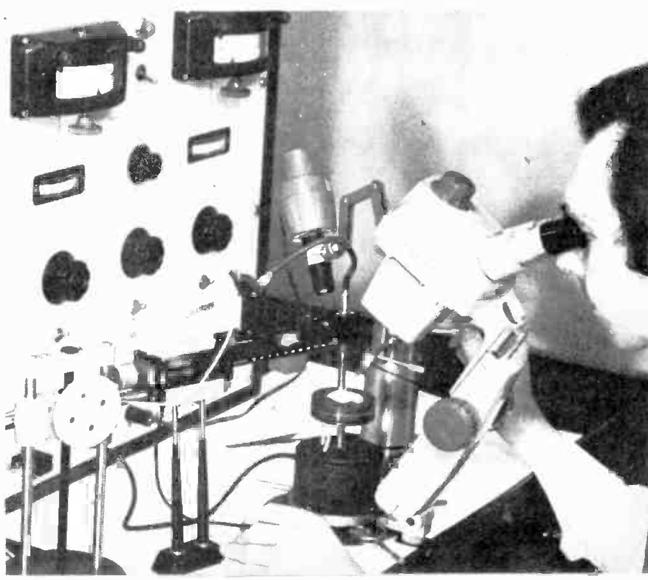
A prototype wheelchair controlled by eye movements is at present being tested at the Institute of Rehabilitation Medicine in New York. If it is eventually put into production, an estimated 100,000 quadriplegics (those with no use of arms or legs) could be made mobile.

Microstrip Production

WITH the increasing use of microwave communications, EMI's activities in microstrip circuits—miniature microwave devices—have rapidly expanded in the last year. Their range has grown to include doppler generators, Gunn effect power sources, aerials, amplifiers and switches.

These new microwave techniques are being applied in many areas including the development of an experimental digital radio link for the Post Office. This will be designed to transmit and receive digital signals at 120 million bits per second.

The photo shows part of the assembly process using a vacuum probe micro-manipulator.



Use integrated circuits to simplify control functions

LOGICAL RADIO CONTROL

By A.J. Dunn

PART TWO

CODER 2 is described in this article in two variants. Although more expensive to make than Coder 1 described last month, they are easier to assemble. Both variants use the same basic printed circuit pattern apart from a minor change to the circuitry involving IC7.

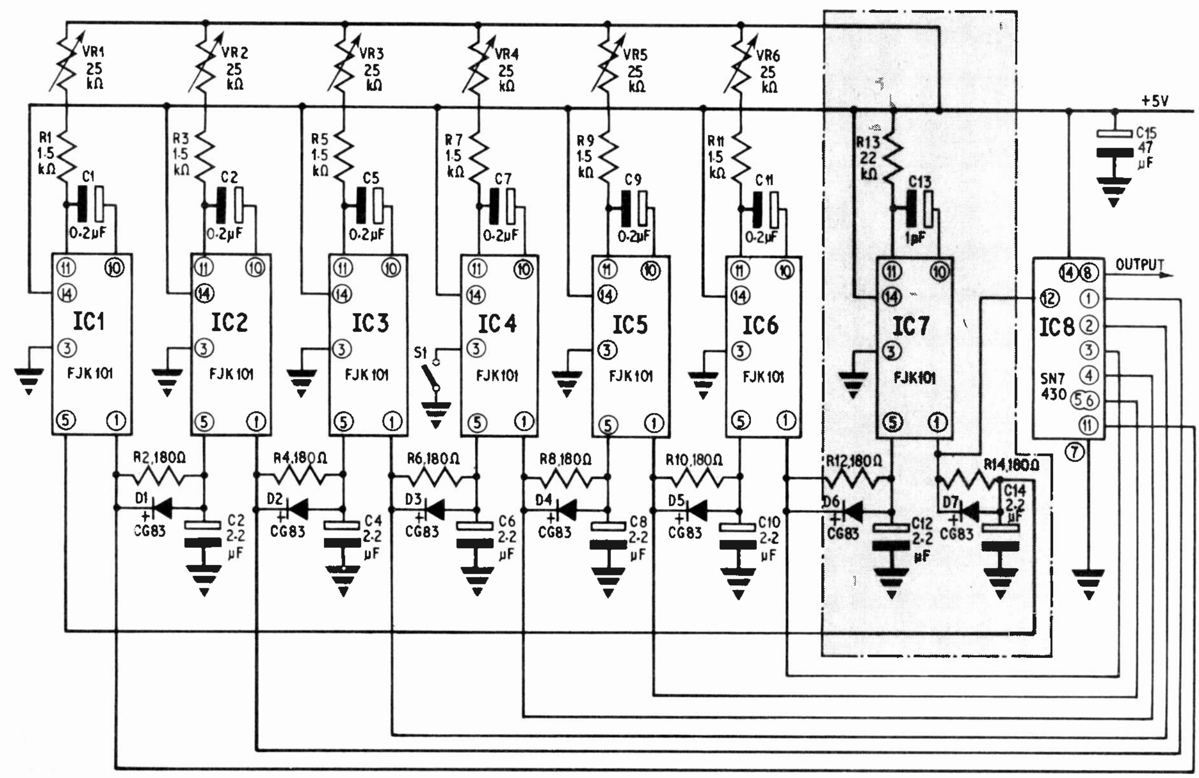
CODER 2A

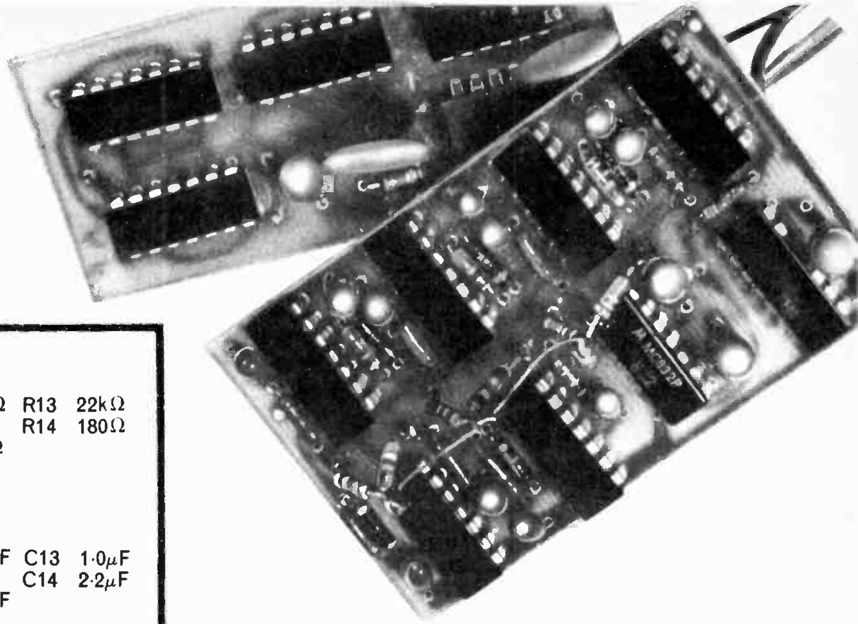
Fig. 10 shows the circuit of Coder 2A. The grey panel area is the part which is altered to make Coder 2B. More about this later.

The particular advantage of Coder 2 is the flexibility of timing since the timing resistance combination of R1-VR1 can vary between 1·5 kilohms and about 40 kilohms (R1 is fixed at 1·5 kilohms) with any value for C1. There is no critical lower value for the minimum signal pulse length.

The integrated circuits IC1 to IC7 (Type FJK101 or 74121) are monostable multivibrators, each triggering the next in turn via the R-D-C network from pin 1 ($\overline{Q}$ output), providing the interval period of about 0·32ms. The resistors in these networks (R2, R4, etc.) should not exceed 200 ohms. The sync pulse

CODER 2A





COMPONENTS . . .

CODER 2A

Resistors

R1	1·5kΩ	R5	1·5kΩ	R9	1·5kΩ	R13	22kΩ
R2	180Ω	R6	180Ω	R10	180Ω	R14	180Ω
R3	1·5kΩ	R7	1·5kΩ	R11	1·5kΩ		
R4	180Ω	R8	180Ω	R12	180Ω		

All ±10%, ⅛ watt carbon

Capacitors

C1	0·22μF	C5	0·22μF	C9	0·22μF	C13	1·0μF
C2	2·2μF	C6	2·2μF	C10	2·2μF	C14	2·2μF
C3	0·22μF	C7	0·22μF	C11	0·22μF		
C4	2·2μF	C8	2·2μF	C12	2·2μF		

All tantalum bead type

Potentiometers

VR1 to VR6 25kΩ linear carbon (6 off)

Integrated Circuits

IC1 to IC7* FJK101 *or* SN74121N (7 off)
IC8 FJH101 *or* SN7430N

D1 to D7 CG83 *or* OA10 (7 off)

Miscellaneous

Fibreglass base printed circuit board and etching kit

is taken from the $\overline{Q}$ output of IC7, the pulse length being 0·7CR or approximately 14ms.

For timing capacitors (C1, C3, etc.) of 0·2μF and control resistance of 25 kilohms in series with 1·5 kilohms, the corresponding maximum signal pulse length is approximately 5ms.

One of the NAND gated inputs (pin 3) is connected to the common "earth" line except in the case of IC4 where an initiating switch is inserted to start the cycle of operation.

The output from the Coder is taken from IC8, a single eight-input positive logic NAND gate.

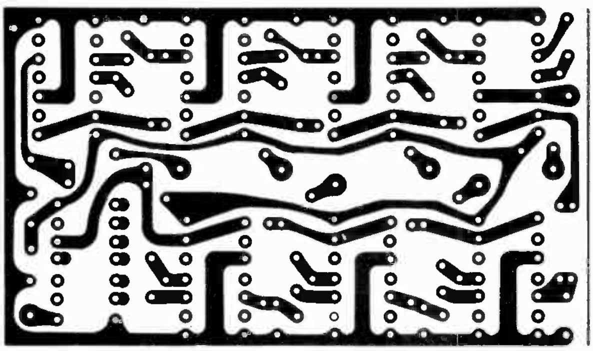
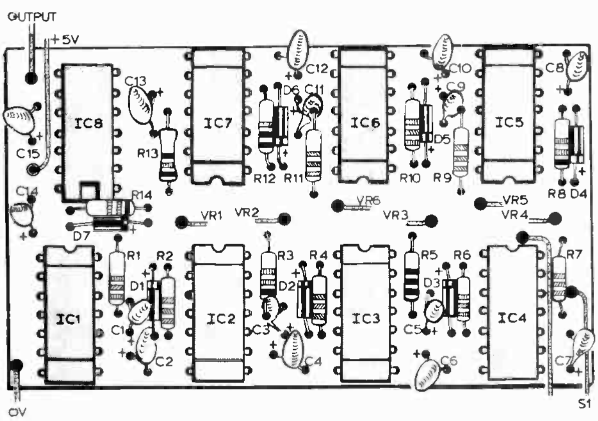


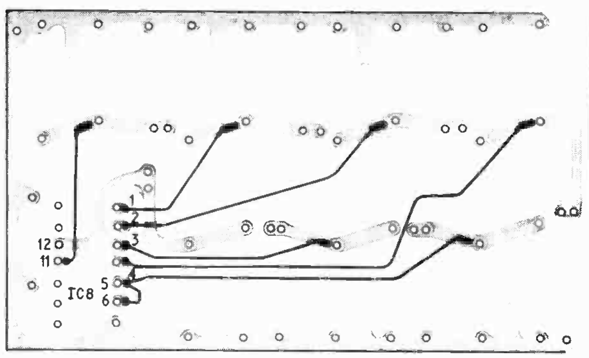
Fig. 10 (far left). Circuit diagram of Coder 2A. The area for modification to convert to Coder 2B is indicated by the grey area

Fig. 11 (left). The printed circuit pattern (full size) for Coder 2A

Fig. 12. Component layout of Coder 2A. The area where modification is required to convert to Coder 2B is shown in Fig. 16

Fig. 13 (below). Wire link connections on the copper side of the board





CODER 2A P.C. BOARD

The pattern for the printed circuit, which should be of fibreglass base, is shown full size in Fig. 11. As with Coder 1 described last month, it is worth providing an extra blank area of board at one end for mounting; this would add about ½in to the length of the working pattern.

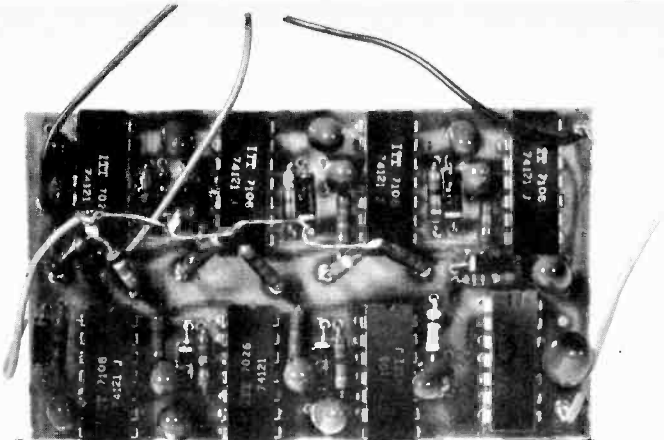
Component layout is shown in Fig. 12, while details of wire link connections are in Fig. 13.

Orientation of the integrated circuits is important; if an error is made after soldering *in situ* it can prove a messy job to remove the i.c. unless a special desoldering tool is available.

CODER 2B

Coder 2B is similar to Coder 2A except it has a fixed cycle time. The integrated circuit IC7 is replaced by a dual four-input NAND gate (DTL type MC832 or 932) equipped with "node" inputs. The outputs from IC7 are capacitor coupled to the opposite "node" inputs, so forming a multivibrator, Fig. 14.

The output from pin 6 initiates the cycle for each period τ_1 (see last month). This period can be adjusted by altering the values of the coupling capacitors C16 and C17. For small variations a series resistor-potentiometer arrangement, as in the other stages, can be connected from pin 3 to the positive line and also from pin 11 to the positive line.



