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FEBRUARY 1972

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ADCOLA L.646

for Factory Bench Line Assembly

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

Standard temp. 360°C at 23 watts.

Special temps. from 250°C—410°C.

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B 38 $\frac{1}{4}$ " — 3.2 mm CHISEL FACE

B 14 $\frac{1}{8}$ " — 2.4 mm CHISEL FACE

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B 42 LL $\frac{1}{4}$ " — 4.75 mm CHISEL FACE

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



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SAFEBLOC

of robust construction

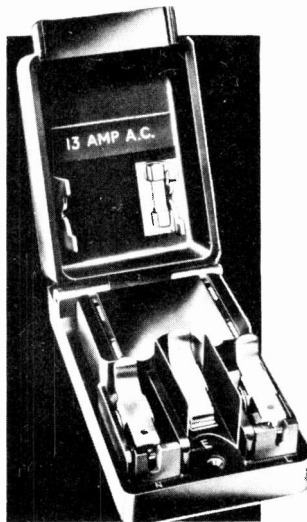
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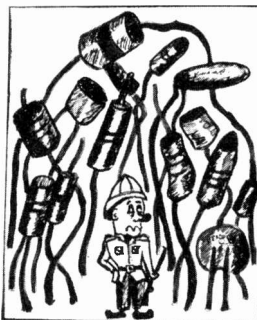
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It's just that the components you want seem to make you the odd man out. Why not stop the never-ending search for items that make you think you must be a pioneer in the electronic jungle.

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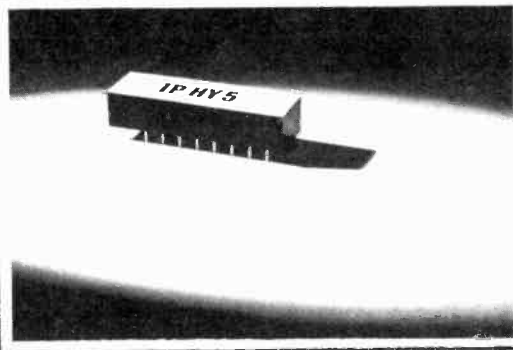
CELECTRON-E

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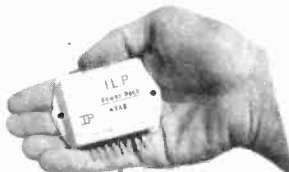


I.L.P. (Electronics) Ltd



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 Integrated 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 IMPEOANCE 22Kohms at 1Khz.

INPUT SENSITIVITY 300 mV for maximum output.

VOLTAGE GAIN 30db at 1KHz.

FREQUENCY RESPONSE 5Hz-60KHz \pm 1db.

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

SUPPLY VOLTAGE \pm 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.

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 \pm 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 \pm 12db.
Bass \pm 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.

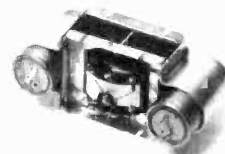
OUTPUT NOISE VOLTAGE

0.5mV.

PRICE

Mono £3-60 Stereo £7-20

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 \pm 22.5 volts, 2 amps simultaneously.

PRICE: £4-50 including Postage and Packing

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TELEPHONE: CANTERBURY 63218

JUST BEGINNING?

Then try our

8-Watt, 10-Transistor Stereo Amplifier R.137

ROC price

£10.50

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

Normal retail price: £14.70

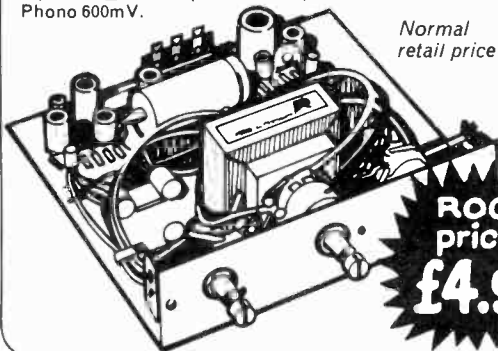


FIRST STEP TO STEREO!

5-Watt Transistor Stereo Amplifier Chassis R.123

Completely self-contained, fully transistorised, mains-powered (240V AC) amplifier, needing only cabinet and knobs. Ideal for adapting mono players to stereo. Frequency response: 40-17,000 Hz \pm 3dB. Output: 2.5 watts per channel @ 8 ohms. Input: Phono 600mV.

Normal retail price: £7.30



ROC price

£4.95

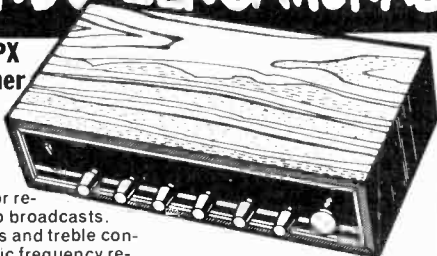
SOUNDS SENSATIONAL

AM/FM/MPX Stereo Tuner Amplifier R.124

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

Normal retail price: £42.00

ROC price: **£29.95**



SAVE £14

AM/FM/MPX Stereo Tuner R.132

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

Normal retail price: £50.00

ROC PRICE

£36



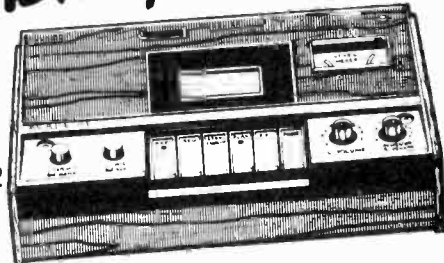
AMAZING OFFER!

Stereo Cassette Tape Unit R.142

Complete stereo record and playback unit with line and microphone inputs. Fitted with tape counter, separate pause control, recording level metres for each channel, pop-up cassette ejection. Supplied complete with two pencil microphones. Wow & flutter better than 0.3%, frequency response 100-10,000 Hz. Tape speed: 1 $\frac{1}{2}$ IPS, 4.75 CMS. Rewind time: Better than 60 sec (C.60 cassette). Normal retail price: £65.00

ROC price

£49.50



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

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

TOP VALUE



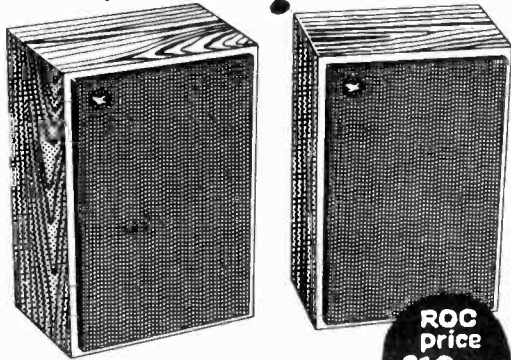
£29

40-WATT TRANSISTOR STEREO AMPLIFIER R.131

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

Normal retail price: £39-60

2 for the price of one! Matched Stereo Speakers R.446



Heavily lagged teak finish cabinets each with large dual cone base unit and separate tweeter. Power handling: 16 watts peak; frequency range: 40-18,000 Hz; impedance: 8 ohms. Size: 14 x 8½ x 6½.

Normal retail price: £19-60

ROC price
£16.40

pay for your mistakes

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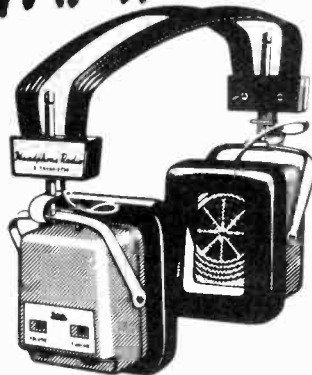
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FANTASTIC BARGAIN



Headphone Radio R.143

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

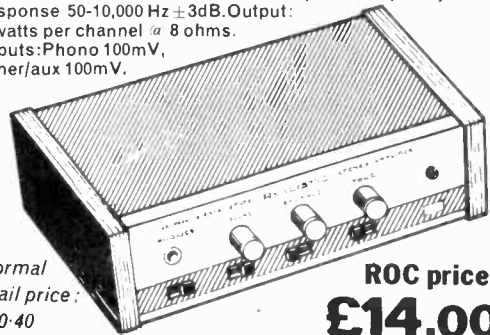
ROC price
£6.90

Normal retail price: £9-40

Don't read this!

10-watt Transistor Stereo Amplifier R.136

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



Normal retail price: £20-40

ROC price:
£14.00

The Perfect match!

AM/FM/MPX Stereo Tuner R.134



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

Normal retail price: £28-60

ROC price
£22

THE BIG DISCOUNT HOUSE

TURNTABLES p.p. 80p

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Empire 999TE/X	20.75
Empire 999SE/X	16.75
Empire 999E/X	12.50
Empire 909E/X	10.00
Empire 909/X	9.75
Empire 909/X	7.60
Empire 90EE/X	7.70

SPEAKER KITS priced per pair

p.p. (a) £1. (b) £1.50	£p
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185	-22	30C18	-61	EAF42	-50	EM84	-32	PCL85	-38	UBF80	-34
1T4	-16	30F5	-84	EB41	-40	EM87	-34	PCL86	-38	UBF89	-32
384	-26	30FL1	-61	EB91	-10	EY51	-33	PCL88	-65	UCR84	-32
3V4	-37	30FL12	-69	EBC33	-40	EY86	-29	PCL800	-75	UCR85	-35
5U4G	-31	30PL14	-68	EBC41	-54	EZ40	-43	PENA4	-77	UCF80	-32
5V4G	-34	30L1	-29	EBU90	-22	EZ41	-43	PEN36C	-70	UCR42	-58
5Y3GT	-25	30L12	-57	EBF80	-32	EZ80	-22	PEL200	-52	UCR81	-32
5Z4G	-34	30L17	-67	EBF89	-29	EZ81	-23	PL36	-49	UCL82	-32
6J30L2	-54	30P4	-57	ECC81	-17	GZ30	-34	PL81	-44	UCL83	-55
6AL5	-11	30P12	-72	ECC82	-20	GZ32	-40	PL81A	-47	UF41	-56
6AM6	-13	30P19	-57	ECC83	-35	GZ34	-48	PL82	-31	UF89	-30
6AQ5	-22	30PL1	-60	ECC85	-34	KT41	-77	PL83	-38	UL41	-57
6AT6	-20	30PL13	-75	ECC80A	-54	KT61	-55	PL84	-30	UL44	-61.00
6AT6	-20	30PL14	-65	ECC80	-27	KT60	-78	PL500	-93	UL84	-30
6BA6	-20	30PL15	-90	ECH82	-28	LN319	-63	PL504	-63	UM84	-22
6BE6	-21	3S16GT	-45	ECH85	-30	LN329	-72	PM84	-63	UY41	-42
6BJ6	-41	35W4	-25	ECH42	-59	LN339	-63	PX25	-95	UY85	-25
6BW7	-52	3Z4GT	-25	ECH81	-29	N78	-87	PY32	-55	VP4B	-77
6F14	-40	807	-45	ECH83	-40	P61	-40	PY33	-55	X78	-22.75
6F23	-68	6063	-62	ECH84	-38	PA8C80	-34	PY81	-25	X79	-22.75
6F25	-53	AC/VP2	-77	ECL80	-30	PC86	-47	PY82	-25	Z77	-22
6K7G	-12	B349	-65	ECL82	-81	PC88	-47	PY83	-28	Transistors	
6K8G	-17	B729	-62	ECL86	-35	PC96	-42	PY88	-38	AC107	-17
6Q7G	-35	CCH35	-67	EF39	-38	PC97	-39	PY800	-34	AC127	-18
6BN7GT	-30	CY31	-30	EF41	-60	PC900	-31	PY801	-34	AD140	-37
6V8G	-25	DAF91	-22	EF80	-23	PC884	-29	R19	-30	AF115	-20
6V8GT	-29	DAF96	-26	EF85	-28	PC885	-25	R39	-56	AF116	-20
6X4	-23	DF33	-38	EF86	-30	PC880	-40	U25	-64	AF117	-20
6X5GT	-28	DF91	-16	EF89	-26	PC889	-45	U26	-58	AF118	-48
10P13	-58	DF96	-36	EF91	-13	PCC189	-48	U47	-64	AF125	-17
12AT7	-17	DH77	-20	EF98	-65	PCC805	-58	U49	-66	AF127	-17
12AU6	-20	DK32	-33	EF183	-28	PCF80	-28	U50	-31	OC26	-25
12AU7	-30	DK91	-28	EF184	-31	PCF82	-31	U51	-31	OC44	-12
12AX7	-22	DK92	-38	EH90	-35	PCF86	-45	U78	-24	OC45	-12
19BG60	-87	DK96	-88	EL33	-55	PCF800	-68	U191	-59	OC71	-12
20P2	-67	DL35	-40	EL34	-45	PCF801	-28	U193	-42	OC72	-12
20P3	-77	DL92	-26	FL41	-54	PCF802	-40	U251	-64	OC75	-12
20P4	-92	DL94	-37	EL84	-23	PCF805	-61	U301	-38	OC81	-12
23L6GT	-19	DL96	-38	EL90	-28	PCF806	-58	U329	-66	OC81D	-12
23L40T	-67	DY86	-24	EL95	-33	PCF808	-68	U301	-68	OC82	-12
30C1	-28	DY87	-24	EL500	-62	PCL82	-82	UABC80	-32	OC82D	-12
30C15	-68	DY802	-33	EM80	-41	PCL83	-57	UAF42	-51	OC170	-28

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

FETS - ANY 6 - 60p

2N3055-65p 2N3054-45p

2N3055A-min. gain 15 @ 4 amps-55p

2N3055B-min. gain 15 @ 3 amps-45p

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Sony's elegantly designed digital alarm clock radio. The digital clock shows you the time minute by minute with matchless accuracy, and once set the Digimatic will wake you up at the same time every morning without having to be re-set. The radio section features Sony's unique sleep button, you fall gently to sleep lulled by the sweet tone of the radio, which switches itself off at a predetermined time. Available in either black, red or white. Frequency range 530-1,605KHz (AM): 87-108MHz (FM). Uses 8 transistors and 8 semi-conductors, built-in ferrite aerial and 3 1/2 in loudspeaker. Power requirements: 230V AC 50Hz. Dimensions: 12 1/2 in x 3 1/2 in x 5 1/2 in.

List Price **LASKY'S PRICE** **£16.75** C & P 45p
£28.94

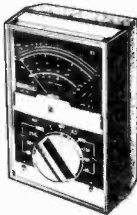
EXCLUSIVE TM-1

1,000 Ohms Volt MINI-TESTER

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

Size Only

- 3 1/2 in x 2 1/2 in x 1 1/2 in
- DC/V: 0-10-50-250-1,000 at 1k OPV
- AC/V: 0-10-50-250-1,000 at 1k OPV
- DC CURRENT: 0-1mA, 100mA
- Resistance: 0-150k
- Decibels: -10dB to 22dB
- Complete with test leads, battery and instructions



LASKY'S PRICE **£1.85** C & P 15p

TM-5 5K ohms/V POCKET MULTIMETER

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

- DC/V: 3-15-50-300-1,200 at 5k OPV
- AC/V: 6-30-300-600 at 2.5k/OPV
- DC Current 0-300µA, 0-300mA
- Resistance: 0-10k/ohms, 0-1M/ohm
- Decibels: -10dB to +16dB
- Complete with test leads, battery and instructions.

LASKY'S PRICE **£2.75** C & P 35p

LASKY'S NEW "LOW NOISE" CASSETTES FROM the U.S.A.

Model	Singles	5	10	20
C.60	32p	£1.52	£2.96	£5.60
C.90	50p	£2.37	£4.62	£8.75
C.120	69p	£3.27	£6.38	£10.85

Post Each 7p. 5-25p. 10-40p. 20-65p.

OUT NOW! 1972 AUDIO-TRONICS

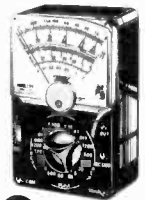
The great new 1972 edition of Lasky's famous Audio-Tronics catalogue is now available—FREE on request. The 44 newspaper size pages—many in full colour—are packed with 1,000's of items from the largest stocks in Great Britain of everything for the Radio and Hi-Fi enthusiast, Electronics hobbyist, Serviceman and Communications Ham. Over half the pages are devoted exclusively to every aspect of Hi-Fi (including Lasky's budget Stereo Systems and Package Deals). Tape recording and Audio accessories and don't miss **LASKY'S AUDIO-TRONICS CREDIT CARD SCHEME** offering holders one month's interest free credit up to £50. Send your name and address and 15p for post and inclusion on our regular mailing list.

ALSO the fantastic £1,000 plus SONY Colour TV Audio-Tronics '72 Competition

TMK MODEL 200 METER KIT

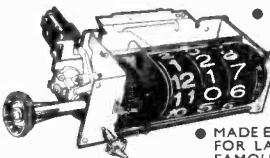
TMK offer the unique opportunity of building a really first-class precision multimeter at a worthwhile saving in cost. The cabinets are supplied with the meter, scale and movement mounted in position. The highest quality components and 1% tolerance resistors are used throughout. Supplied complete with full constructional circuit and operating instructions.

Specification
20,000 P.O.V. Multimeter. Features 24 measurement ranges with mirror scale accuracy. DC/V and current: 2% A.C.V: 3%. Resistance: 3%. Special 0-6V DC range for transistor circuit measurements.