*** MODIFICATIONS TO MAKE CODER 2B**

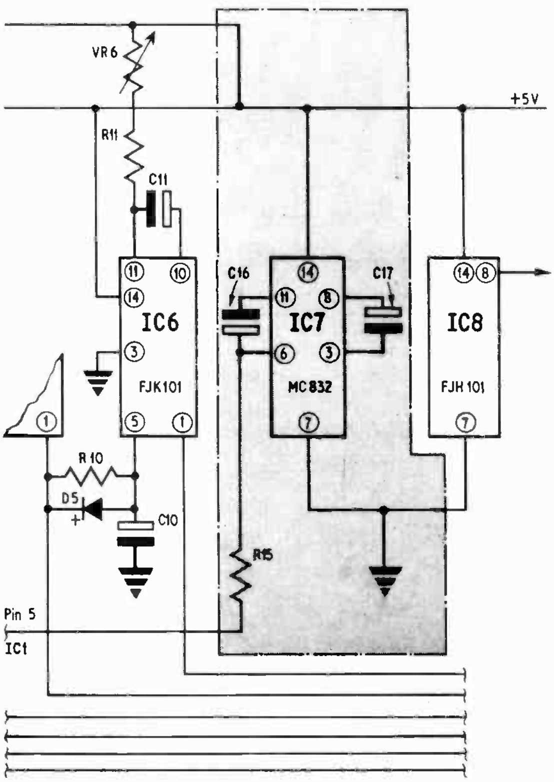
Integrated Circuit
IC7 Change to MC832 *or* 932. DTL range

Diodes
D6 and D7 not required

Add Resistor
R15 180Ω ⅛ watt carbon

Capacitors
C15, C16 10μF tantalum or electrolytic (2 off)

CODER 2B



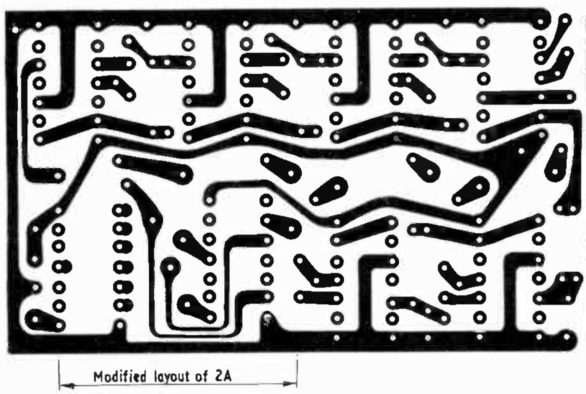
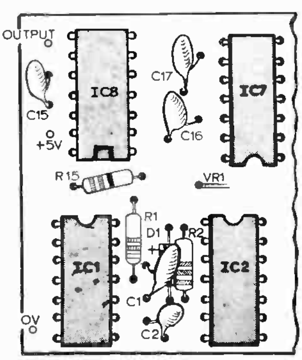


Fig. 14 (left). Modification of Coder 2A circuit from part of Fig. 10 to convert to Coder 2B

Fig. 15 (above). Printed circuit pattern (full size) for Coder 2B

Fig. 16 (right). Modified area of layout for Coder 2B



The modified printed circuit pattern is shown full size in Fig. 15, while the modified part of the component layout is shown in Fig. 16.

DECODER

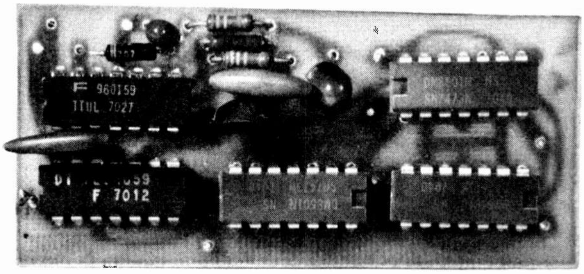
A decoder is essentially a means of translating the information transmitted in pulse code to some form of sequential mode analogous to the operation of model functions.

In the decoder described here, three dual JK flip-flops make up a shift register (Fig. 17) driven by a negative going pulse, derived by feeding the input signal through two paralleled NAND gates. A retriggeragle monostable is also used to detect the signal period.

The circuit shown in Fig. 17b is used to produce the negative going pulses required by the shift register inputs to 'clock' and 'clear': this should be considered in connection with the waveform diagram Fig. 18.

The input signal (Fig. 18a) is applied to two parallel NAND gates, each with a "fan-out" of eight, producing the requisite negative going signal (Fig. 18b) adequate to drive the 6 (× 2) clock input loads.

The $0{\cdot}1\mu F$ capacitor is used to slow the fast edges slightly and prevent spurious ringing effects. This signal is applied to the input of the retriggerable monostable whose output (Q) is maintained high (Fig. 18c) till after the last trigger (pulse No. 6)



Finished decoder board

dependent upon C1 and R1 ($2{\cdot}2\mu F$ and $20k\Omega$) as pulse width $\tau \simeq 0{\cdot}36\, R_1\, C_1 \left(1 + \frac{0{\cdot}7}{R}\right)$ R being in kilohms; C in pF; and τ in nanoseconds.

CLEAR PULSE

The positive going edge is differentiated by C2 and R2 (Fig. 18c), the negative going spike turning off TR1 whose output is a positive pulse situated in the middle of the sync period (Fig. 18d). This pulse

DECODER

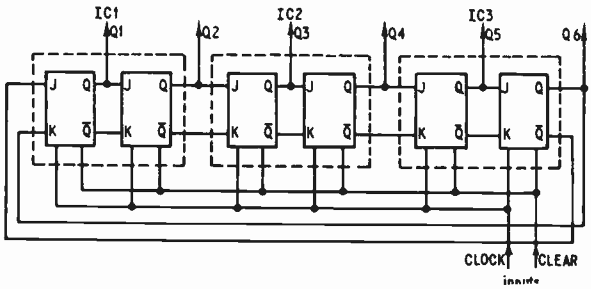


Fig. 17a. Interconnection of six JK flip-flops to form a shift register for decoding

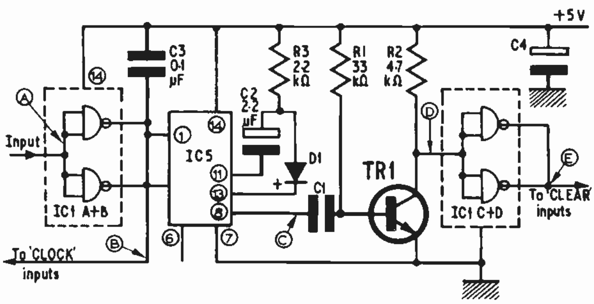


Fig. 17b. Circuit of the "clock" and "clear" pulse generator on the decoder board

COMPONENTS . . .

DECODER

Resistors
- R1 4·7kΩ
- R2 33kΩ
- R3 22kΩ
- All ±10%, ⅛W carbon

Capacitors
- C1 0·1µF ceramic disc
- C2 2·2µF tantalum
- C3 0·1µF ceramic disc
- C4 47µF elect.

Integrated Circuits
- IC1 MC846 *or* 946 quad 2-input gate (DTL)
- IC2, IC3, IC4 FJJ121 *or* 7473N Dual JK (TTL) (3 off)
- IC5 F9601 retriggerable monostable

Transistor and Diode
- TR1 2N3704
- D1 OA202

Miscellaneous
- Fibreglass printed circuit board and etching kit

is applied to two parallel NAND gates whose negative going output (Fig. 18e) drives the "clear" inputs of the register.

The action of the "clear" pulse is to set the outputs (Q) of all six flip-flops to "0" awaiting the arrival of the first signal pulse which causes the output of the first flip-flop to go high (1) (since it takes an input from an inverted output ($\overline{Q}$) for the period of the pulse and the interval period. The second signal pulse causes the second output to change to "1" and the first output to revert to "0".

Subsequent pulses appear individually as positive output pulses at the five flip-flop outputs.

The output from Q1 is shown at "B" in Fig. 19b.

SIXTH CHANNEL

The sixth channel output is obtained, if required, by the use of a further quadruple NAND gate wired as shown in Fig. 19a and if desired, associated with a servo unit. The positive going input signal at "A" is gated with the output of the flip-flop output Q1 to produce the signal shown in "C". This is again gated with the input to produce a negative going pulse as at "D", which is inverted, using another gate to produce the sixth positive going signal output at "E".

The shift register is formed by connecting the dual flip-flops in cascade as shown in Fig. 17a, it being noted that one interconnection pair is reversed to store the necessary "1".

Fig. 20 shows the printed circuit layout, the components being assembled as shown in Fig. 21. Note again the orientation of the integrated circuits and polarity of the capacitors and diode.

When carefully soldered, thin insulated wire should be used to wire up the signal connection pads, the positive supply connections and the earth connections (Fig. 22).

DECODER VARIATIONS

The shift register can be extended for as many outputs (channels) as required provided that the "fan out" performance of parallel gates exceeds the number of loads—two per "clock" and "clear" input.

The present cost of SN7473N i.c.s invites the use of a cheaper gate to obtain the last output (Fig. 19) but a single flip-flop (FJJ111) could be used to store the "1".

If Coder 2B (with positive sync pulse) is used the circuit in Fig. 17b is modified and the inverted ($\overline{Q}$) output from pin 6 of IC5 is applied to the base of TR1 and an output is taken from its collector (collector load 5·1kΩ) direct to the "clear" inputs.

The "clear" input signal (which overrides the action of "clock" pulses) is maintained to the end of the cycle.

A 1,000pF capacitor should be connected between the clock inputs and ground (0V) to prevent spurious ringing and the "extra" flip-flop method should be employed.

CONSTRUCTION NOTES

It cannot be over-emphasised that care should be taken with construction, particularly the soldering; if sound components are used and the circuit wired correctly, no difficulty may be expected; however, a simple solder bridge between copper pads can cause

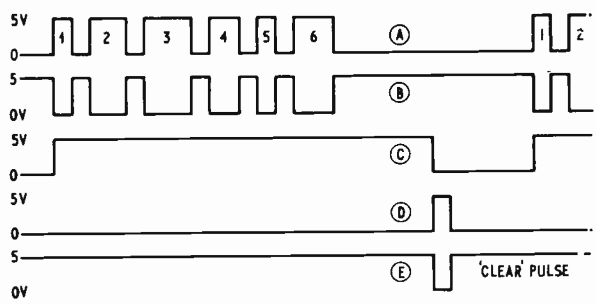


Fig. 18a. A typical input to first two NAND gates in IC1

Fig. 18b. Output of first two NAND gates fed into the clock line and into the signal period detector multivibrator IC5

Fig. 18c. Output Q from the resettable monostable multivibrator IC5

Fig. 18d. Output waveform from TR1 indicating the positive pulse in the middle of the sync period

Fig. 18e. The pulse in Fig. 18d is inverted by two more paralleled NAND gates to produce a sharp "clear" pulse

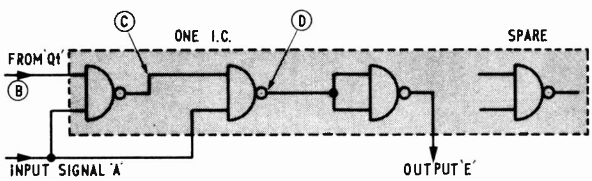


Fig. 19a. Quad 2-input NAND gate is used to obtain the sixth channel from the Q1 output. Waveforms are given below

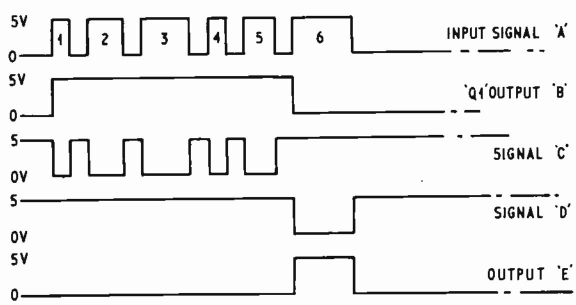


Fig. 19b. Waveforms at input and outputs of the gates

complete malfunction, necessitating the use of an oscilloscope to locate the fault.

The following notes may be of value:

1. The i.c.s should be obtained from a reliable source and properly identified. It is difficult to remove a "dud" and the copper printing may be stripped with excess heat.
2. The capacitors should be inspected for leaking and loose ends and then should be polarised before assembly. A "working" voltage should be applied from a battery via a current meter noting that the leakage current falls to a low value: the absence of an initial charging current indicates an open circuit capacitor and an unpolarised or short circuit capacitor will cause excess current causing i.c. failure. Tantalum capacitors or long life electrolytics are preferred.
3. The wire ends of the diodes should be carefully bent with wiring pliers to avoid fracture of the glass seals.
4. Soldering should not be attempted without a clean small bit.
5. The recommended technique for insulating wire connections is to bare the ends of an excess length of multi-stranded wire, twist up and solder the ends, causing the insulation to creep back beyond the point where baring took place. The ends are then cropped till $\frac{1}{16}$in of clean soldered wire is exposed: the iron is applied to the tinned copper pad until it runs freely; then the wire is applied.

TESTING

The components should be inserted on the board and wired up as indicated, noting and checking the polarity of each component as fitted. Before any interconnecting wires are fitted the board should be held to the light and the component connections checked against the theoretical circuit. The variable resistors (coders) may be replaced by a selection of fixed resistors (as shown in photograph) within the VR range and the current supply voltage applied, noting the current to be less than 150mA. If an oscilloscope is available the waveform can now be examined at the output, otherwise an audio test may be applied (capacitor and headphones) noting the output of the multivibrator, each stage and at final output. The coder can now be connected to the decoder as in Fig. 1 noting that the supply current to the decoder is less than 50mA.

An oscilloscope triggered from the coder output should show the pulse train input and individual decoder output pulses.

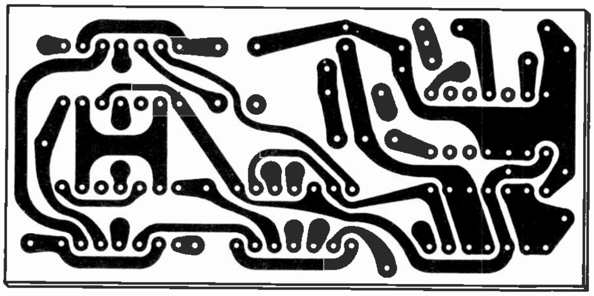
A d.c. meter (of 20 kΩ per volt resistance or better) should indicate different voltages of the order of $\frac{1}{2}$ to $\frac{3}{4}$V at each decoder output in accordance with the values of coder resistance used. The meter performing an integrating action on the 5V pulses, being present, say, for 4 milliseconds every 30 or $4/30 \times 5$V. The variable resistors may now be fitted and their action noted in changing the decoded pulse length or d.c. output. ★

Note: In Part 1 last month the following corrections are necessary:

Fig. 5. Capacitor C15 should be reversed

Fig. 7. The blob of ink at bottom centre is not part of the printed circuit pattern

Table 1. The quad 2-input NAND gate by STC-ITT should be MIC9465D



LOOK FOR THE FOLLOW-UP ARTICLE

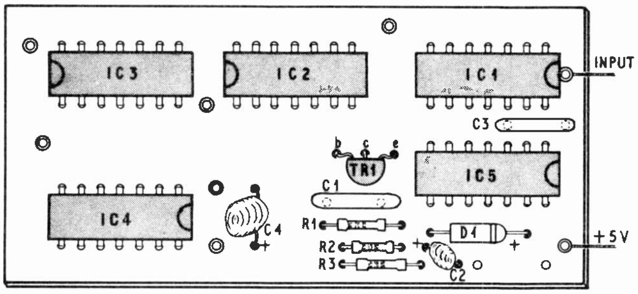
MODEL SERVO CONTROL

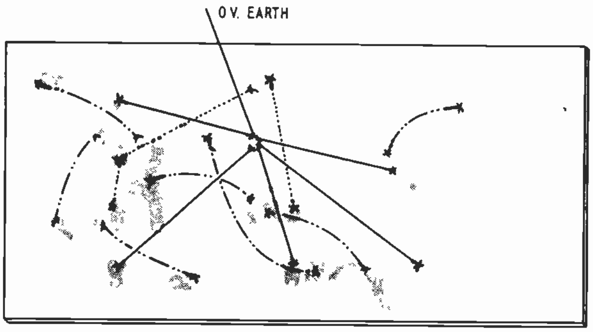
IN NEXT MONTH'S ISSUE

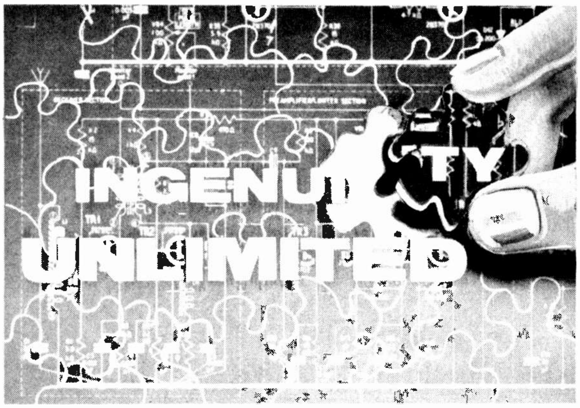
Fig. 20 (left). Printed circuit pattern for the decoder

Fig. 21. Component layout of the decoder board

Fig. 22 (below). Link wires are soldered on to the copper side for power supplies and signal lines







A selection of readers' suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.
This is YOUR page and any idea published will be awarded payment according to its merits.