ONLY **LASKY'S PRICE** **£4.60** C & P 15p

DIGITAL CLOCK SCOOP



- SHOCK AND VIBRATION PROOF
- 12-HOUR ALARM SWITCH
- HOURS, MINUTES AND SECONDS READ-OFF
- FORWARD AND BACKWARD TIME ADJUSTMENT
- SILENT OPERATION
- SYNCHRONOUS MOTOR
- MADE ESPECIALLY FOR LASKY'S BY FAMOUS MAKER
- MAINS OPERATION

EXCLUSIVELY FROM LASKY'S in chassis form for you to mount in any housing. The clock measures 4 1/2 W x 1 1/2 H x 3 1/2 D (overall from front of drum to back of switch). SPEC.: 210/240V AC, 50Hz operation; switch rating 250V, 3A. Complete with instructions.

HUNDREDS OF APPLICATIONS. COMPLETE WITH KNOBS
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TRIO HS.1 HS.2. STEREO HEADPHONE BARGAINS



Models HS.1 and HS.2. Both these sets by TRIO offer really superb stereo reproduction in a lightweight, fully adjustable headset designed for optimum comfort. Listening fatigue is unknown with TRIO headphones. Brief spec: both models : Input imp. 8 nominal (matching 4 to 8) : max. input 0.5W ; frequency response 20-19KHz ; output sensitivity at 1mW input ; HS.1 118dB, HS.2 111dB ; weight 0.66lbs. Identical in appearance—both models are finished in ivory with contrasting foam-filled ear pads and head band.

HS.1 List Price £8.40. HS.2 List Price £6.75.
Lasky's Price **£5.00** **Lasky's Price** **£4.00** C & P 25p

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20 watt, high fidelity loudspeaker kit contains all parts necessary to complete the system, except timber and other material for the cabinet itself, with detailed, illustrated instructions.

Specification: 20 Watts DIN, 4 ohms impedance, 8 ins bass unit, dome HF radiator, crossover frequency 4,000 Hz.



Axent 100

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



Audiom 100

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



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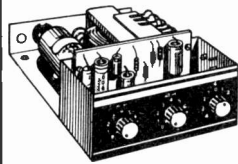
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SUPERSOUND 13 HI-FI MONO AMPLIFIER

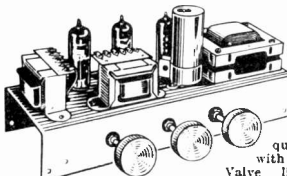


A superb solid state audio amplifier. Brand new components throughout. 5 silicon transistors plus 2 power output transistors in push-pull. Full wave rectification. Output approx. 13W r.m.s. into 8 ohm. Frequency response 12Hz-30kHz \pm 3db. Fully integrated pre-amplifier stage with

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PRICE £10.50 P. & P. 25p.

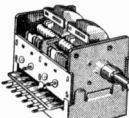
DE LUXE STEREO AMPLIFIER



A.C. mains 200-240 volts. Using heavy duty fully isolated mains transformer with full wave rectification giving adequate smoothing with negligible hum. Valve line up: 2x ECL86 Triode Pentodes.

1 x E280 as rectifier. Two dual potentiometers are provided for bass and treble control, giving bass and treble boost and cut. A dual volume control is used. Balance of the left and right hand channels can be adjusted by means of a separate "balance" control fitted at the rear of the chassis. Input sensitivity is approximately 300mV for full peak output of 4 watts per channel (8 watts mono), into 3 ohm speakers. Full negative feedback in a carefully calculated circuit, allows high volume levels to be used with negligible distortion. Supplied complete with knobs, chassis size 1 1/2in. w x 4in. x. Overall height including valves 5in. Ready built and tested to a high standard. Price £8.92. P. & P. 45p.

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BRAND NEW FM MULTIPLEX STEREO DECODER UNITS. Manufactured by PHILIPS. Size 2 1/2in x 3 1/2in x 1in. All transistor. 6mA. Supplied pre-aligned with full circuit diagram and connection details. £4 each. Post free.

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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. 85p. P. & P. 13p. Pri. 200/240V. Sec. 10-0-10 at 2 amp. £1.85. P. & P. 30p. Tapped Primary 200-220-240V. Sec. 21-5V at 500mA. 65p. P. & P. 13p.

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SONOTONE STAHC 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. £1.68. P. & P. 10p.

LATEST RONETTE T/O Mono Compatible Cartridge for EP/LP/78 mono or stereo records on mono equipment. £1.50. P. & P. 10p.

QUALITY RECORD PLAYER AMPLIFIER MK II

A top-quality record player amplifier employing heavy duty double wound mains transformer, ECC83, EL84, and rectifier. Separate Bass, Treble and Volume controls. Complete with output transformer matched for 3 ohm speaker. Size 7in. w x 3d. x 6h. Ready built and tested. PRICE £3.75. P. & P. 40p. ALSO AVAILABLE ready to fit cabinet below. PRICE £4.88. P. & P. 50p.

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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. 3in HEAVY DUTY TWEETERS. Powerful ceramic magnet. Available in 3, 8 or 15 ohm 88p each. P. & P. 13p.

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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 1 1/2 x 1 1/2 x 1 1/2in. Brand new - complete with instructions. Price 85p. P. & P. 13p.

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HARVERSONIC SUPER SOUND 10 + 10 STEREO AMPLIFIER KIT



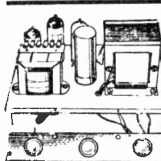
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A really first-class Hi-Fi Stereo Amplifier Kit. Uses 14 transistors including Silicon Transistors in the first five stages on each channel resulting in even lower noise level with improved sensitivity. Integrated pre-amp with Bass, Treble and two 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 \pm 3dB. 12-30,000Hz. Sensitivity better than 80mV into 1M Ω . Full power bandwidth \pm 3dB 12-15,000Hz. Bass boost approx. to \pm 12dB. Treble cut approx. to -16dB. Negative feedback 18dB over main amp. Power requirements 30V at 1.0 amp. Overall size—12" wide 8" deep x 2 1/2" high. Fully detailed 7-page construction manual and parts list free with kit and send 16p 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 deck, etc.) and will then provide mixing and fading facilities for medium powered Hi-Fi Discosque audio, etc.



3-VALVE AUDIO AMPLIFIER HA34 MK II

Designed for Hi-Fi reproduction of records. A.C. Mains operation. Ready built on plated heavy gauge metal chassis, size 7 1/2in w. x 4in. d. x 4 1/2in. h. Incorporates ECC83, EL84, E280 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 41 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. £3.88. 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 x 3in. deep x 3in. high overall. AC mains 200/240V. Supplied absolutely Brand New, completely wired and tested with good quality output transformer. FEW ONLY.

OUR ROCK BOTTOM BARGAIN PRICE £2.75 P. & P. 35p.

10/14 WATT HI-FI AMPLIFIER KIT

A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84 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 3-15 Ω 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, BF86 and E280 rectifier. Simple instruction booklet 15p (Free with parts). All parts sold separately. ONLY £7.97. P. & P. 55p. Also available ready built and tested complete with std. input sockets, £9.97. P. & P. 55p.

HANDBOOK OF TRANSISTOR EQUIVALENTS AND SUBSTITUTES

A must for servicemen and home constructors. Including many 1000's of British, U.S.A., European and Japanese transistors. ONLY 40p. Post 5p.

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BF02 = 7402	Quad 2-input pos. NOR gates	0-15	0-14	0-12
BF03 = 7403	Quad 2-input pos. NAND gates (with open collector output)	0-15	0-14	0-12
BF04 = 7404	Hex Inverters	0-15	0-14	0-12
BF05 = 7405	Hex Inverter (with open-collector output)	0-15	0-14	0-12
BF10 = 7410	Triple 3-input pos. NAND gates	0-15	0-14	0-12
BF13 = 7413	Dual 4-input Schmitt trigger	0-29	0-28	0-24
BF20 = 7420	Dual 4-input pos. NAND gates	0-15	0-14	0-12
BF30 = 7430	8-input pos. NAND gates	0-15	0-14	0-12
BF40 = 7440	Dual 4-input pos. NAND buffers	0-15	0-14	0-12
BF41 = 7441	BCD to decimal driver	0-67	0-64	0-58
BF42 = 7442	BCD to decimal decoder (4-10 lines, 1 of 10)	0-67	0-64	0-58
BF46 = 7446	BCD-to-seven-segment decoder/driver	2-00	1-75	1-50
BF47 = 7447	BCD-to-seven-segment decoder/drivers (1.5V outputs)	0-97	0-94	0-88
BF48 = 7448	BCD-to-seven-segment decoder/driver	0-97	0-94	0-88
BF50 = 7450	Expandable dual 2-input and-or-invert	0-15	0-14	0-12
BF61 = 7461	Dual 2-wide 2-input and-or-invert gates	0-15	0-14	0-12
BF63 = 7463	Quad 2-input expandable and-or-invert	0-15	0-14	0-12
BF64 = 7464	Dual 3-input and-or-invert gates	0-15	0-14	0-12
BF60 = 7460	Dual 4-input expander	0-15	0-14	0-12
BF70 = 7470	Single-phase J-K flip-flop	0-29	0-28	0-24
BF72 = 7472	Master slave J-K flip-flop	0-29	0-28	0-24
BF73 = 7473	Dual Master slave J-K flip-flop	0-37	0-35	0-32
BF74 = 7474	Dual D type flip-flop	0-37	0-35	0-32
BF75 = 7475	Quad latch	0-47	0-45	0-42
BF76 = 7476	Dual J-K with pre-set and clear	0-43	0-40	0-38
BF80 = 7480	Gated full adders	0-87	0-84	0-88
BF81 = 7481	16-bit read/write memory	0-97	0-94	0-88
BF82 = 7482	2-bit binary full adders	0-97	0-94	0-88
BF83 = 7483	Quad full adder	1-10	1-05	0-95
BF86 = 7486	Quad 2-input exclusive NOR gates	0-32	0-30	0-28
BF90 = 7490	BCD decade counter	0-87	0-84	0-88
BF91 = 7491	8-bit shift registers	0-87	0-84	0-78
BF92 = 7492	Divide-by-twelve counters	0-87	0-84	0-88
BF93 = 7493	4-bit binary counters	0-87	0-84	0-88
BF94 = 7494	Dual entry 4-bit shift register	0-77	0-74	0-68
BF95 = 7495	4-bit up-down shift register	0-77	0-74	0-68
BF96 = 7496	5-bit parallel in parallel out shift register	0-77	0-74	0-68
BF100 = 74100	8-bit bistable latches	1-75	1-65	1-55
BF104 = 74104	Single J-K flip-flop equivalent 9000 series	0-97	0-94	0-88
BF105 = 74105	Single J-K flip flop equivalent 9001 series	0-97	0-94	0-88
BF107 = 74107	Dual Master slave flip-flops	0-40	0-38	0-36
BF110 = 74110	Gates master-slave flip-flops	0-55	0-53	0-50
BF111 = 74111	Dual data lock-out flip-flop	1-25	1-15	1-00
BF118 = 74118	Hex set-reset latches	1-00	0-95	0-90
BF119 = 74119	Hex set-reset latches, 24-pin	1-35	1-25	1-10
BF121 = 74121	Monostable multivibrators	0-87	0-84	0-88
BF141 = 74141	BCD-to-decimal decoder/driver	0-67	0-64	0-58
BF145 = 74145	BCD-to-decimal decoder/driver O/C	1-50	1-40	1-30
BF150 = 74150	16-bit data selector	1-80	1-70	1-60
BF151 = 74151	8-bit data selectors (with strobe)	1-00	0-95	0-90
BF153 = 74153	Dual 4-line-to-1-line data	1-20	1-10	0-95
BF154 = 74154	4- to 16-line decoder	1-80	1-70	1-60
BF155 = 74155	Dual 2- to 4-line decoder	1-40	1-30	1-20
BF156 = 74156	Dual 2- to 4-line decoder O/C	1-40	1-30	1-20
BF160 = 74160	Sync. decade counter	1-80	1-70	1-60
BF161 = 74161	Sync. 4-bit binary counter	1-80	1-70	1-60
BF190 = 74190	Sync. up-down BCD counter	3-50	3-25	3-00
BF191 = 74191	Sync. binary up-down counter (single clock line)	3-50	3-25	3-00
BF192 = 74192	Sync. up-down decade counter	2-10	1-95	1-75
BF193 = 74193	Sync. binary up-down counter (two clock lines)	2-10	1-95	1-75
BF196 = 74196	Pre-settable 50MHz decade counter	1-80	1-70	1-60
BF197 = 74197	Pre-settable 50MHz binary counter	1-80	1-70	1-60
BF198 = 74198	8-bit parallel L-R shift register	5-50	5-00	4-00
BF199 = 74199	8-bit parallel access shift register	5-50	5-00	4-00

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

BRAND NEW LINEAR I.C.'s—FULL SPEC.

Type No.	Case	Leads	Description	1-24	25-99	100 up
BP 201C—SL201C	TO-5	8	G.F. Amp	63p	53p	45p
BP 701C—SL701C	TO-5	8	OP Amp	63p	50p	45p
BP 702C—8L702C	TO-5	8	OP Amp Direct OP	63p	50p	45p
BP 702—72702	D.I.L.	14	G.F. OP Amp (Wide Band)	53p	45p	40p
BP 709	D.I.L.	14	High OP Amp	53p	45p	40p
BP 709P— μ A709C	TO-3	8	High Gain OP Amp	53p	45p	40p
BP 710—72710	D.I.L.	14	Differential comparator	53p	45p	40p
BP 711— μ A711	TO-5	10	Dual comparator	58p	50p	45p
BP 741—72741	D.I.L.	14	High Gain OP Amp (Protected)	75p	60p	50p
μ A 703C— μ A703C	TO-5	6	R.F.—L.F. Amp	43p	35p	27p
TAA 263	TO-72	4	A.F. Amp	70p	60p	55p
TAA 298—	TO-74	10	G.F. Amp	90p	75p	70p
TAA 350	TO-5	8	Wide loud limiting amplifier	170p	158p	150p

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AUDIO AMPLIFIER MODULE

*GUARANTEED NOT LESS THAN 3 WATTS RMS

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

- Sensitivity 40mV for 1 watt VOLT-AGE GAIN 40dB but can be varied up to 73dB for some applications.
- Signal to Noise Ratio 86dB.
- Frequency response better than 50Hz to 25KHz for -3dB.
- Normal supply Voltage 9-24V.
- Suitable for 8-16 OHM Loads.
- Overall Size 2" x 3" x 1".
- Typical Total Harmonic distortion at 1 watt less than 1%.
- Supply voltage (V_s) = 24V 15ohm load. *Module Tested and Guaranteed*
- Quantity 1-9 10-25
Price each £2.63 £2.28
Larger quantities quoted on request

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

NOTE THESE PRICES!

Type No.	Function	I.C.'s		
		DTL 930 SERIES	LOGIC	
BF930	Expandable dual 4-input NAND	23p	20p	15p
BF932	Expandable dual 4-input NAND buffer	23p	23p	20p
BF933	Dual 4-input expander	25p	23p	20p
BF935	Expandable Hex Inverter	25p	23p	20p
BF936	Hex Inverter	25p	23p	20p
BF944	Dual 4-input NAND expandable buffer without pull-up	25p	23p	20p
BF945	Master-slave JK or RS	35p	32p	20p
BF946	Quad, 2-input NAND	23p	20p	15p
BF948	Master-slave JK or RS	35p	32p	20p
BF951	Monostable JK	90p	85p	80p
BF962	Triple 3-input NAND	23p	20p	15p
BF9093	Dual Master-slave JK with separate clock	80p	75p	70p
BF9094	Dual Master-slave JK with separate clock	80p	75p	70p
BF9097	Dual Master-slave JK with Common Clock	80p	75p	70p
BF9099	Dual Master-slave JK Common Clock	80p	75p	70p

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

DTL AND TTL INTEGRATED CIRCUITS

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

PAK No.	IC's	50p	PAK No.	IC's	50p
UIC930	12 x μ A 930	50p	UIC948	8 x μ A 948	50p
UIC932	12 x μ A 932	50p	UIC951	5 x μ A 951	50p
UIC933	12 x μ A 933	50p	UIC961	12 x μ A 961	50p
UIC935	12 x μ A 935	50p	UIC9093	5 x μ A 9093	50p
UIC936	12 x μ A 936	50p	UIC9094	5 x μ A 9094	50p
UIC944	12 x μ A 944	50p	UIC9097	5 x μ A 9097	50p
UIC945	8 x μ A 945	50p	UIC9099	5 x μ A 9099	50p
UIC946	12 x μ A 946	50p	UIC x 920 Assorted 930 Series		£1-50

Packs cannot be split but 25 Assorted Pieces (our mix) is available as PAK UICX9. Data Booklet available for the BF930 Series. PRICE 13p.