STABILISED SUPPLY WITH OVERLOAD PROTECTION

The circuit diagram Fig. 1 was designed to power a 12 watt stereo amplifier. It was found to be desirable to have a constant voltage regardless of power being delivered by the amplifier. The circuit in Fig. 1 was evolved to achieve these requirements.

The potential at point A is always a fixed fraction of V_0 and is determined by R2 and R3. As R_L is lowered V_0 will lower causing the potential at A to decrease. As the base potential of TR1 is fixed by the Zener and VR1 so TR1's base-emitter diode D4 becomes more forward biased. Hence more current flows into the Darlington pair TR2 and TR3 which supplies R_L with a greater current, restoring the original output voltage.

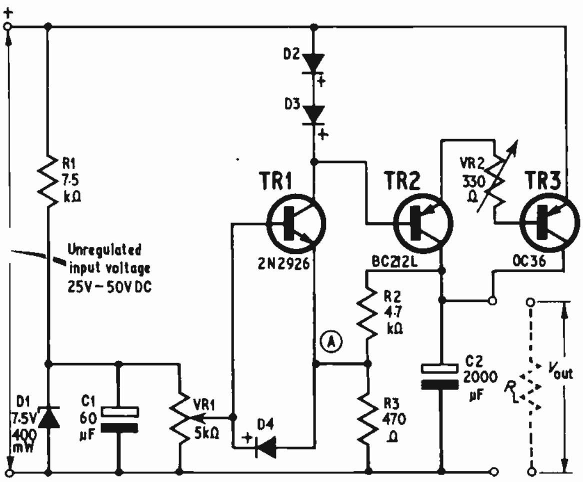


Fig. 1. Circuit diagram of the stabilised supply overload protection

Components VR2, D2 and D3 provide a current limit which is set by adjustment of VR2. Diodes D2 and D3 should be silicon types and have turn-on voltages of 0·6V each. Transistor TR3 is a germanium transistor and so V_{be} will be about 0·2V while V_{be} for TR2 will be about 0·6V.

When a small current is being supplied to the load the voltage drop across D2 and D3 is not large enough to affect the circuit, but if R_L becomes very small the voltage drop across VR2 is arranged to bring D2 and D3 into conduction, preventing an excessive current through TR3. A sharper limiting action could be achieved by replacing D2 and D3 with a zener and increasing the value of VR2.

The output voltage is set to the required value by VR1. To obtain low voltages, say 10V, a bleeder resistor should be inserted across the output as TR3 has a leakage current of about 4mA. Capacitor C1 is included so that the output voltage rises slowly when the circuit is switched on. Diode D1 is included to protect TR1 when the circuit is switched off.

The output resistance of the circuit has been calculated and is given by:

$$R_0 = \frac{R2 + R3}{h_{FE(TR2)} \times h_{FE(TR3)}}$$

This is 3Ω at the worst and about 0·5Ω at the best.

J. Welch,
Northampton.

RESETTABLE COUNTER

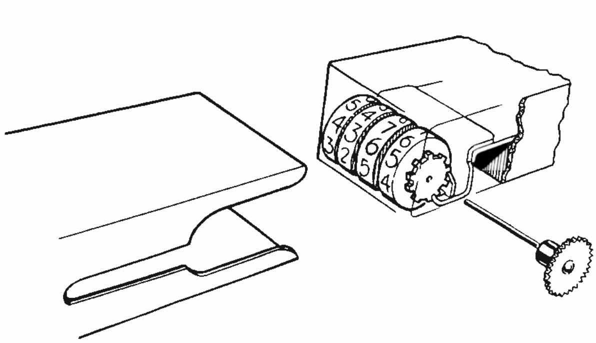
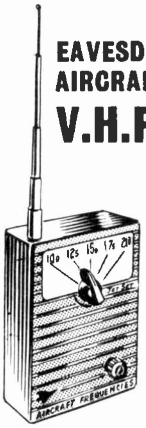


Fig. 1. Exploded view of the counter

I HAVE converted an ordinary electromagnetic counter into a resettable counter by removing the spindle that supports the number wheels, and replacing it by one about ½in longer. On the protruding end I fixed a small knob. A slot was cut in the metal cover to enable it to be slid over the protruding spindle, see Fig. 1. The counter may now be reset by turning the knob.

With some counters a second ratchet under the number wheels prevents them being reversed. A small lever may be fixed to the second ratchet to enable it to be disengaged when reversing the counter.

A. Hartley,
Bolton,
Lancs.



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Many thousands of v.h.f. Aircraft Band Converters now selling in U.S.A. *Listen in to* **AIRLINES, PRIVATE PLANES, JETPLANES.** *Eavesdrop on exciting crosstalk between pilots, ground approach control, airport tower. Hear for yourself the disciplined voices hiding tenseness on talk downs.* Be with them when they have to take nerve rippling decisions in emergencies—Tune into the international distress frequency. Covers the aircraft frequency band including **HEATHROW, GATWICK, LUTON, RINGWAY, PRESTWICK ETC., ETC. CLEAR AS A BELL.** This fantastic fully transistorised instrument *can be built by anyone nine to ninety in under two hours.* (Our design team built four—everyone worked first time.) *No knowledge of radio or electronics required.* No soldering necessary. Fully illustrated simply worded instructions take you step-by-step. Uses standard PP3 battery. Size only 4½" × 3" × 1½". All you do is extend rod aerial, place close to any ordinary medium-wave radio (even tiny portables) **NO CONNECTIONS WHATEVER NEEDED.** Use indoors or outdoors. **THERE WILL BE ENORMOUS DEMAND FOR THIS NEW DESIGN. SEND NOW. ONLY £2·37** (47/6) + 23p (4/6) p. & p. for all parts, including case, nuts, screws, wire, etc., etc. (parts available separately).

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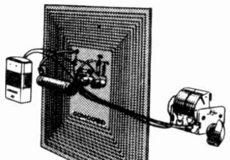

FIND BURIED TREASURE WITH THIS READY BUILT & TESTED

Treasure Locator Module

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BRAND NEW FULLY TRANSISTORISED PRINTED CIRCUIT METAL DETECTOR MODULE. *Ready built and tested*—just plug in a PP3 battery and 'phones and it's working. Put it in a case, screw a handle on and **YOU HAVE A PORTABLE TREASURE LOCATOR EASILY WORTH ABOUT £20!** Extremely sensitive—penetrates through earth, sand, rock, wood, dirt, water, etc.—**EASILY LOCATES COINS, GOLD, SILVER, WATCHES, JEWELLERY, NUGGETS, METALLIC ORE, HISTORICAL RELICS, BURIED PIPES, KEYS, NAIL-IN-TREES, ETC., ETC.** Signals exact location by "beep" pitch increasing as you near buried metallic objects. **PRINTED CIRCUIT SEARCH COIL** *so stable and sensitive it will detect certain objects buried* **SEVERAL FEET BELOW GROUND! GIVES CLEAR SIGNAL ON ONE COIN!** *You could even pay for your holidays with two or three days electronic beachcombing—it's almost like having a licence to print money!* Unclaimed treasure now exceeds the combined wealth of all nations. **ORDER NOW WHILE PRESENT STOCKS LAST—TREMENDOUS DEMAND EXPECTED AT THIS REMARKABLY LOW PRICE. DEMONSTRATIONS DAILY. ORDERS DESPATCHED IN STRICT ROTATION. SEND NOW £4·95 + 30p carr. (99/- + 6/-), etc.** (High quality Danish Stethoscope headphones **£2·75** (55/-) extra if required.)

SHORTWAVE TRANSISTOR RADIO

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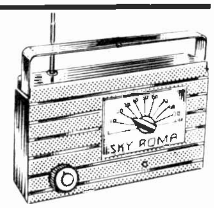


Can be built in one evening

At last! After trying countless circuits searching for easy build, work first-time short waver. Giving advanced world-wide performance, we chose this "Sky Roma". Anyone from 9 years up can follow the step-by-step, easy-as-ABC, fully illustrated instructions. (We built ten prototypes and every one worked first time), no soldering necessary. 76 stations logged on rod aerial in 30 mins.—**Russia, Africa, USA, Switzerland, etc.** Experience thrills of world wide news, sport, music, etc. **Eavesdrop on unusual broadcasts.** Uses PP3 battery. Transistorised (no valves). Size only 3" × 4½" × 1½". As tremendous demand anticipated price held to only **£2·25** (45/-) + 17p (3/6) p. & p. for all parts incl., cabinet, screws, instructions, etc. (Parts available separately.)

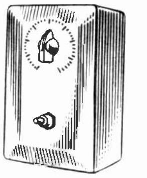
FIND BURIED TREASURE!

TREASURE LOCATOR TRANSISTORISED

NOW IT'S HERE AT LAST, after experimenting for four and a half months with a multitude of different circuits and carrying out actual field tests with prototypes, our design team have come up with this real winner. This fully portable transistorised metal locator detects and tracks down buried metal objects—it signals exact location with loud audible sound (no phones used)—uses any transistor radio which fits inside—no connections needed. **FINDS GOLD, SILVER, LOST COINS, JEWELLERY, KEYS, WAR SOUVENIRS, ARCHAEOLOGICAL PIECES, METALLIC ORE, NUGGETS, ETC., ETC.** Outdoors or indoors. *Extremely sensitive, will signal presence of certain objects buried several feet below ground!* No knowledge of radio or electronics required. *Can be built with ease in one short evening by anybody from nine years of age upwards,* with the wonderfully clear, easy to follow, step-by-step, fully illustrated instructions—it really is easy as ABC. transistorised — no valves. Uses standard PP3 battery. No soldering necessary. Size of detector head 13½" × 10" × 2½". **Great demand expected at this remarkably low price—ORDER WHILE PRESENT STOCKS LAST.** All parts including detector head case, nuts, screws, wire, simple instructions, etc., etc. **ONLY £2·37** (47/6) + 27p (5/6) p. & p. (Sectional handle as illustrated **75p** (15/- extra). Parts available separately. Made up looks worth £15!

ONLY £2·37 (47/6)

SOOTHE YOUR NERVES, RELAX WITH THIS AMAZING RELAXATRON



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CUTS OUT NOISE POLLUTION—SOOTHES YOUR NERVES! Don't underestimate the uses of this fantastic new design—the **RELAXATRON** is basically a pink noise generator based on avalanche operated transistors. Besides being able to mask out extraneous unwanted sounds, it has other very interesting properties. For instance, many people find a rainstorm mysteriously relaxing, a large part of this feeling of well-being can be directly traced to the sound of falling raindrops—a well-known type of pink noise. *A group of Dentists have experimented on patients with this pink noise* — **NO ANAESTHETICS WERE USED!** The noise ostensibly created a most definite reactionon these patients, nervous systems with the results that their pain systems were blocked. **IF YOU WORK IN NOISY OR DISTRACTING SURROUNDINGS, IF YOU HAVE TROUBLE CONCENTRATING, IF YOU FEEL TENSED, UNABLE TO RELAX**—then build this fantastic Relaxatron. Once used you will never want to be without it—use this amazing pink noise generator whenever you feel uneasy, can't relax or wish to concentrate. **TAKE IT ANYWHERE,** pocket sized. Uses standard PP3 batteries (current used so small that battery life is almost shelf-life). **CAN BE EASILY BUILT BY ANYONE OVER 12 YEARS OF AGE** using our unique, step-by-step, fully illustrated plans. No soldering necessary. All parts including case, a pair of crystal phones, Components, Nuts, Screws, Wire, etc., etc. no soldering. **Send only £2·25 + 25p** (45/- + 5/-) p. & p. (Parts available separately.)

GET A GOOD NIGHT'S SLEEP—EVERY NIGHT! INGENIOUS ELECTRONIC

SLEEP INDUCER only £2·75 (55/-)

CAN'T SLEEP AT NIGHTS? DO YOU WAKE UP IN THE NIGHT AND CAN'T GET OFF TO SLEEP AGAIN? WOULD YOU LIKE TO BE GENTLY SOOTHED OFF TO SATISFYING SLEEP EVERY NIGHT? Then build this ingenious electronic sleep inducer. *It even stops by itself so you don't have to worry about it being on all night!* The loudspeaker produces soothing audio-frequency sounds, continuously repeated—but as time goes on the sounds gradually become less and less—until they eventually cease altogether, *the effect it has on people is amazingly very similar to hypnosis.* A control is provided for adjusting the length of times, etc., all transistor, can be built by anyone over 12 years of age in about two hours. No knowledge of electronics or radio needed. Extremely simple, easy-to-follow, step-by-step, fully illustrated instructions included. *No soldering necessary.* Works off standard batteries—extremely economical. Size only 3" × 4½" × 1½"—take it anywhere. **All parts** including case, loudspeaker, components, nuts, wire, screws, etc., etc. **THERE WILL BE A GREAT DEMAND FOR THIS UNIQUE NEW DESIGN—SEND NOW £2·75 + 25p** (55/- + 5/-) p. & p. (parts available separately).

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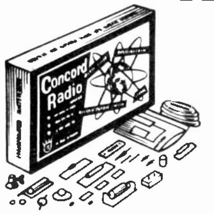

Amazing Radio Construction set! Become a radio expert for **£1·97** (39/6). A complete Home Radio Course. No experience needed. Parts including simple instructions for each design. Illustrated step-by-step loudspeaker, personal plans, all transistors, phone, knobs, screws, etc., all you need. Presentation Box **37p** (7/6) extra as illus. (if required) (extra parts available separately) no soldering necessary. Send only **£1·97** (39/6) + 23p (4/6) p. & p.

REAL WORKING ELECTRONIC ORGAN

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Don't confuse with ordinary electric organs that simply blow air over mouth-organ type reeds, etc. Eight months were spent in creating and testing this superb, revolutionary electronic organ. Fully transistorised — no valves. **Proper self-contained loudspeaker.** *Fifteen separate keys span two full octaves—play the "Yellow Rose of Texas", play "Silent Night" play "Auld Lang Syne", play lots and lots of similar tunes* on this real working electronic organ. Although it's no theatre organ it's certainly no tiny thing, it measures 13½ × 10 × 2½". You have the thrill and excitement of building it together with the pleasure of playing a real, live, throbbing electronic organ. *Take it anywhere—play it anywhere.* **NO PREVIOUS KNOWLEDGE OF ELECTRONICS NEEDED—NONE WHATEVER.** No soldering necessary, it really is as simple as ABC to make. **Anyone from nine years upwards can build it easily in one short evening** following the fully illustrated, step-by-step,simply worded instructions. **BIG DEMAND ANTICIPATED FOR THIS UNIQUE INSTRUMENT** at our low, low building price. **ONLY £2·75** (55/-) + 23p (4/6) p. & p. for all parts, including case, loudspeaker, transistors, condensers, resistors, knobs, transformer, volume control, wire, nuts, screws, simple (but full) instructions, etc., etc. Uses standard battery (parts available separately). Have all the pleasure of making it yourself, finish with an exciting gift for someone.

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SME Model 3009 Series II short arm pick-up

Audio Fair

A brief look at some recent developments in the hi fi industry

By M. A. COLWELL

AUDIO by definition means pertaining to sounds, so perhaps one could be forgiven for expecting noises resembling several kinds of phenomena. And since the Audio Fair has been described as an exhibition of home entertainment, perhaps we could likewise expect to see an assortment of musical instruments, television and radio, or—dare we suggest—electronic games. However, television was strictly banned by the organisers on the day of opening, so how far should we define "home entertainment" in terms of electronics?

Today's Audio Festival and Fair is a far cry from that high fidelity social function erstwhile held in luxury carpeted surroundings at the Hotel Russel and previously at the Waldorf.

LONDON OR BRIGHTON?

Because of overcrowding, the Audio Fair organisers were probably right in finding an alternative venue. Consequently in 1969 we heard some convincing arguments that Olympia *was* suitable; that acoustically treated demonstration rooms could be successful.

Give them their due, Rex Hassan and company tried hard amid tremendous criticism, but a great deal can be learned by closer examination of the Fair as a whole and its venue. and it is quite obvious that some more hard thinking must be done to rate this exhibition as near a success as can be achieved.

Now is the right time to take stock of such irritating discomforts as would not be tolerated in any hotel premises. Among these, I place catering at the head of the list, litter strewn gangways second, and poor ventilation third. And oh! that dreadful train service!

In the previous week I sampled the exhibition at Brighton called Inter/Nepcon and subsequently conclude that these premises must supersede Olympia by decades. Apart from the sweet ozone and spotless terraced houses nearby, the Metropole has every reason to be proud of its conference and exhibition centre and I recommend it wholeheartedly to organisers of such as the size of the Audio Fair.

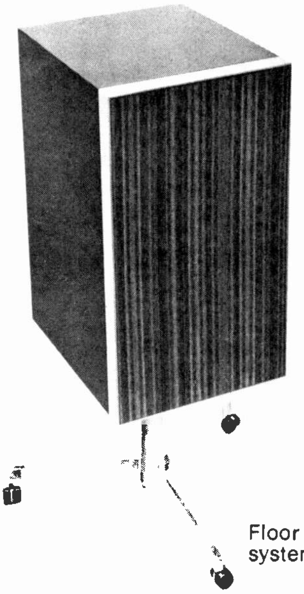
BROAD RANGE

The range of exhibits at this year's Fair has broadened to include medium fi, low fi, and even (if it is possible) no fi at all. The extension of range to include electro-musical gimmicks, record and tape shops, nameplates, and the not-so-high-as-it-used-to-be-fi inevitably lowers the general image that we have become so accustomed to in the past.

The overall technical standard of equipment and products shown was generally interfered with by infiltration of medium fi, but well established high quality products were still to be found.

RANK INFLUENCE

One interesting point to emerge is the influence of big business on the market through an established small company name. I am referring in particular



Floor standing speaker system from Ferrograph to the Rank Organisation whose acquisition of Wharfedale and Leak has already been geared towards mass marketing.

Although Harold Leak (now retired) did produce most of the parts that make up a complete hi fi system, he did not market a transcription unit. Logical first step then for Rank was to fill this gap, but not from their own stable. They have contracted with the Lenco Company of Switzerland to sell transcription units that they call the "Delta". Believe it or not, these are identical to the established Goldring Lenco GL75.

At least Rank recognises quality when it comes to such deals but it is a smack in the eye for the reputation of the former all-British Leak company. A Shure M75 magnetic cartridge is fitted to the Lenco pick-up arm, which has the usual cueing.

NEW SPEAKER SYSTEMS

Another first timer from Ferrograph, who previously preferred to specialise mainly in the high quality tape recording field, is a loudspeaker system. It is a three-unit assembly designed in collaboration with a university acoustics team, and uses two Goodmans treble units and one KEF B139 woofer.

Ferrograph state that their sophisticated crossover network eliminates what little coloration exists outside the pass bands. From this we can deduce that bandpass cut-off is very sharp so that interaction between speaker units is minimal. They quote a "sensibly flat" response from 30Hz to 15kHz.

Metrosound Audio Products Ltd. also announces a new speaker, the Duplex 25, to match their new ST60 amplifier (or any other make). With one conventional cone type unit for the low frequency end, they have incorporated a new electrostatic unit based on a new patent specification. High frequency dispersion is said to be improved by mounting this behind a lenticular grille.

The Duplex 25 is 27½in high and can handle 25 watts. Nominal impedance is 8 ohms and frequency range is quoted without reference level as 40Hz to 18kHz. Price at time of going to press £52.

HI FI IN KIT FORM

Looking for further outlets for their existing speaker kits, EMI Sound Products Ltd. are now marketing a range of enclosures in kit form from £5·80 for a compact bookshelf model to £29·50 for a large floor standing model. A hammer and screwdriver are the only tools needed to assemble these; the baffle-boards are already cut to suit the appropriate kits.

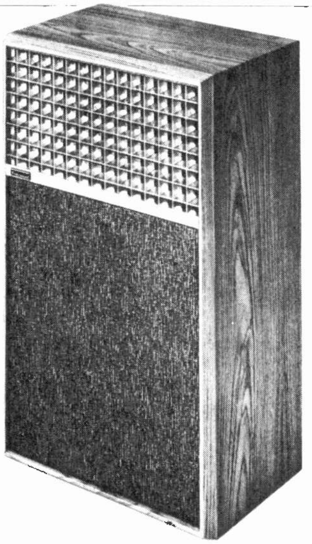
Heath (Gloucester) Ltd., who sell the famous Heathkits, announce a new tuner-amplifier kit, the AR-2000. The tuner processes a.m. (L.W., M.W., and S.W.) and f.m. mono and stereo broadcast signals, using up-to-date techniques, including f.e.t front end and integrated circuits for the f.m. i.f. and decoder stages. Ceramic filters are also used.

The kit price at £89·90 is competitive with equivalent commercial ready made units, but is still a little expensive for a kit.

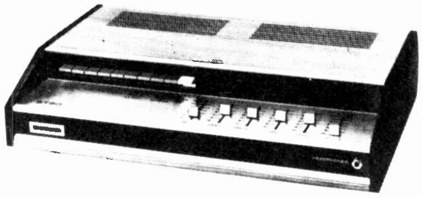
Another well established name in hi fi circles is looking to expansion at a rapid rate. No less than eight new products were shown on the Goodmans stand.

Well known for its wide range of quality loudspeakers, they are competing forcefully with the likes of the Rank Organisation. The new items include an attractive a.m./f.m. tuner amplifier the Model One-Ten at £135; the Module 80 Compact, a combined f.m. stereo tuner amplifier of high performance with record player type GL75 at £165; the Dimension-8 bi-directional speaker at £69 teak, £75 white finish.

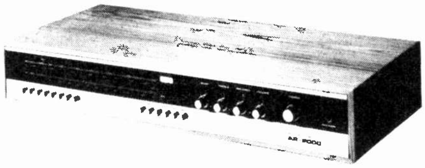
Goodmans also introduced a speaker kit, the DIN20 incorporating an 8in bass unit and an h.f. dome radiator with a crossover unit. This is a budget price kit of excellent quality for those with limited financial resources at £12·54 including purchase tax. Goodmans also expect to release their new professional stereo tape recorder in 1972 at a price in the region of £400. The prototype shown at the Fair looks very impressive and uses slider controls, twin capstans, and switchable 2-speed NAB or DIN equalisation.



Duplex 25 electrostatic and cone speaker from Metrosound



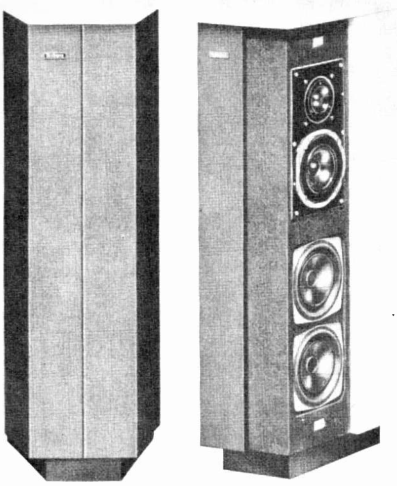
Metrosound ST60 amplifier



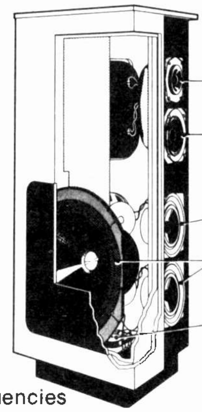
Heathkit tuner amplifier type AR-2000

SEEN AT THE FAIR

SEEN AT THE FAIR



The new four-channel stereo phones from Koss, the K2+2



Goodmans Dimension-8 bi-directional speaker system goes a long way to improving stereo spread at high frequencies

BELT DRIVE

Past experiments on belt drive turn-tables have met with cynical comment, but progress to date is brought to fruition in the GL85 integrated transcription turntable unit and pick-up arm from Goldring.

The turntable is driven by a "non-stretch" flat belt from a low speed 16-pole synchronous motor. Motor speed is accurately controlled by an electronic stabiliser circuit. Two speeds are available and an illuminated stroboscope indicates speed accuracy.

An electronic sensing device raises the pick-up arm at the end of the record and switches off the motor. This unit is expected to be available in January and is to be supplied complete with plinth for £72·78 including purchase tax.

The Connoisseur BD2 turntable at £32 now has push button speed change.

STEREO PHONES

Among headphones on show, which seem now to be a common occurrence for demonstration at the Fair, Koss were dominant with the excellent PRO-4AA stereo phones popping up on several stands, not the least being our own. The first four-channel headphones were also demonstrated by Tape Music Distributors Ltd. the distributors for Koss. They are the K2+2, using four separate dynamic drivers, and are likely to sell for around £45.

A.K.G. introduced the K180 (at £30) high quality headset with balancing volume controls.

Wilmex were demonstrating the Japanese Stax SR3 electrostratic headset with their power driver switch-over unit type SRD5. At 420 grams these are comparatively lightweight. The SRD5 will power two pairs of SR3 phones. A complete set of one pair of phones and one power unit costs £45·40; a second pair of phones would cost £31. In spite of reassurances I don't particularly care for high voltages so close to my ears.

DEMONSTRATIONS

The Hi-Fi Theatre is an excellent way of getting to know people and several personalities in the world of audio engineering, with a selection of magazine writers, gave some fascinating demonstrations, albeit, we are pleased to record, without commercial prejudice.

This is an essential alternative to an otherwise biased demonstration that may be set up on manufacturers' stands. The range was very wide and we were pleased to note the "free-for-all" session on the Friday where various magazines collaborated to help the public audience with their hi fi problems. This session was later edited and broadcast on BBC Radio London in November.

WE WERE THERE

What of PRACTICAL ELECTRONICS? Judging by the sales of P.E. Gemini Amplifier reprints, especially at the exhibition, this project is still a very popular do-it-yourself amplifier design.

The amplifier, originally shown last year, was joined this year by its new companion the P.E. Gemini Tuner, a stereo f.m. tuner of compatible design, with integrated circuit phase lock loop decoder and high selectivity ceramic filters.

Full details of this new design will appear in PRACTICAL ELECTRONICS very soon.

Also represented on the P.E. stand was our new companion EVERYDAY ELECTRONICS, which showed among other items, the integrated circuit record player, that appeared in the November issue.

Finally, a note for your new 1972 diary; the other London audio exhibition, Sonex at Skyway Hotel, near London Airport, will be open to the public March 24 to 26 inclusive, preceded by two "trade only" days.

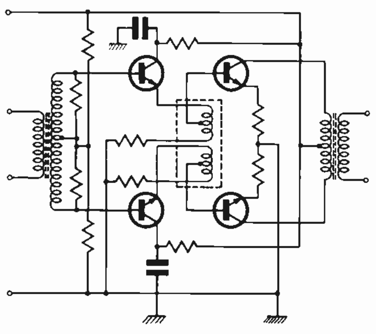
★

PATENTS REVIEW...

IMPROVING AMPLIFIER PERFORMANCE

IN their new British Patent 1 232 324, Redifon Limited discuss multistage transistor amplifiers of the push-pull type, capable of operating over a wide frequency range with coupling of the stages directly and by an inductive device with a view to improving performance.

BP 1 232 324



Redifon explain that it is already known that a pair of transistors can be biased into class A conditions and coupled by way of a transformer so as to drive a further pair of transistors biased into class B conditions. It is also known that a pair of transistors can be biased into class B conditions and directly coupled to a further pair of transistors biased also into class B.

But, according to Redifon, in the transformer coupled arrangement there is difficulty in providing a driver transformer for the class B stage with a sufficiently low leakage reactance to transfer power over a wide frequency band with little distortion.

Various ways round problems like these have been suggested, but Redifon claim they have a novel idea in suggesting an amplifier with a first stage in class A and a second stage in class B, using an inductive device with a pair of tapped windings, arranged so that an output electrode of a transistor in the first branch of the first stage is connected to one end of one of the tapped windings, and an output electrode of a transistor of the second branch of the first stage is connected to one end of the other of these windings.

An input of a transistor in the first branch of the second stage is connected to the tapping of the first tapped winding and an input electrode of a transistor in the second branch of the second stage is connected to the tapping of the other one of the tapped windings.

The two windings of the inductive device are connected in a sense such that power for driving each transistor of the second stage is provided by both the transistors of the first stage.

Redifon give a circuit diagram for an amplifier of this type and the specification also carries some specific component values. Because of the load sharing by the transistors of the first stage, regulation is improved and distortion due to the effect of intermittent load imposed by each second stage transistor, is reduced.

SYNTHETIC ANIMAL SOUNDS

IN the name of Santa Rita Technology Inc. of California, BP 1 228 405 is particularly interesting because of its possible application to the projected airport at Foulness.

As is well known it is often necessary to rid airport runways of birds. This can be done by generating alarm signals, but, as Santa Rita explain, recording natural animal sounds and replaying them over a public address system is quite often only short-lived in its effect. The birds in some strange way seem to get used to the recording and recognise it as phoney.

Their new invention is a system for producing synthetic animal sounds and in its simplest form it comprises a signal generator for generating carrier signals in the frequency range 500Hz to 5,000Hz. The selected carrier is amplitude modulated by another tone in the range 50Hz to 300Hz and a straightforward electro-acoustic transducer is used to convert the modulated carrier signal into a sound signal.

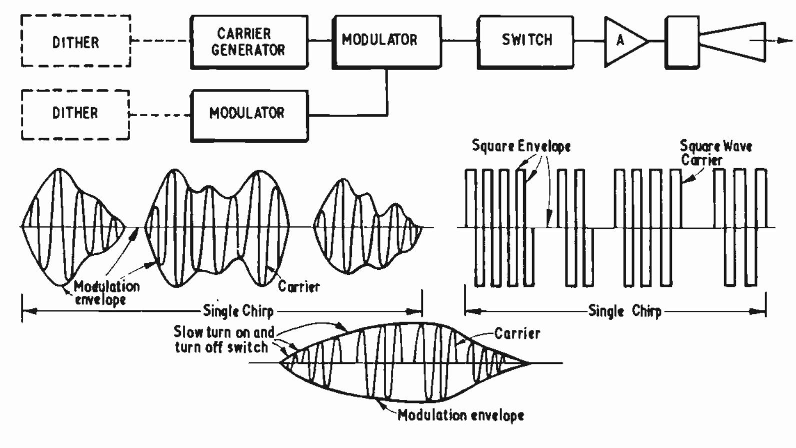
The sound generator can be arranged to turn the modulated carrier signal on and off at a rate of one to five times per second either sharply or gradually. And it may also have a dither arrangement for dithering the frequency of the modulating means over a two-to-one range. Moreover, the carrier signal can also be dithered over a frequency range comparable to the frequency of modulation.