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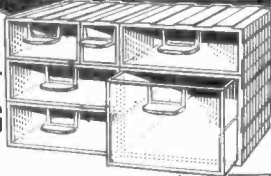


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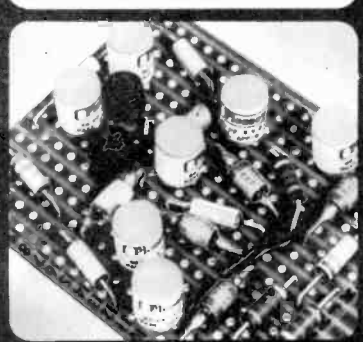
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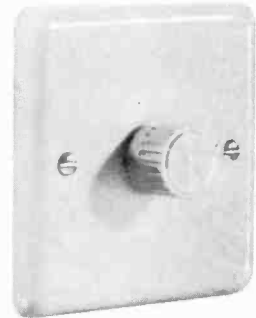
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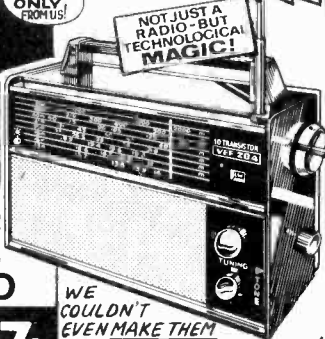
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Important! This latest model incorporates all the latest technological improvements and supersedes all earlier models! Yes! **DESIGNED FOR WORLD WIDE RECEPTION**—it'll probably make your present radio seem like a "crystal set"! It even incorporates a special **MARINE WAVEBAND** to receive spoken communications from ship-to-shore! We're almost giving them away at only £13.97—a mere fraction of even today's Russian miracle price! Compare performance with £42 radios! *Refund if not astounded! Purer and sweeter tone than ever! Wider band spread for "pin-point" station selection! The Russians have really surpassed themselves this time proving again their ability in the field of space communications. Yes, 8 separate wavebands, including Standard Long, Medium and Short waves to cover the world, PLUS special "ship-to-shore" **MARINE BAND!** Thousands of different transmissions and stations at your fingertips 24 hours a day, including ships at sea, etc., and messages from all over world. You must hear it to believe it! Superb, sweet tone—controlled from a whisper to a roar! Push-pull output! Separate ON/OFF volume and Treble/Bass tone controls! Press-button dial illumination! Take it anywhere—runs economically on standard batteries or through battery eliminator from 220/240V a.c. mains. Internal ferrite rod plus telescopic aerial. It's also a fabulous **CAR RADIO!** Black and Chrome case 11in x 9in x 3½in overall approx. Made to give years of perfect service. Complete with **WRITTEN GUARANTEE**, manual with simple operating instructions and circuit diagram. **ONLY £13.97** (with mains/battery eliminator £1.38 extra). **POST 50p.** Standard batteries 38p extra. Can also be used through extension amplifier, tape recorder or public address system. Send today or call. (**Sorry**—we cannot change these new radios for any earlier model already purchased!)

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WORLD WIDE RECEPTION
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IN4007	1000	190	150
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IN4001	50	045	040
IN4002	100	055	045
IN4003	200	060	050
IN4004	400	070	060
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SPECIFICATION R100/101

14 watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0.1%. P.U.1 (for ceramic cartridges) 150mV into 3 Meg. P.U.2 (for magnetic cartridges) 4mV @ 1kHz into 47K equalised within \pm 1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power.) Tape out facilities; headphone socket, power out 250mW per channel. *Tone controls and filter characteristics.* Bass: +12dB to -17dB @ 60Hz. Bass filter: 6dB per octave cut. Treble control: treble +12dB to -12dB @ 15kHz. Treble filter: 12dB per octave. *Signal to noise ratio:* (all controls at max.) R101—P.U.1, and radio—65dB. P.U.2—58dB. R100 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. *Cross talk* better than -35dB on all inputs. *Overload characteristics* better than 26dB on all inputs. Size approx. 13½ x 9in x 3½in.

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	10%	1Ω-10Ω	E12	1-0p 0-8p
	10%	1Ω-10Ω	E12	1-0p 0-8p
	10%	1Ω-10Ω	E12	1-0p 0-8p
	10%	1Ω-10Ω	E12	1-0p 0-8p
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AC128	12p	BSX21	25p	ORP12	48p	2N3703	14p
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AF115	20p	BY210	20p	IN4002	10p	2N3705	15p
AF117	20p	BY213	20p	IN4003	11p	2N3706	15p
BC107	10p	OA85	7p	IN4004	12p	2N3707	18p
BC108	10p	OA91	5p	IN4005	13p	2N3708	10p
BC109	10p	OA202	7p	IN4006	13p	2N3709	11p
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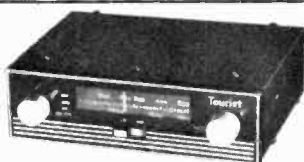
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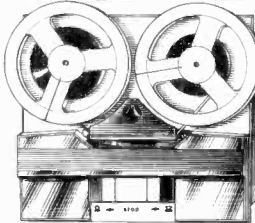
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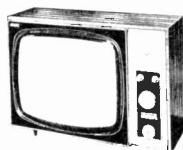
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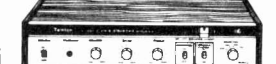
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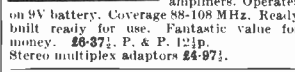
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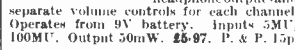
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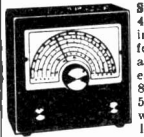
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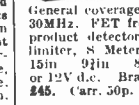
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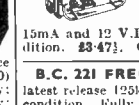
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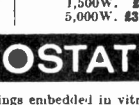
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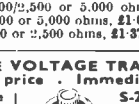
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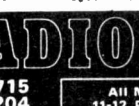
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UPDATING THE MOTORWAYS

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

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

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

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

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

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

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

F.E.B.

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

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**WHY WORRY ABOUT
COLD, DAMP MORNINGS?
BOOST YOUR CAR IGNITION
VOLTAGE WITH THIS ADD-ON
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AND ENSURE YOUR CAR GETS . . .**

OFF TO A GOOD START



By A.J. DUNN

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

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

ENERGY REQUIREMENTS

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

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

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

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

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

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

The net loss when not active is 0.9V on a supply that rises above 13.6V hence it may be fitted and forgotten.

TWO VERSIONS

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

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

CIRCUIT ACTION

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

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

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

This transistor, in its diode role is normally reverse biased relative to the capacitor. If it is made to conduct the inverter stalls as both diodes D1 and D2 are turned on continuously so short circuiting the output. This occurs when the voltage across TR5 equals the turn-on voltage of the silicon diodes. From Fig. 4 it can be seen that this occurs beyond

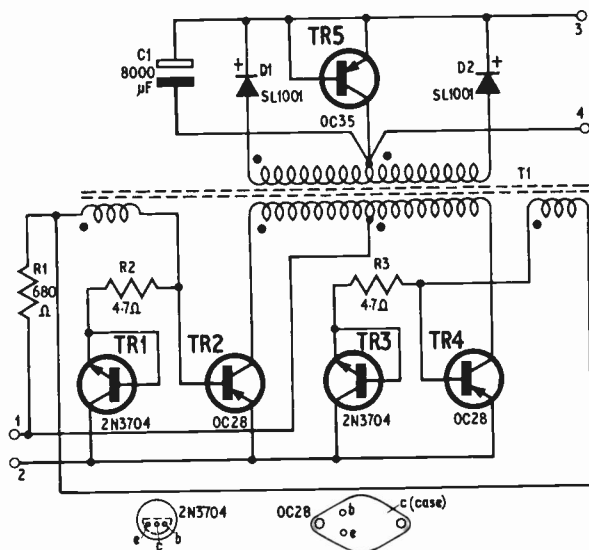


Fig. 3a. Circuit diagram of Unit B (general purpose)

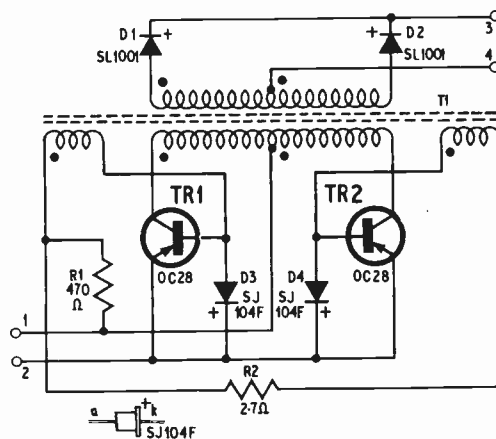


Fig. 3b. Circuit diagram of Unit A

the average non-running ignition current of 3.5A to ensure easy starts under heavy load.