Consequently, it is apparently easy to vary the sound signal components and so avoid the birds getting used to any one signal.

The specification shows a block diagram of the basic layout. Some waveforms show how the "chirps" produced can be either in square wave or sinusoidal form.

Santa Rita claim special success in the diversion of red-winged blackbirds from a landing strip for jets with a 3,000Hz carrier and a 100Hz dithered random square wave amplitude modulation signal.

BP 1 228 405



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.

RECHARGEABLE BATTERIES

Although rechargeable nickel cadmium cells are now quite common, it is claimed that the latest range, type NCC, from **Ever Ready** can be recharged to half their nominal capacity in 60 seconds using standard HP2 cells.

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Full technical details of the NCC range and stockists can be obtained from Ever Ready Company (Great Britain) Ltd, Special Battery Division, Hockley, Essex.

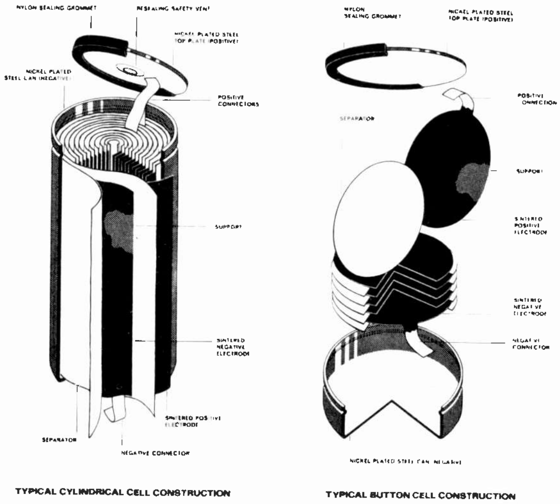
INVEST IN CATALOGUES

Time and again we get readers writing in asking where they can obtain certain items, ranging from resistors to infra-red emitting diodes. Apart from telling readers the source of supply we suggest that they should invest in some of the excellent components catalogues available from advertisers.

Typical of these are the latest component catalogues from such firms as: **Electrovalue** (64 pages, 10p), **Home Radio (Components) Ltd** (315 pages, 50p at shop or 70p by post), **Henry's Radio Ltd.** (350 pages, 40p at shop, 55p by post), **LST Electronic Components Ltd** (44 pages, no charge), and **G. W. Smith and Co. (Radio) Ltd.** (272 pages, 37½p at shop, 47½p by post).

The catalogues from Home Radio, Henry's and G. W. Smith contain special redeemable vouchers to help off-set the outlay for the catalogue.

The LST catalogue, available free, have added several new items to its opto-electronics section including inexpensive gallium arsenide light sources and planar silicon photo transistors.



Cell construction for the Ever Ready NCC range

There are many other interesting items listed in the LST catalogue including details of their data sheet service.

For our Midland readers, who often complain that they have to order from our London and Southern based advertisers, **Hawnt & Co. Ltd.** publish an excellent components catalogue.

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There are two ranges available: range "A" has an s.r.b.p. base and range "B" which has a fibreglass base. The s.r.b.p. base is cheaper and easy to work with, but the fibreglass base overcomes some of the problems of extreme atmospheric conditions. All boards are flux varnished to keep the copper clean and make soldering easier. Range "A" costs from 15p; range "B" from 18p for one basic pattern.

Typical of the kind of circuits that can be built up on the boards are amplifiers, oscillators, tone circuits, switching circuits, timers, car and home electronic aids. One basic pattern will accommodate up to four transistor stages, whether they be *pnp*, *npn*, f.e.t. or u.j.t. devices. Multiple pattern boards are also available for more complex circuits.

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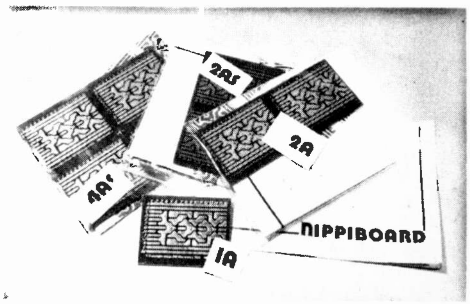
Details of prices and complete range of "Nippiboards" can be obtained from NIP Electronics, P.O. Box 11, St. Albans, Herts.

Nippiboards from NIP Electronics



The Crab Nebula in the constellation of Taurus. Catalogue No. M1 (NGC 1952)

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RADIO ASTRONOMY TECHNIQUES

By F. W. Hyde

PART 8

In Part 3 the two aerial phase-switched interferometer was briefly described. It is now necessary to deal with this system in more detail since it is the next ste pin the project for those who have the space for it, as the same requirements as to base line apply here. The difference between the simple two-aerial system and the phase-switched system is the extra electronic units necessary and the aerial feeder modifications.

THE PHASE-SWITCHED INTERFEROMETER

When two aerials are spaced an exact number of wavelengths apart the aerial pattern will be such that the centre lobe will be at a maximum in the plane of symmetry. At this point the pattern is exactly the same as the simple interferometer, where the lengths of the feeders are exactly equal to each other. If now a length of cable equal to one half of a wavelength is introduced in one feeder line the pattern will change so that there is a displacement of the lobes. This displacement will bring the minimum point between lobes to the centre of the plane of symmetry, see Figs. 8.1a, b.

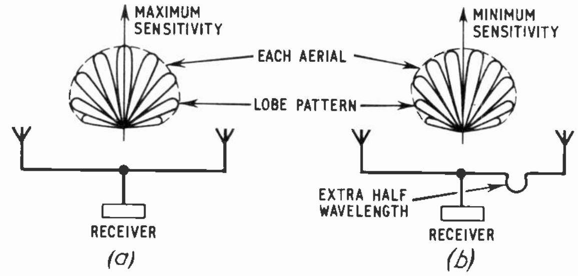


Fig. 8.1. The introduction of one half wavelength piece of cable into one feeder line displaces the aerial pattern as shown in (b)

As the aerial is moved with the rotation of the earth the aerial pattern can be changed at a predetermined rate so that if there is a source of radiation in the aerial beam it can be scanned. The alternate "putting in" and "taking out" of the half wave section which does the scanning can be done by using an electronic switching system.

PHASE SWITCHING SYSTEM

The number of times that the half wave section is switched in and out of circuit is largely a matter of choice, and to some extent depends on the purpose of the project under study. The circuits that will be given will have different speeds of switch operation, but the results on the recorder will not noticeably vary. The record that appears on the chart is an indication of the intensity of the radiation in terms of the modulation of that radiation at the switching frequency. If the switch frequency is, say, 900Hz, then the radiation received by the aerial will have a component at 900Hz superimposed upon it. This can be amplified and detected in the system and the result recorded on the charts as shown in Figs. 8.2a, b, c. The pattern that appears is the result of the sequence through which the input to the receiver goes before being recorded. This sequence is as follows:

With the source of radiation in the centre of a lobe, that is at maximum sensitivity, the length of the paths will be equal and the aerials will each send to the receiver the same level of signal. The two levels will add together so that the receiver will receive twice the value of the signal. When the half wave section is added the paths now being unequal, the resultant signal will be zero. Therefore the actual amplitude of the signal reverses in phase with the adding and subtracting of the half wave section.

The switching frequency is controlled by a circuit which provides a square wave to operate the switch and at the same time to operate a synchronous detector which reverses the phase of the output in unison with the switch. The block diagram Fig. 8.3 shows the individual units in which it will be seen that in addition to the units already in operation, there are four new ones.

The switch generator is a multivibrator of the usual type, and may be a part of the unit which includes the narrow band amplifier and the synchronous detector. The actual arrangement is left to the individual constructor.

Each unit will now be described separately, starting with the phase switch for the aerial. There are variations of this: one type being a hybrid junction used as a balanced network made up largely of coaxial cable, and a more simple diode switch unit. Both give similar results but the hybrid junction needs more skill to construct and has to be replaced as a whole when the frequency is changed.

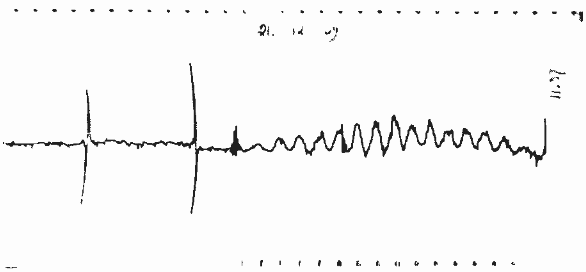
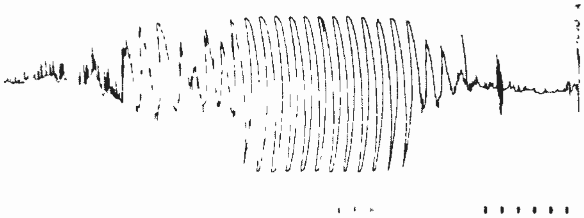
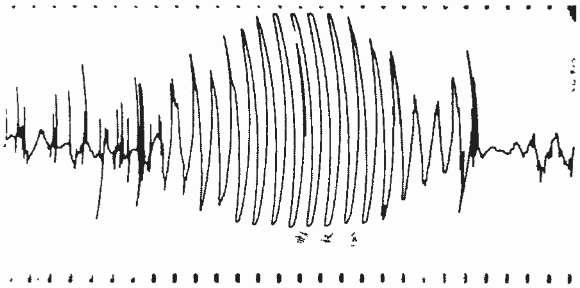


Fig. 8.2. Chart recordings of the sun
(a) quiet sun



(b) active sun, showing ionospheric effects at left side of recording



(c) very active sun at the time of a flare, again showing the effects of ionospheric disturbance

HYBRID JUNCTION PHASE SWITCH

The hybrid junction phase switch consists of a network of coaxial cable with the switching diodes as part of the assembly, see Fig. 8.4. The action of this switch can be understood by following the diagram and remembering that a "short" looks like an open circuit when seen through a quarter wavelength of transmission line.

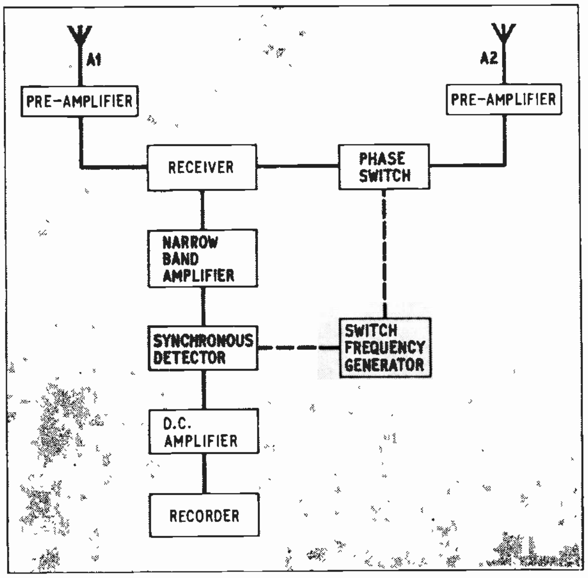


Fig. 8.3. Block diagram of the phase-switched interferometer. Units forming the original simple interferometer are shown in unshaded boxes

The switching frequency, which is provided by the switch frequency generator and its amplifier, is fed to the diodes via the choke and capacitor filter network. Suppose that the right-hand diode D2 is conducting, then at the junction of the quarter-wave section with the hybrid it will appear "open", the signal can therefore pass from the input via the first quarter-wave section through the three-quarter wave section to the output point and thence to the receiver.

At this time the left-hand diode D1 is non-conducting and therefore "open"; it appears as a short at the left-hand junction of the hybrid and no signal can pass. When the switch reverses then the left-hand side carries the signal and the right-hand side is blocked off.

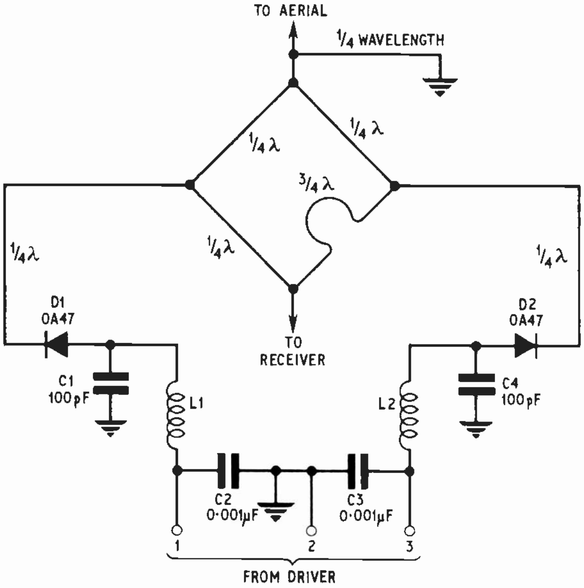


Fig. 8.4. A hybrid junction phase switch circuit

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OC41	0·13	AD149	0·30
OC44	0·13	AUY10	1·25
OC45	0·13	25034	0·25
OC71	0·13	2N3055	0·63
OC72	0·13		
OC73	0·17	**Diodes**	
OC81	0·13	AAY42	0·10
OC81D	0·13	OA95	0·19
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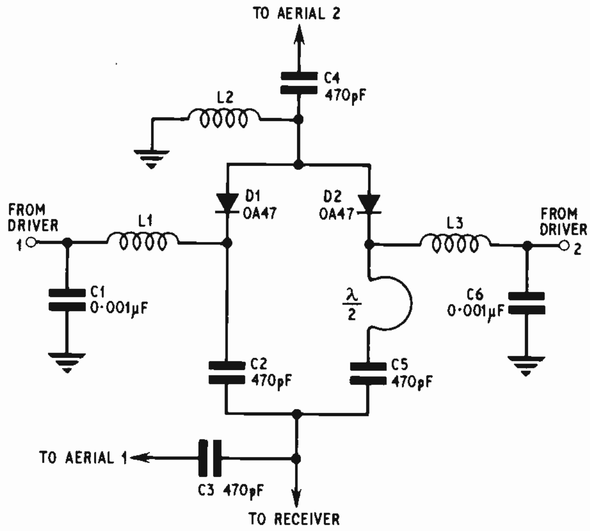


Fig. 8.5. A simple diode switch circuit

SIMPLE DIODE SWITCH

The simple diode switch consists of a network shown in Fig. 8.5 which uses diodes and a half-wavelength section for the frequency of operation. One advantage of this type of switch is that by having a number of half-wave sections, each for a different frequency, they can be conveniently plugged in to two aerial sockets thus making a very versatile assembly.

The sequence of operation in this switch is that the switching signal is fed into the points 1 and 2 via the filter network; in one direction a diode will conduct, say the left-hand side D1, at this time the other will be non-conducting so that the signal will pass via the conducting arm. When the switching voltage reverses, the diode on the right-hand side will conduct and the signal will pass via the half-wave section. When the switch is in operation the half-wave section will be alternately "in" and "out". The same conditions apply therefore as with the more complicated hybrid unit.

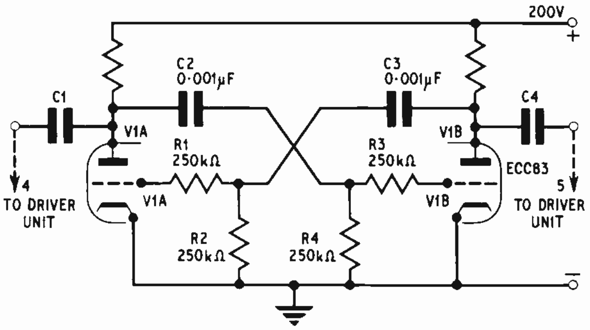


Fig. 8.6. Typical circuit for a switch frequency generator

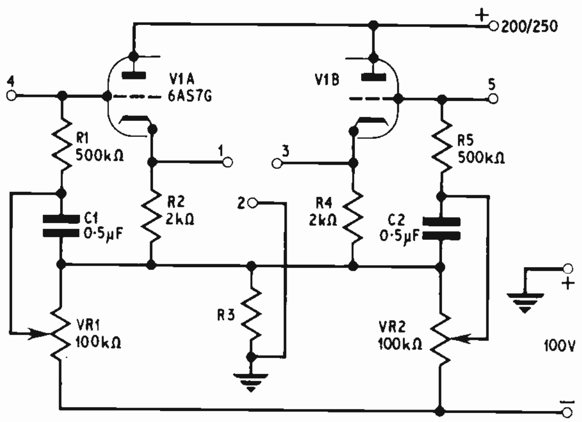


Fig. 8.7. Typical circuit for a driver amplifier for interposition between the switch frequency generator and the phase switch

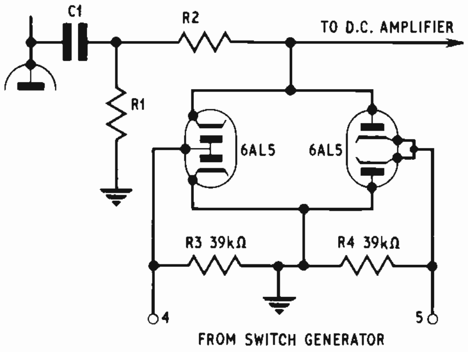


Fig. 8.8. Typical circuit for a phase sensistive detector

THE SWITCH FREQUENCY GENERATOR

The switch frequency generator is basically an audio oscillator operating at the frequency chosen for the switch. In this case it is a multivibrator which delivers about 30 volts peak-to-peak with a square wave form, and the circuit is shown in Fig. 8.6. The voltage output is sufficient for the operation of the synchronous detector, but needs a driver amplifier for the phase switch. The reason for this is that the diodes in the phase switch need to pass a current of the order of 50mA so that the power driver is necessary to accomplish this. The driver amplifier is shown in Fig. 8.7.

SYNCHRONOUS DETECTOR

As has been explained, the switching in and out of the half-wave section creates a condition where the receiver is fed with a signal which reverses in sign, hence the term phase switch. The reversal is in this case 180 degrees, so a system is required to follow this after the detection and amplification of the switch modulation. The diagram in Fig. 8.8

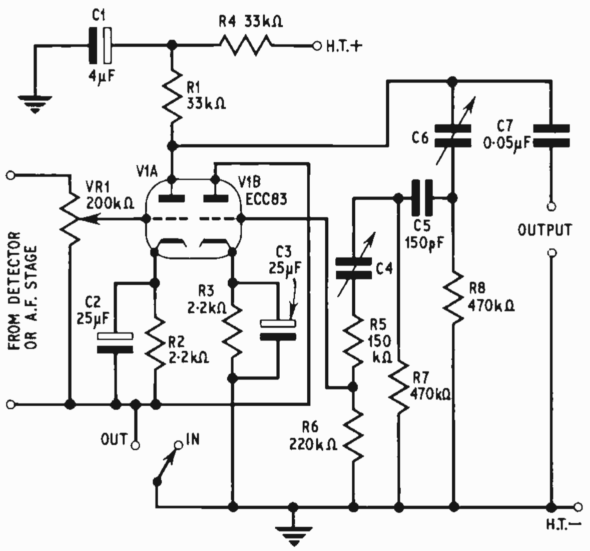
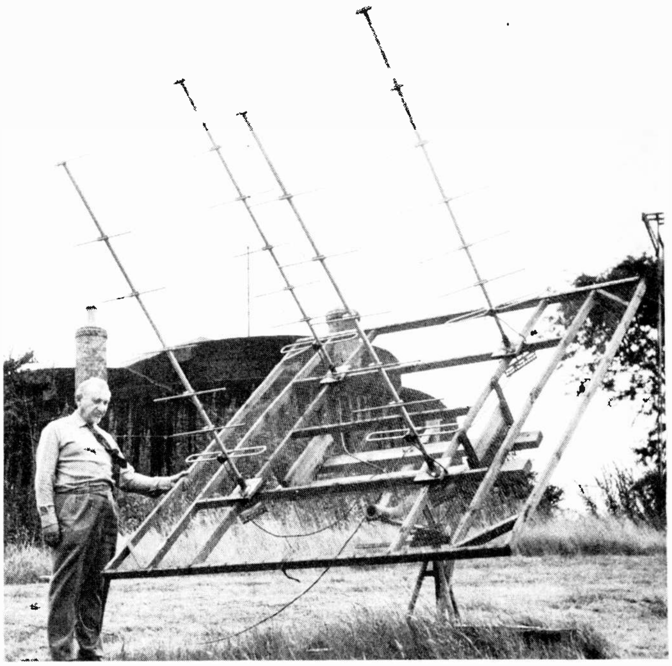


Fig. 8.9. Typical circuit for a narrow band amplifier set for switch frequency 900–1,000Hz



A solar radio telescope aerial working at 200MHz

shows the details of the circuit for the synchronous detector, and this is fed from the narrow band amplifier and coupled direct to the d.c. amplifier.

NARROW BAND AMPLIFIER

The narrow band amplifier is an important part of the system because it passes the signal at switch frequency and attenuates those signals which are not required. Strong signals from interference and radio signals which break through from commercial stations are largely eliminated.

The circuit shown in Fig. 8.9 is suitable for the switch frequency adopted. There may be a certain amount of insertion loss due to this amplifier; if this is so and the amplifier has been fed from the second detector of the receiver, then an additional stage of amplification can be interposed between the detector and the narrow band amplifier.

CONNECTING UP THE SYSTEM

The whole system is now ready to be connected up. It may be that there will be some snags in getting things right straight away. This raises the important point as to the stability of power supplies. If the units are checked individually for operation it should not be too difficult to get the system working satisfactorily. An oscilloscope would be a very useful adjunct in this connection, for all the systems can then be visually checked. For example the square wave pulses must be of equal width and amplitude. The phasing of the whole system can be more easily checked when an oscilloscope is used since each successive part of the system can be dealt with in sequence and any trouble quickly found.

Another point that perhaps should be emphasised again is the importance of good jointing and efficient bonding. Poor earth bonding can lead to many troubles, not least of which is spurious noise and breakthrough. If the area is one where there is a great deal of commercial activity it could be that there will be blocking of the pre-amplifiers. In this case it will be necessary to use some sort of filtering at the aerial input to offset this. Transistor pre-amplifiers are particularly prone to this trouble.

ACKNOWLEDGEMENT

The photographs of chart recordings Fig. 8.2 were taken by J. C. Codling, Clare Secondary School.

In the next article some more sophisticated units for the phase-switching system will be described.

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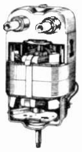

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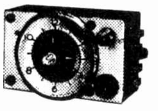
20 AMP ELECTRICAL PROGRAMMER



Learn in your sleep: Have Radio playing and kettle boiling as you awake—switch-on lights to ward off intruders—have warm house to come home to. All these and many other things you can do if you invest in an Electrical Programmer. Make by the famous Smiths Instrument Company. This is essentially a 230/240V mains operated Clock and a 20 amp Switch, the switch-off time of which can be delayed up to 12 hours (continuously variable not stepped). Similarily the switch-on time can be delayed. This is a beautiful unit, size 5¼ × 3¾ × 2¼in deep. Metal encased, glass fronted with chrome surround. Offered at £2·40 plus 23p postage and insurance.

RESETTABLE FUSE

How long does it take you to renew a fuse? Time yourself when next one blows. Then reckoning your time at £1 per hour see how quickly our resettable fuse (auto circuit breaker) will pay for itself. Price only £1 each or £11 per dozen, specify 5, 10 or 15 amp *simply fit in place of switch.*

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.

2½kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2½ kW), switch down for half heat (1¼kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3·75. Post and ins. 38p.

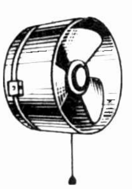
COMPUTER TAPES

2,400ft of the Best Magnetic Tape money can buy—users claim good result with Video and sound. 1in wide £1·45 plus 33p post and insurance, with cassette. ¾in wide £1·25 plus 30p post and insurance with cassette. ½in wide £1 plus 25p post and insurance with cassette. Spare spools and cassettes—1in £1. ¾in 85p. ½in 75p each plus 20p post and insurance.

SPARTAN Portable RADIO

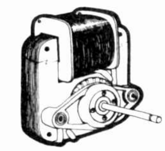
Long and medium wave. 7 transistor, size 6in × 4in × 1½in with larger than usual speaker giving very good tone. Built-in ferrite aerial and telescopic aerial for distant stations. A real bargain complete with leather case, carry sling, earplug and case £3·75 plus 25p post and ins.

EXTRACTOR FAN



Cleans the air at the rate of 10,000 cubic ft per hour. Suitable for kitchens, bathrooms, factories, changing rooms, etc., its so quiet it can hardly be heard. Compact, 5½in casing with 5½in fan blades. Kit comprises motor, fan blades, sheet steel casing, pull switch, mains connector, and fixing brackets, £2 plus 36p post and ins.

MAINS MOTOR

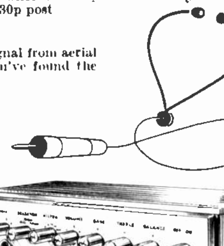


Precision made — as used in record decks and tape recorders—ideal also for extractor fan, blower, heaters, etc. New and perfect. Snip at 50p. Postage 15p for first one then 5p for each one ordered.

CAPACITOR DISCHARGE CAR IGNITION

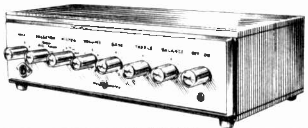
This system which has proved to be amazingly efficient and reliable was first described in the Wireless World about a year ago. We can supply kit of parts for improved and even more efficient version. (P.W. June), price £4·95. When ordering please state whether for positive or negative systems. Plus 30p post

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.

P. E. GEMINI



Dual purpose twin 30 watt stereo amplifier for exceptional performance. Complete kit of parts less case £45 or reprint of data & parts less 55p

STANDARD WAFER SWITCHES

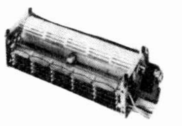
Standard size 1¼ wafer—silver-plated 5-amp contact, standard ¼in spindle 2in long—with locking washer and nut.

No. of Poles	2 way	3 way	4 way	5 way	6 way	8 way	9 way	10 way	12 way
1 pole	40p	40p	40p	40p	40p	40p	40p	40p	40p
2 poles	40p	40p	40p	40p	40p	40p	40p	70p	70p
3 poles	40p	40p	40p	40p	70p	70p	70p	95p	95p
4 poles	40p	40p	40p	70p	70p	70p	70p	£1·20	£1·20
5 poles	40p	40p	70p	70p	95p	95p	95p	£1·45	£1·45
6 poles	40p	70p	70p	70p	95p	95p	95p	£1·70	£1·70
7 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£1·95	£1·95
8 poles	70p	70p	70p	95p	£1·20	£1·20	£1·20	£2·20	£2·20
9 poles	70p	70p	95p	95p	£1·45	£1·45	£1·45	£2·45	£2·45
10 poles	70p	70p	95p	£1·20	£1·45	£1·45	£1·45	£2·70	£2·70
11 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£2·95	£2·95
12 poles	70p	95p	95p	£1·20	£1·70	£1·70	£1·70	£3·20	£3·20

15 WATT 12" HI-FI SPEAKER

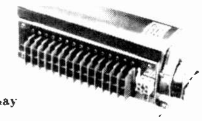
Is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi and public address. Handling 15W R.M.S.—Cone moulded fibre—Freq. response 30 10,000 c.p.s.—specify 3 or 15 ohms. Chassis dia. 12in—12¼in over mounting lugs. Overall height 5¼in. A £10 speaker offered this month for £3·75 plus 30p post and ins.

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 34p. P. & P. 40p.

HONEYWELL PROGRAMMER



This is a drum type timing device, the drum being calibrated in equal divisions for switch setting purposes with trips which are infinitely adjustable for position. They are also arranged to allow 2 operations per switch per rotation. There are 15 changeover micro switches each of 10 amp type operated by the trips thus 15 circuits may be changed per revolution. Drive motor is mains operated 5 r.p.m. Some of the many uses of this timer are Machinery control, Boiler firing, Dispensing and Vending machines, Display lighting animated and signs, Signalling, etc. Price from makers probably over £10 each. Special snip price £5·75 plus 25p post and insurance. Don't miss this terrific bargain.

INTEGRATED CIRCUIT BARGAIN

A parcel of integrated circuits made by the famous Plessey Company. A once-in-a-lifetime offer of Mirco-electronic devices well below cost of manufacture. The parcel contains 5 ICs all new and perfect, first-grade device, definitely not sub-standard or seconds. 4 of the ICs are single silicon chip GP amplifiers. The 5th is a monolithic *npn* matched pair. Regular price of parcel well over £5. Full circuit details of the ICs are included and in addition you will receive a list of many different ICs available at bargain prices 25p upwards with circuits and technical data of each. Complete parcel only £1 post paid. *DON'T MISS THIS TERRIFIC BARGAIN.*

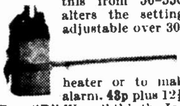
DIGITAL COUNTER TIMER

Very stable and reliable crystal controlled circuit. Capable of work in excess of 15 MHz. Construction simplified by use of 15 integrated circuits. Complete kit with case £37·50 or construction data and price list 30p.

70 THINGS YOU CAN MAKE

Send S.A.E. today for list of 70 constructor projects—instruments, alarms, counters, locks, radios etc. etc.

THERMOSTATS



Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboards. Has spindle for pointer knobs. Quickly adjustable from 30–80°F, 40p. Calibrated dial 20p extra. Suitable box for wall mounting. 25p.

Type "B" 15 amp. This is a 17in long rod type made by the famous Sunvic Co. Spindle adjusts this from 50–550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnace, oven, kiln, immersion heater or to make flame-stat or fire alarm. 48p plus 12½p post and insurance.

Type "D" We call this the Ice-stat as it cuts in and out at around freezing point. 2/3 amps. Has many uses one of which would be to keep the loft pipes from freezing, if a length of our blanket wire (16yd. 50p) is wound round the pipes. 40p.

Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 50p.

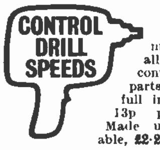
Type "F". Glass encased for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 80p.

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.