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

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

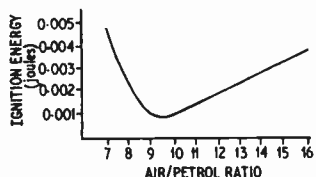


Fig. 1. Graph showing ignition energy requirements for different mixture ratios

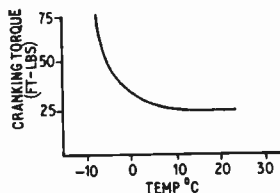


Fig. 2. Graph showing how low temperatures increase the cranking torque requirement

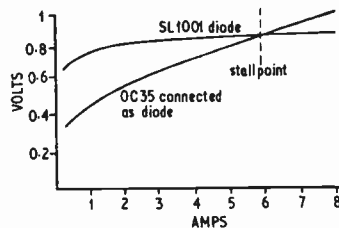
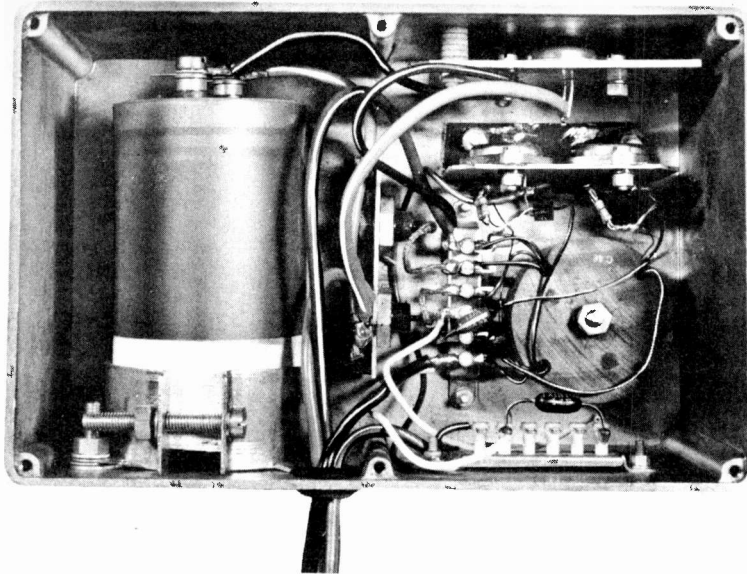


Fig. 4. Graph showing how the OC35 connected as a diode governs the stall point of the inverter oscillator of Unit B



Unit B assembled and wired

Components ...

UNIT B (General purpose)

Resistors

R1 680-1,000 Ω 2.5W (see text)

R2, R3 4.7 Ω 1W (2 off)

R4 390 Ω 1W

Capacitor

C1 8,000 μ F elect. 25V

Transistors

TR1, TR3 2N3704 (2 off)

TR2, TR4 OC35 (2 off)

Diodes

D1, D2 SL1001 or SL1003 (2 off)

Transformer

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

Switches

S1 2A on/off toggle (Negative earth only)

S2 2A press switch (Negative earth only)

S3 2A single pole change-over (Positive earth only)

Miscellaneous

Insulated terminal strip, diecast box 7 $\frac{1}{2}$ in \times 4 $\frac{1}{2}$ in \times 3in, mica washers p.v.c. tape

HIGH SPEED ADJUSTMENT

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

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

NEGATIVE EARTH

The in-circuit negative earth connections for Unit A are given in Fig. 5a. The input circuit has

lead 1 (Fig. 3b) connected to chassis negative and lead 2 to the starter motor relay connector.

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

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

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

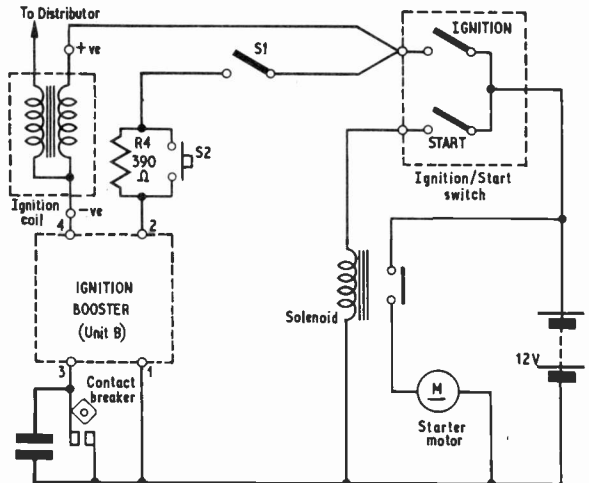
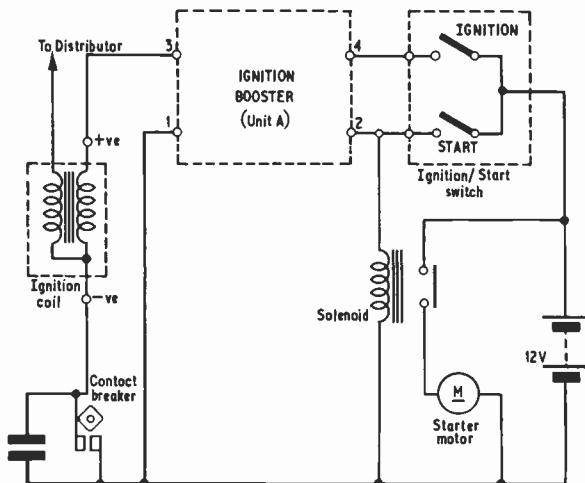


Fig. 5a. Showing the ignition circuit connections for Unit A. Fig. 5b. In-circuit connections for Unit B. These are for negative earth systems only

POSITIVE EARTH

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

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

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

SPARK ENERGY

The spark energy required for a normal ignition is taken as approximately 0.005 joules and up to ten times this figure may be available in modern engines, however, the spark voltage is often the determining factor in starting. For example a particularly rich mixture may be ignited at 7kV by one third of the spark energy available at 5kV.

The performance of a standard coil ignition is shown in Fig. 7. Here the marked fall at higher energy speeds being partly due to the decreasing time available for the coil current to develop. This can be explained by considering that the average 12V ignition coil has an inductance of 10mH and a resistance of about 3.5 ohms. The non-running current is therefore 3.5A. This current increases initially with speed and dynamo output but later falls.

The coil inductive time constant (L/R) can be calculated as 2.8ms and is the time necessary to develop 60 per cent of the possible inductive energy.

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

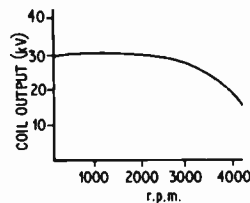


Fig. 7. Graph showing how coil output falls at high revs

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

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

INCREASING VOLTAGE

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

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

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

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

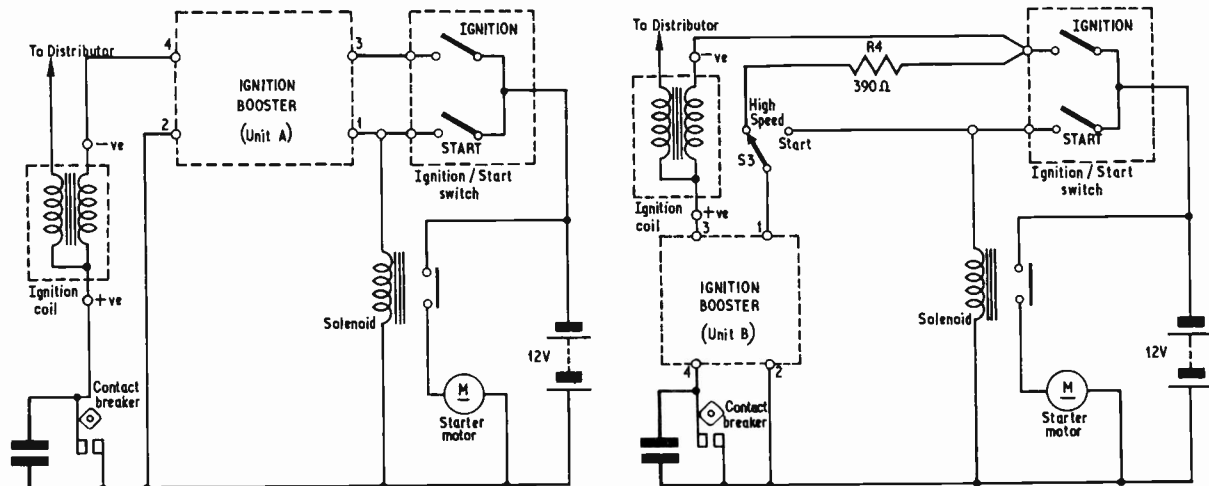


Fig. 6a. Showing the ignition circuit connections for Unit A. Fig. 6b. In-circuit connections for Unit B. These are for positive earth systems only

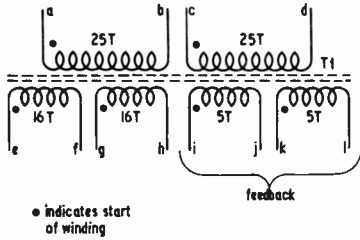


Fig. 8. Winding details for inverter transformer

COIL WINDING

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

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

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

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

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

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

COMPONENTS

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

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

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

1. The inherent resistance of the capacitor and ignition coil circuit should be approximately that of

critical damping which is $R \approx 2\sqrt{\frac{L}{C}}$ where

$R=3.5$ ohms and $L=10$ mH, which are the resistance and inductance of the coil unit. Rearranging this for the value of capacitors this works out to approximately 3,000 microfarads.

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

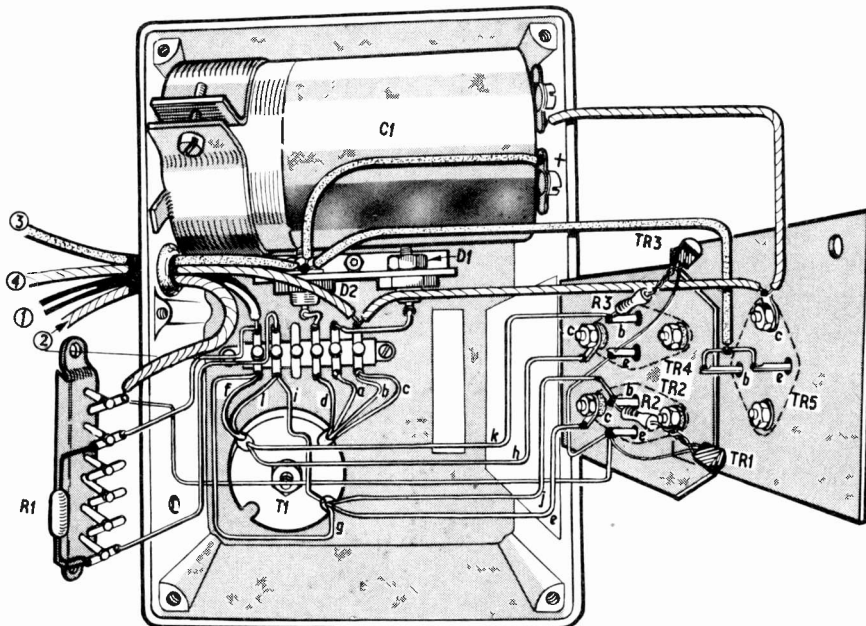


Fig. 9. Interwiring and component layout of Unit B. All components are electrically insulated from chassis

Components ...

UNIT (A Start only)

Resistors

- R1 470-680 Ω 2.5W (see text)
- R2 2.7 Ω 5W (see text)

Transistors

- TR1, TR2 OC23 or OC29 (2 off)

Diodes

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

Transformer

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

Miscellaneous

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

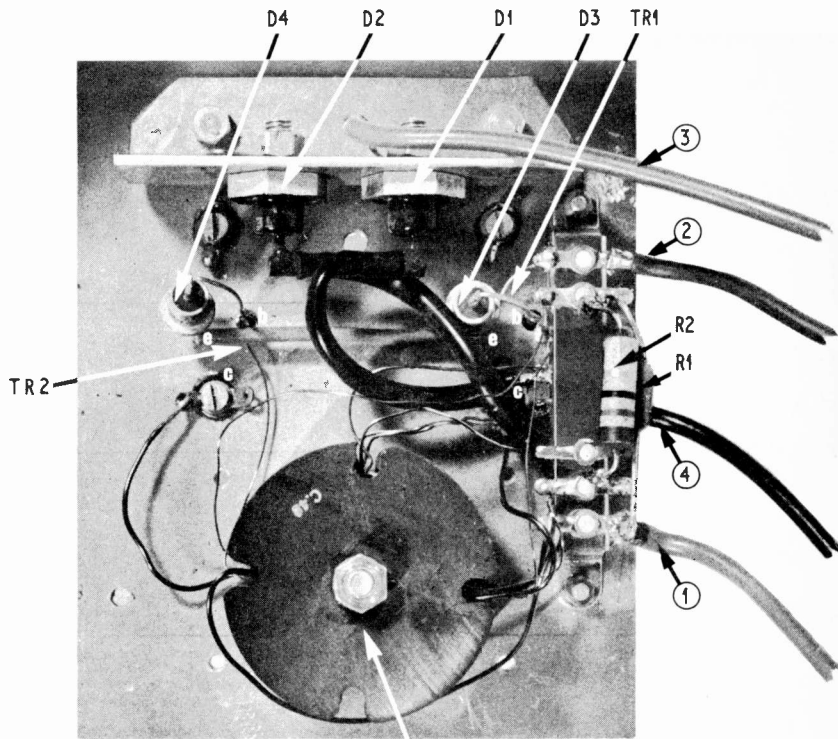


Fig. 10. Wiring and component layout for Unit A. All components are electrically insulated from chassis

ASSEMBLY OF UNITS

Assembly and wiring details for both versions of the booster are given in Figs. 9 and 10. Components for the general purpose unit are shown contained in a 7½in \times 4½in \times 3in diecast box. This is necessary for the unit is mounted in the vicinity of the ignition coil, since it will exclude oil and moisture. An alternative open assembled version of the "start-only" unit can be mounted on a plate behind the dashboard.

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

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

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

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

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

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

Table 1:

Input		Output		Load	Efficiency	R1
Volts	Amps	Volts	Amps	Ohms	Per cent	Ohms
8.25	0.5	15	—	o/c	—	350
6.25	3.5	7.5	2.1	3.6	71	350
7.75	1	—	—	s/c	—	350
5.7	4	5.5	2.6	o/c	—	90
6	3.5	7.5	2.5	3	89	90
6.5	2.5	—	—	s/c	—	90
5.1	4.6	5.5	2.9	1.9	68	44

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



FIBRE OPTICS

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

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

LIGHT GUIDE

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

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

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

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

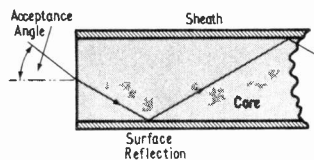


Fig. 1. Fibre optic light transmission



Fig. 2. Fibre strands forming a light guide

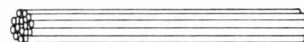


Fig. 3. Image bundle

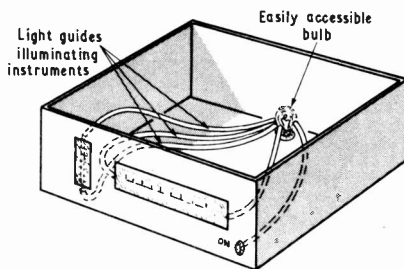


Fig. 4. Multipoint illumination with light guides

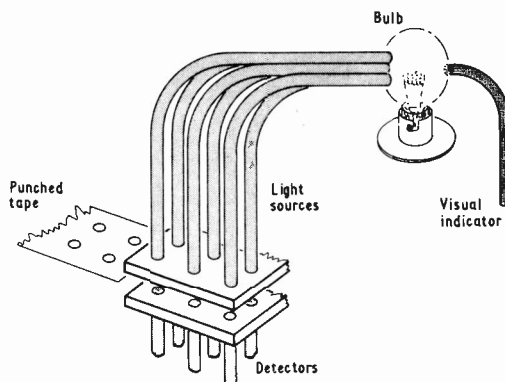


Fig. 5. Multi-position read and detect assembly

SAFE LIGHT SOURCE

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

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

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

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

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

LIGHT DETECTION

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

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

FLAME DETECTION

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

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

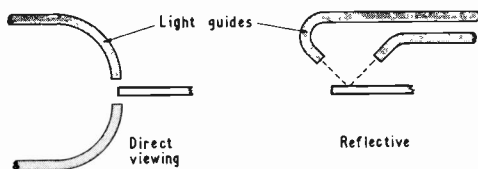


Fig. 6. Remote position detection

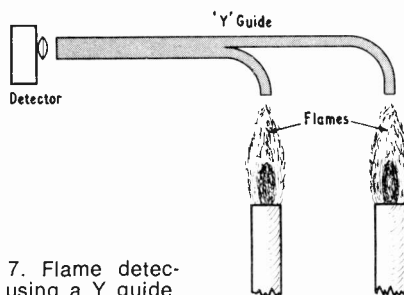


Fig. 7. Flame detection using a Y guide

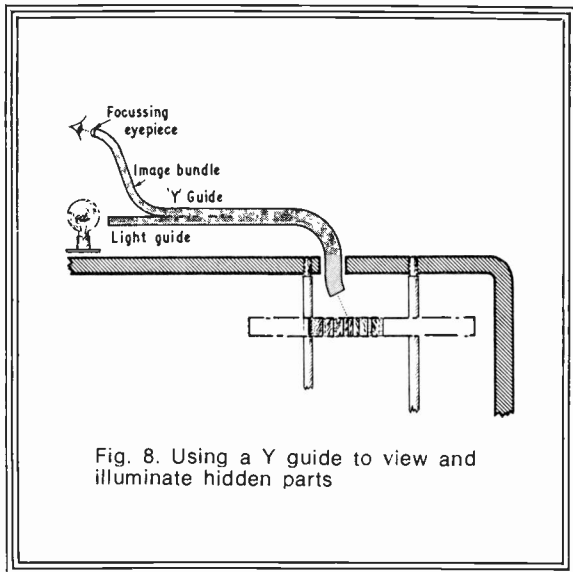


Fig. 8. Using a Y guide to view and illuminate hidden parts

IMAGE TRANSMISSION

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

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

PRESENT LIMITATIONS

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

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

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

PRACTICAL CONSIDERATIONS

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

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

bends at least more than three times the cable diameter.