DRILL CONTROLLER

NEW 1KW MODEL



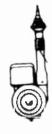
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. £1·50 plus 13p post and insurance. Made up model also available, £2·25 plus 13p post and p.

Send S.A.E. for list of parts

HIGH ACCURACY THERMOSTAT

Uses differential comparator I.C. with thermister as probe. Designer claims temperature control to within 1/7th of a degree. Complete kit with power pack £5·50.

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.

AUTO-LITE

as circuit in this month's issue. Kit of parts £1·20 post paid.

TOGGLE SWITCH

3 amp 250V with fixing ring 7½p each, 75p doz.

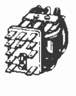
CAR ELECTRIC PLUG

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.

ROCKER SWITCH

13 amp self-fixing into an oblong hole, size approximately 1in × ¾in, 6p each, 10 for 54p.

MAINS RELAY BARGAIN



Special this month are some single, double and treble pole changeover relays. Contacts rated at 15 amps. Operating coil wound for 240V a.c. Good British Make. Unused. Size approx. 1½in × 1in.

Open construction

Single pole	25p each	10 for £2·25
Treble pole	40p each	10 for £3·60

BALANCED ARMATURE UNIT

500 ohm, operates speaker or microphone, so useful in intercom or similar circuits, 38p each, £3·50 doz.

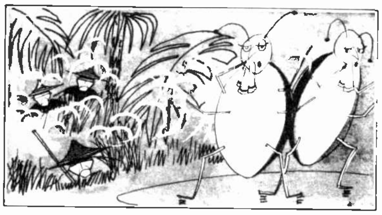
Where postage is not stated then orders over £5 are post free. Below £5 add 20p. Semi-conductors add 5p post. Over £1 post free. S.A.E. with enquiries please.

J. BULL (ELECTRICAL) LTD.

(Dept. P.E.) 7 Park Street, Croydon CRO 1YD

Gerry Brown . . .

ON THE FRINGE



OLFACTRONICS

I've just heard that a Nipponese company are making claim to an invention which amounts to an electronic "nose."

Naturally, smell sensors are not unknown, the Americans developed a device which could smell-out the Vietcong a few years back; this was a kind of funnel-shaped thing containing a microphone which had its fixing adjacent to a thin membrane. The membrane carried a number of sensitive (un-fed) bed-bugs which reacted to the natural body-odours of the enemy in a way which really *had* to be seen! The "tattoo" which they beat-out on the skin resulted in a signal that could be amplified after the microphone.

The device from Nippon, however, is quite different to previous sensors. For one thing, it can apparently differentiate between a number of different odours, and for another, it is entirely solid-state.

Several compounds are employed in the fabrication of the new device, typical of which are the oxides of tin, zinc, and the sesquioxide of iron. Whenever such gases as hydrogen, carbon dioxide, acetylene, or propane are applied to the sensor its conductivity decreases sufficiently to give an easily noticed indication, often without further amplification!

We can only hope that the art of olfactronics (my handle) will soon become sufficiently sophisticated to counter the current wave of destruction by detecting the smell of gelignite before it blows someone apart.

COOL GLOW

Right "out of the blue" (well, probably nearer purple) someone has come up with a rather interesting way of making a draught. It all came about when Oscar Blomgren of Inter-Probe, Chicago, tried applying an electric field to the task of diverting an oxy-acetylene flame away from the inside of a blow-torch to prevent its deterioration. Instead, he got a cooling effect!

The cooling results from that funny effect you'll probably remember from experimenting with the school physics lab Wimshurst machine, electric wind. This, as you may recall, has nothing to do with flatulence but is associated with the purply-blue corona discharge that appears around any sharp, or pointed, parts of the machine's electrodes.

The vortex columns of air produced by the discharge are employed by Blomgren to cool the air near any heated surfaces. So efficient is this method of cooling that a glow-discharge produced by a 30kV potential, at only 200μA, is reported to have already reduced the temperature of an object from 1,675 degrees Fahrenheit to a mere 970 degrees Fahrenheit in a couple of seconds! An ideal device, one would think, where there was a special need for absence of motor-driven fans with their attendant vibration. Such noiseless cool must be a real "blow" for fan-makers!

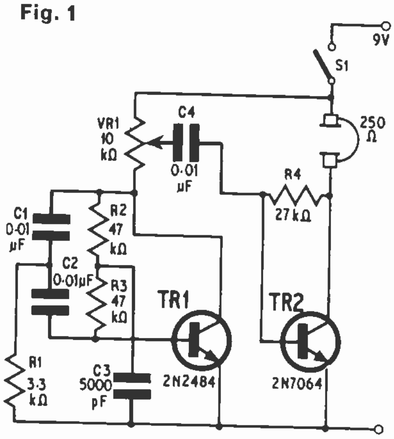
JABBER-JAMMER

It's quite on the cards that you can tolerate the majority of ambient noises like the intermittent tip-tap of the typewriter I am using right now, and the noise from a neighbour's transistor radio. Even so, the chances are that you will experience much more difficulty when attempting to concentrate on some abstruse problem when it is accompanied by the chatter of people in conversation nearby. How to overcome it is a perfectly reasonable question.

Just yesterday, I came to learn the answer to this, seemingly, difficult poser and Fig. 1 shows the easiest solution. The circuit comprises a simple audio oscillator connected direct to a hearing aid type earphone. The frequency of the device can be varied according to one's particular choice.

This done, it is then only necessary to bring the volume level up to a point which satisfies the compromise between being deafened by the oscillator, and going out of one's tiny mind as a result of the unwelcome intrusion into it by somebody's "yatter".

Fig. 1



CHILD CARE

The burning need for something that will protect (in particular) the very young from the sometimes malevolent intentions of child-snatchers is a problem that has been in the limelight recently. Even when no harm is intended, the resulting anguish can often, and quite understandably, be unbearable.

From time to time, like others before me, I have made several vain efforts to solve this very real threat to youngsters. Among the ideas have been some which relied upon a weight-sensing switch in the child's pram, or a simple switch arrangement attached to the pram harness. Limitations, unfortunately, exist in these ideas since no facility was provided which sensed movement of the carriage. Perhaps another switch associated with the brake would be the answer; so it goes on, until, ultimately, one is tempted to give the problem up. But, there *are* quite a few other ways of tackling this enigma.

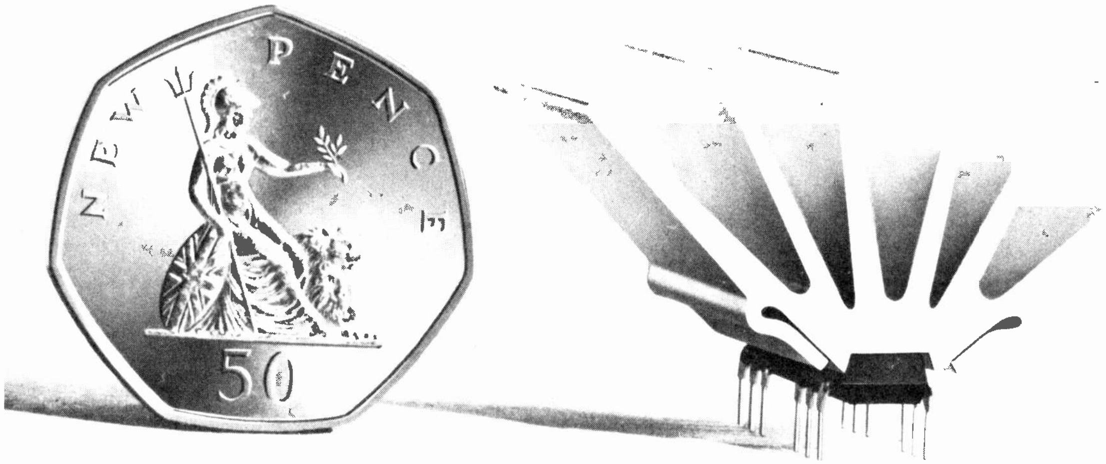
Not unnaturally, it would be well on the way to meeting our requirements if the abduction alarm had, in addition to warning ability, a fail-safe feature. It was in this vein that I chanced to come upon an idea that might just be the answer. If the child to be protected carried a low power radio control transmitter (complete with sewn-in antenna) in its coat, a signal would be transmitted, certainly to within the immediate locale of an interested parent.

It could be arranged that "mother" held, at home, a receiver tuned to the signal transmitted from the child and which operated a bell every time the transmitter went out of range. It would then be a simple matter to determine whenever junior was either in the course of being kidnapped, or had just plain toddled off somewhere. Who knows, it might just be better than sending up distress rockets!

Unfortunately, the Post Office is hardly likely to approve of this particular form of "model control" —Ed.

new

Super IC-12



High fidelity Monolithic Integrated Circuit Amplifier

Two years ago Sinclair Radionics announced the World's first monolithic integrated circuit Hi-Fi amplifier, the IC.10. Now we are delighted to be able to introduce its successor, the Super IC.12. This 22 transistor unit has all the virtues of the original IC.10 plus the following advantages:

1. Higher power.
2. Fewer external components.
3. Lower quiescent consumption.
4. Compatible with Project 60 modules.
5. Specially designed built-in heat sink. No other heat sink needed.
6. Full output into 3, 4, 5 or 8 ohms.
7. Works on any voltage from 6 to 28 volts without adjustment.
8. NEW 22 transistor circuit.

Output power 6 watts RMS continuous (12 watts peak).

Frequency Response 5 Hz to 100KHz ± 1 dB.

Total Harmonic Distortion Less than 1%. (Typical 0.1%) at all output powers and all frequencies in the audio band.

Load Impedance 3 to 15 ohms.

Power Gain 90dB (1,000,000,000 times) after feedback.

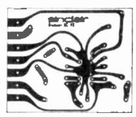
Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

Size 22 x 45 x 28 mm including pins and heat sink.

Input Impedance 250 Kohms nominal.

Quiescent current 8mA at 28 volts.

With the addition of only a very few external resistors and capacitors the Super IC.12 makes a complete high fidelity audio amplifier suitable for use with pick-up, F.M. tuner etc. Alternatively, for more elaborate systems, modules in the Project-60 range such as the Stereo 60 and A.F.U. may be added. The comprehensive manual supplied with each unit gives full circuit and wiring diagrams for a large number of applications in addition to high fidelity. These include car radios, oscillators etc. The very low quiescent consumption makes the Super IC.12 ideal for battery operation.



Price, inc. FREE printed circuit board for mounting.

£2.98 Post free

SINCLAIR GENERAL GUARANTEE

Should you not be completely satisfield with your purchase when you receive it from us, return the goods without delay and your money will be refunded in full, including cost of return postage, at once and without question. Full service facilities are available to all Sinclair customers.

Sinclair Radionics Ltd, London Rd, St. Ives
Huntingdonshire PE17 4HJ
Telephone St Ives (048 06) 4311

sinclair

Sinclair Q16/Micromatic

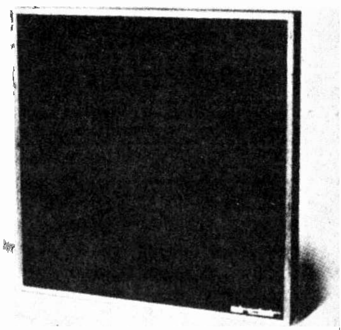
Q16 High fidelity loudspeaker

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: $9\frac{3}{4}$ in. square on face x $4\frac{3}{4}$ 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 ______________________
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P.E.1/72

Sinclair Radionics Ltd., London Rd, St. Ives
Huntingdonshire PE17 4HJ.
Telephone St. Ives (048 06) 4311

sinclair

SPECIAL PURCHASE !

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

LEAK MK I TRANSCRIPTION PICK-UP ARMS. Using the world famous gimbal pivot system. Complete but less pick-up head. **£2·50.** P. & P. 20p.

INPUT MATCHING TRANSFORMER. Beautifully made in heavy Mu-metal cylindrical case for minimum hum pick-up. Size 1½" high × 1¼" 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 2¼" × 3" approx. **25p** pair. P. & P. 5p.

HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT

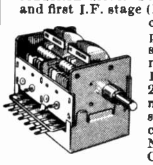
NEW IMPROVED MODEL WITH HIGHER OUTPUT AND INCORPORATING HIGH QUALITY READY DRILLED PRINTED CIRCUIT BOARD FOR EASY CONSTRUCTION

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 1MΩ. Full power bandwidth ± 3dB 12–15,000Hz. Bass boost approx. to ± 12dB. Treble cut approx. to −16dB. Negative feedback 18dB over main amp. Power requirements 35V at 1·0 amp. Overall size—12" wide × 8" deep × 2½" high.
Fully detailed 7-page construction manual and parts list free with kit or send 18p plus large S.A.E.

PRICES AMPLIFIER KIT, **£10·50** P. & P. 15p.
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.

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 2¾in 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.



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.

SPECIAL OFFER!!
HI-FI LOUDSPEAKER SYSTEM

Beautifully made teak finish enclosure with most attractive Tygan-Vynair front. Size 16½in high × 10½in wide × 5¼" 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.

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.

SPEAKER CABINET BARGAIN
Beautifully made all wooden construction medium walnut front, gold anodised expanded aluminium grille and dark sides. Approx. size overall 11½in high × 5in deep × 13½in wide at base. Baffle cut out for 8in speaker. Could accommodate amplifier or radio together with speaker. FEW LEFT ONLY **£1·38** post free.

HI-FI STEREO HEADPHONES

Adjustable headband with comfortable flexifoam ear-muffs. 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.

SINGLE HEADPHONE. With aluminium headband. Approx. 200 ohm. **25p.** P. & P. 8p.

CRYSTAL MIKES. High imp. for desk or hand use. High sensitivity. **93p.** P. & P. 8p.

HIGH IMPEDANCE CRYSTAL STICK MIKES. OUR PRICE **£1·05.** P. & P. 8p.

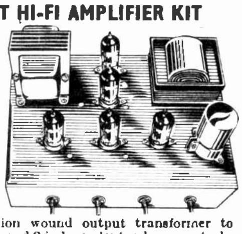
GENERAL PURPOSE HIGH STABILITY TRANSISTOR PRE-AMPLIFIER. For P.U. Tape, Mike, Guitar, etc., and suitable for use with valve or transistor equipment. 9–18V. Battery or from H.T. line 200/300V. Frequency response 15Hz–25KHz. Gain 26dB. Solid encapsulation size 1¾ × 1¼ × ⅝in. Brand new — complete with instructions. Price **88p.** P. & P. 13p.

BRAND NEW E.M.I. LIGHTWEIGHT PICK-UP ARM WITH ARM REST. Fitted mono t/o stylus and cartridge for LP/78, ONLY **£1.** P. & P. 8p.

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.

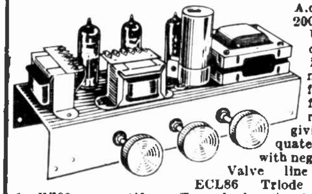
10/14 WATT HI-FI AMPLIFIER KIT



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.

FANTASTIC "POLY PLANAR" WAFER-TYPE, WIDE RANGE ELECTRO-DYNAMIC SPEAKER
Size only 11¾in × 14¾in × 1$\frac{3}{16}$in deep. Weight only 19oz. Can replace cone speakers in any application and is particularly useful for those with limited space. Extremely rugged and shockproof. Operating temperature −20°F to +175°F. 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.

DE LUXE STEREO AMPLIFIER

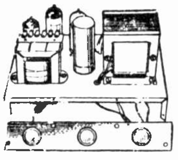


A.c. mains 200–240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up:—2 × ECL86 Triode Pentodes. 1 × EZ80 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300m/v for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 11in. w × 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. Price **£8·92.** P. & P. 45p.

4-SPEED RECORD PLAYER BARGAINS
Mains models. All brand new in maker's packing.
LATEST B.S.R. C109/A21 4-SPEED AUTOCHANGER. With latest mono compatible cartridge **£6·97.** Carr. 50p. With stereo cartridge **£7·97.** Carr. 50p.
SUITABLE PLINTH UNIT FOR ABOVE with rigid plastic cover. **£5·75** complete. P. & P. 50p.
LATEST GARRARD MODELS. All types available 1025, 2025, SP25, 3000, AT60, etc. S.A.E. for Latest Prices!
PLINTH UNITS cut out for Garrard Models 1025, 2025, 2000, 3000, 3500, etc. With rigid transparent plastic cover. Special design enables above models to be used with cover in position. Also suitable for housing AT60 and SP25. OUR PRICE **£5·75** complete. P. & P. 50p.

LATEST ACOS GP91/1SC Mono Compatible Cartridge with t/o stylus for LP/EP/78. Universal mounting bracket. **£1·50.** P. & P. 8p.
SONOTONE 9TAHC COMPATIBLE STEREO CARTRIDGE T/O stylus. Diamond Stereo LP and Sapphire 78. ONLY **£2·50.** P. & P. 10p. Also available fitted with twin Diamond T/O stylus for Stereo LP. **£3.** P. & P. 10p.
LATEST RONETTE T/O Stereo Compatible Cartridge for EP/LP/Stereo/78. **£1·63.** P. & P. 10p.
LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. **£1·50.** P. & P. 10p.

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

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES
A must for servicemen and home constructors. 1971 edition including many 1000's of British, U.S.A., European and Japanese transistors. ONLY **40p.** Post 5p.

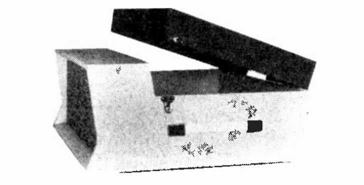
HIGH GRADE COPPER LAMINATE BOARDS
8 × 6 × $\frac{1}{16}$in. FIVE for **50p.** P. & P. 13p.

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

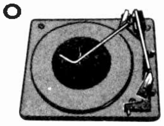
(Please write clearly)
PLEASE NOTE: P. & P. CHARGES QUOTED APPLY TO U.K. ONLY. P. & P. ON OVERSEAS ORDERS CHARGED EXTRA.

R.C.S. PORTABLE PLAYER CABINET



Really smart appearance with space for R.C.S. Amplifiers and most modern autochangers. Size 18 × 15 × 8in. Chrome fittings. Carrying handle. Two tone rexine covered. Red/Grey or Mottled Blue and Grey or Wood Grain effect. **£4** Post 25p

BSR C.109 SUPERSLIM STEREO & MONO



Plays 12", 10" or 7" records. Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. AC 200/250v. Size 13¾ × 11¼in. Above motor board 3¼in. below motor board 2½in.
with STEREO and MONO XTAL **£7·75** Post 25p.

GARRARD SINGLE PLAY TA Mk II. Ideal Discotheque or Hi-Fi. Stereo/Mono. **£10**

GARRARD PLAYERS with Sonotone 9TA Cartridges. Stereo Diamond and Mono Sapphire. SP25 Mk III £16. Model 3500 Stereo and Mono Autochanger £14. Post 25p.

RCS DE-LUXE 3 WATT AMPLIFIER. Ready made tested. 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ80. Response 50-12,000 cps. Sensitivity 200mV. Post 25p. **£4**

R.C.S. TEAKWOOD BASE. Ready cut out for mounting (state player make and model). **£2·75**
R.C.S. PLASTIC COVERS FOR ABOVE BASE. Durable tinted plastic, attractive appearance. **£2·75**

EMI PICK-UP ARM. With mono xtal and stylus £1·25.
HI-FI PICK UP CARTRIDGES. Diamond Stereo/Mono 9TA £2·50; GP94 £2·50; GP93 £2·00; Mono GP91 £1·50; GC8 £1·25; ACOS L.P. only 50p.

E.M.I. WOOFER AND TWEETER KIT

£5·75 POST 25p

Comprising a fine example of a Woofer 10¾ × 6¼in. with a massive Ceramic Magnet, 44oz, Gauss 13,000 lines. Aluminium Cone centre to improve middle and top response. Also the E.M.I. Tweeter 3½in. square has a special lightweight paper cone and magnet flux 10,000 lines.

Impedance Standard	8 ohms
Maximum power	12 watts
Useful Response	35 to 18,000 cps
Bass Resonance	45 cps

WEYRAD P50 — TRANSISTOR COILS

RA2W Ferrite Aerial	65p	Spare Cores	3p
Osc. P50/1AC	30p	Driver Trans. LFDT4	50p
I.F. P50/2CC 470 kc/s	33p	Printed Circuit, PCA1	50p
3rd I.F. P50/3CC	33p	J.B. Tuning Gang	65p
P51/1 or P51/2	33p	Weyrad Booklet	10p
P50/3V	33p	OPT1	55p

Mullard Ferrite Rod 8 × ⅜in. 20p. 6 × ¼in. 25p.

VOLUME CONTROLS

Long spindles. Midget Size 5 K. ohms to 2 Meg. LOG or LIN. L/S 15p. D.P. 25p. STEREO L/S 55p. D.P. 75p. Edge 5K. S.P. Transistor 25p.

80ohm Coax 4p yd.

BRITISH AERIALITE AERAXIAL-AIR SPACED 40 yd. £1·40; 60 yd. £2. FRINGE LOW LOSS Ideal 625 and colour **10p yd**

VEROBOARD 0·15 MATRIX
2½ × 5in. 26p. 2½ × 3¾in. 17p. 3¾ × 3¾in. 26p. 3¾ × 5in. 30p.
EDGE CONNECTORS 16 way 25p; 24 way 38p.
PINS 36 per packet 21p. FACE.CUTTERS 38p.
S.R.B.P. Board 0·15 MATRIX 2½in wide 3p per 1in., 3¾in. wide 4p per 1in.; 5in. wide 5p per 1in. (up to 17in.).
S.R.B.P. undrilled $\frac{1}{16}$in. Board 10 × 8in. 15p.

BLANK ALUMINIUM CHASSIS. 18 s.w.g. 2½in. sides 6 × 4in. 45p; 8 × 6in. 53p; 10 × 7in. 65p; 12 × 8in. 85p; 14 × 9in. 90p; 16 × 6in. 90p; 12 × 3in. 50p.
ALUMINIUM PANELS 18 s.w.g. 6 × 4in. 9p; 8 × 6in. 15p; 14 × 3in. 16p; 10 × 7in. 19p; 12 × 5in. 20p; 12 × 8in. 28p; 16 × 6in. 28p; 14 × 9in. 34p; 12 × 12in. 40p.

1¼inch DIAMETER WAVECHANGE SWITCHES. 25p.
2 p. 2-way, or 2 p. 6-way, or 3 p. 4-way 25p each.
1 p.1 2-way, or 4 p. 2-way, or 4 p. 3-way 25p.
TOGGLE SWITCHES, sp. 14p; dp. 18p; dp. dt. 23p.

"THE INSTANT" BULK TAPE ERASER AND HEAD DEMAGNETISER

200/250 v. A.C. Leaflet S.A.E. **£2·35** Post 15p

R.C.S. STABILISED POWER PACK KITS

All parts and instructions with Zener Diode, Printed Circuit, Bridge Rectifiers and Double Wound Mains Transformer input 200/240V a.c. Output voltages available 6 or 9 or 12 or 15 or 18 or 20V d.c. at 100mA or less PLEASE STATE VOLTAGE REQUIRED. Details S.A.E. **£2** Post Free

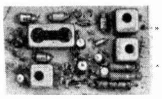
R.C.S. GENERAL PURPOSE TRANSISTOR PRE-AMPLIFIER BRITISH MADE

Ideal for Mike, Tape, P.U., Guitar, etc. Can be used with Battery 9-12v. or H.T. line 200-300v. D.C. operation. Size 1¾" × 1½" × ½". Response 25 c.p.s. to 25 Kc/s, 26 db gain. For use with valve or transistor equipment. Full instructions supplied. Brand new. Guaranteed. Details S.A.E. **90p** Post 10p

NEW TUBULAR ELECTROLYTICS				CAN TYPES	
2/350V	14p	250/25V	14p	16+16/500V	55p
4/350V	14p	500/25V	20p	50+50/350V	35p
8/450V	14p	1000/25V	35p	60+100/350V	58p
16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	18p	32+32/450V	33p
25/25V	10p	8+16/450V	20p	350+50/325V	50p
50/50V	10p	16+16/450V	25p	32+32+32/350V	43p
100/25V	10p	32+32/350V	25p	100+50+50/350V	48p

SUB-MIN. ELECTROLYTICS. 1, 2, 4, 5, 8, 16, 25, 30, 50, 100, 200mF 15V 10p; 500, 1000mF 12V 18p; 2000mF 25V 42p.
CERAMIC, 1pF to 0·01mF, 4p. Silver Mica 2 to 5000pF, 4p.
PAPER 350V-0·1 4p, 0·5 13p; 1mF 15p; 2mF 150V 15p. 500V-0·001 to 0·05 4p; 0·1 5p; 0·25 8p; 0·47 25p.
SILVER MICA. Close tolerance 1%. 2·2-500pF 8p; 560-2,200pF 10p; 2,700-5,600pF 20p; 6,800pF-0·01, mfd 30p each.
TWIN GANG. "0-0" 208pF + 176pF, 65p; Slow motion drive 365pF + 365pF with 25pF + 25pF, 50p; 500pF slow motion, standard 45p; small 3-gang 500 pF £1·60.
SHORT WAVE SINGLE. 10pF, 30p, 25pF, 55p, 50pF, 55p.
CHROME TELESCOPIC AERIALS 23in. Swivel base 20p.
TUNING. Solid dielectric. 100pF, 500pF, 35p each.
TRIMMERS. Compression 30, 50, 70pF, 5p; 100pF, 150pF, 8p; 250pF, 10p; 600pF, 750pF, 10p; 1250pF, 10p.
SILICON REC. 40–LUCAS 2DS500 Bridge 70v. 5 amp £1.
RECTIFIERS CONTACT COOLED half wave 60mA 38p; 85mA 48p. SILICON BYZ13 30p; BY100 30p; BY127 30p. Full wave Bridge Rectifiers 75mA 50p; 150mA 98p.
EX-GOVT. RECTIFIERS 250V 200mA 30p.
NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p.
RESISTORS. ¼ w., ½ w., 1 w., 20% 1p; 2 w. 5p. 10 Ω, to 10M.
HIGH STABILITY. ½ w. 2% 10 ohms to 1 meg., 10p. Ditto 5%. Preferred values 10 ohms to 10 meg., 4p.
WIRE-WOUND RESISTORS 5 watt, 10 watt, 15 watt, 10 ohms to 100K 10p each; 2½ watt, 1 ohm to 8·2 ohms 10p.

PHILIPS TRANSISTOR FM STEREO MULTIPLEX DECODER



As used in LEAK Troughline Tuner. Brand New. Pre-aligned with 9 semiconductors. 24V d.c. at 6mA. Complete with circuit and connection details. 3¼ × 2 × 1 in. **£4** Post Free

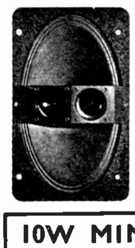
MAINS TRANSFORMERS

All post 25p each

250-0-250 80 mA. 6.3 v. 4 amp.	£1·40
250-0-250 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	£2
350-0-350 80 mA. 6.3 v. 3.5 a. 6.3 v. 1 a, or 5 v. 2 a.	£2
300-0-300 v. 120 mA., 6.3 v. 4 a. C.T.; 6.3 v. 2 a.	£2·50
MINIATURE 200 v. 20 mA., 6.3 v. 1 a. 2¼ × 2¼ × 2in.	75p
MIDGET 220 v. 45 mA., 6.3 v. 2 a. 2¼ × 2¼ × 2in.	90p
P.E. AURORA TRANS. 12 + 12v., 500mA	£1·50
MINI-MAINS 20v. 100mA. 1¼ × 1¼ × 1¼in.	50p
HEATER TRANS. 6.3 v. 3a.	60p
Ditto tapped sec. 1.4 v., 2, 3, 4, 5, 6.3 v. 1½ amp.	80p

GENERAL PURPOSE LOW VOLTAGE. Tapped outputs at 2 amp., 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. £2
1 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £2
2 amp., 6, 8, 10, 12, 16, 18, 20, 24, 30, 36, 40, 48, 60. £3
AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. Input/Output, 150w. £2; 500w. £5; 1000w. £12
CHARGER TRANSFORMERS. Input 200/250v. for 6 or 12v., 1½ amp., £1·20; 2 amp £1·50; 4 amp. £2
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12v. outputs. 1½ amp. 40p; 2 amp. 55p; 4 amp. 85p.
All Transformers Postage 25p each

E.M.I. 13½ × 8in. LOUDSPEAKERS



With twin tweeters. And crossover. 10 watt. State 3 or 8 or 15 ohm. As illustrated. **£4** Post 15p

With flared tweeter cone and ceramic magnet. 10 watt. Bass res. 45-60 cps. Flux 10,000 gauss. State 3 or 8 or 15 ohm. **£2·25** Post 15p

Recommended Teak Cabinet Size 16 × 10 × 9in. Post 25p. **£5**

10W MINI-MODULE £3·25 LOUDSPEAKER KIT

Post 25p

Triple speaker system combining on ready cut baffle. ½ in. chipboard 15 in. × 8½ in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 3 or 15 ohm.
TEAK VENEERED BOOKSHELF ENCLOSURE. 16 × 10 × 9in. Modern design, with Fluted Wood Front. Highly recommended. **£5** Post 25p

ALL MODELS "BAKER SPEAKERS" IN STOCK

BAKER 12in MAJOR £9

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

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TEAK HI-FI SPEAKER CABINETS. Fluted wood front.
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LOUDSPEAKER CABINET WADDING 18in. wide, 15p ft

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8 ohm, 10 watt. Large ceramic magnet. Special Cambric cone surround. Frequency response 30–12,000 cps. Ideal P.A. Columns. Hi-Fi Enclosure Systems, etc. **£4**

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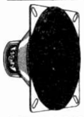

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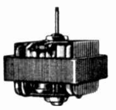

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AF118 60p
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AF127 20p
AF139 30p
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2N2160 60p
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DEVICES MAY BE MIXED TO QUALIFY FOR QUANTITY PRICING

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

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Complete with 8-page booklet, circuits and data

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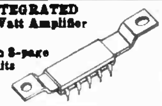

ZENER DIODES

	1-24	25+	100+	500+	1000+
400m/w BZY 88 series*	12p	10p	8p	7p	6p
1½ watt ZL series	25p	23p	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	£1·06
SC40D	400	6 amps	£1·00
SC45A	100	10 amps	£1·06
SC45B	200	10 amps	£1·16
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" × ½"

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	80p
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

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**
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100 + 10p
500 + 9p
1000 + 8p

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

2N2926 Green **10p**
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500 + 6p
1000 + 5p

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

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

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

OA202 **10p**
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