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

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

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

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

PLANNING

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

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

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



Arrangement of 3 light guides. The Crofon 64 filament guide in plastics and two "mares" tails in glass. Notice the polished ends

The short piece of Perspex rod shown is not a suitable material for optical transmission

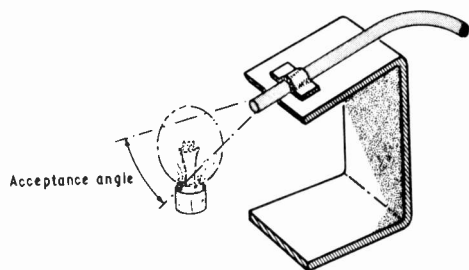


Fig. 9. Bracket for mounting light guide near car lamp

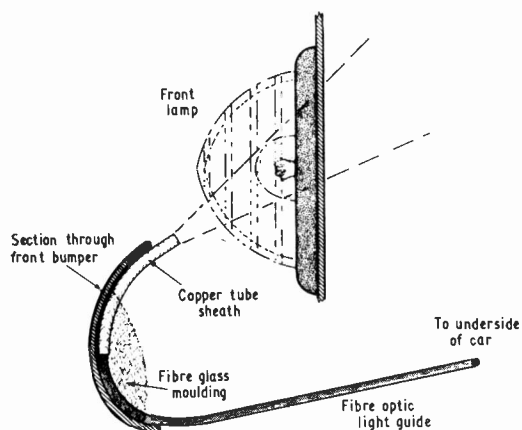


Fig. 10. Direct view mounting of light guide behind front bumper

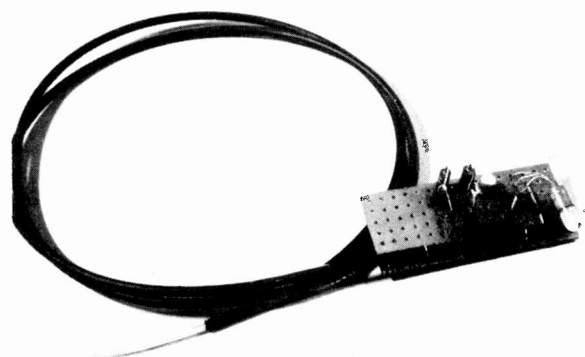
for end finishing, and ensure that bends and positioning is correct. You cannot easily add extra guide if an error occurs.

REAR LAMP FITTINGS

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

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

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



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

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

FRONT LAMP FITTINGS

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

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

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

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

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

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

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

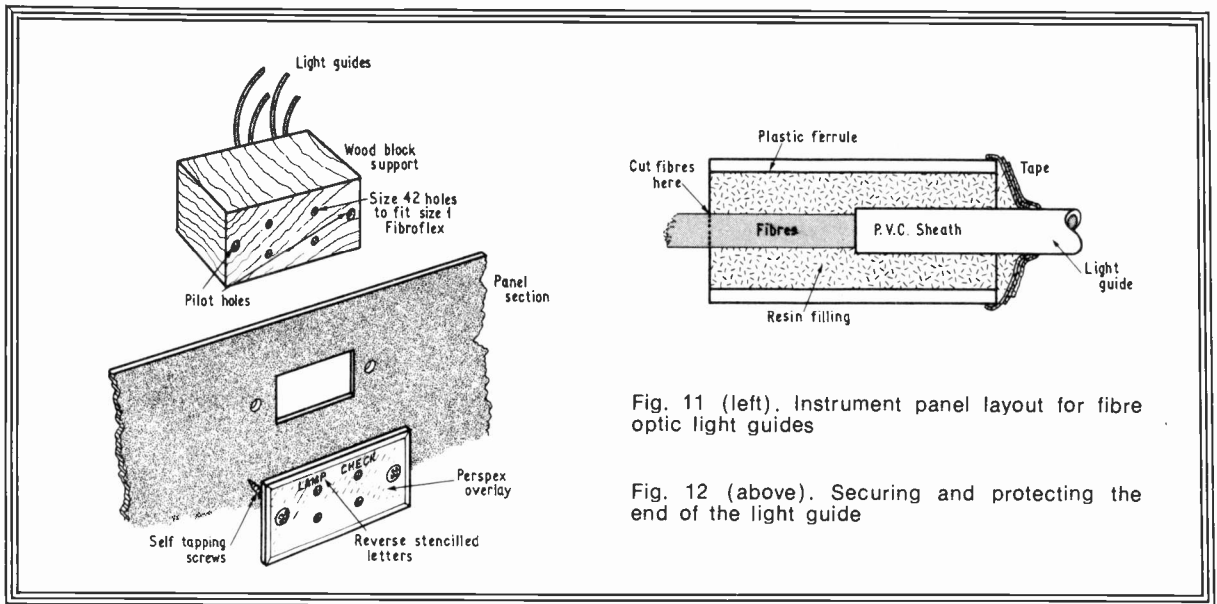


Fig. 11 (left). Instrument panel layout for fibre optic light guides

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

INSTRUMENT FACIA

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

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

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

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

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

INSTALLATION

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

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

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

SUPPLIERS

Crofon Type 1610 64 filament sheathed plastics guide 0.13in. diameter, 35p per foot (as shown in photograph)
Single fibre Type 0010 unshathed £1.50 per 25 metre reel.

Henry's Radio Ltd, 309 Edgware Road, London W.2.
64 filament plastics guide, 0.13in diameter, approx 42½p per foot (305mm) (minimum length supplied 2ft)

Proops Brothers Ltd., The Hyde Industrial Estate, Edgware Road, Hendon, London NW9 6JS.

Fibroflex, size 1, multistrand, 1.1mm, approx 25p per foot (305mm) (minimum length supplied 8ft)

The Emprise Company, 59 St Christopher Road, Colchester, Essex, CO4 4NF.



POINTS ARISING

LIE DETECTOR (January 72)

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

I.C. DIGITAL DICE (December 71)

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



E.240 20 watt 240 volts soldering iron fitted with 1/4" iron coated bit. Spare bits 3/32", 1/8" and 3/16" available. Can also be supplied for 220 and 110 volts. Price **£1.80**.

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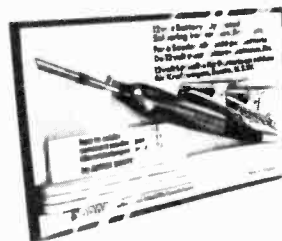
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SK. 2 SOLDERING KIT

This kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, Heat Sink, 1 amp fuse and booklet "How to Solder"

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MES. 12

A battery operated 12 volts 25 watt soldering iron complete with 15' lead, two crocodile clips for connection to car battery and a booklet "How to Solder" packed in a strong plastic wallet. Price **£1.95**.

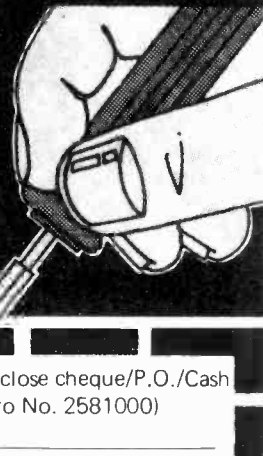


SK.1 SOLDERING KIT

The kit contains a 15 watt 240 volts soldering iron fitted with a 3/16" bit, nickel plated spare bits of 5/32" and 3/32", a reel of solder, heat sink, cleaning pad, stand and booklet "How to Solder". Also available for 220 volts.

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Crystal, hand	50p
Crystal, Inserts with bracket	20p
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Dee-Gee 25 watt pencil bit soldering irons	98p
Speakers, 2 1/2 in, 8 ohms	50p
Insulating Tape, 1/4 in wide, 10 yard rolls	5p
Miniature Output Transformers	12p
Rotary Switches, 4 pole 3 way or 2 pole 6 way	15p
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Unrepeatable Offer!!!!
Surplus VERO-BOARDS, 3 1/2" x 2 1/2" x .15"
Only 10p each or £1.00 per dozen

Electrolytic Capacitors		Miniature type. Both wires same end.	
2,000 µf 25 volt Rev.	25p	5 µf 10 volt	} 3p each.
1,000 µf 70 volt	35p	10 µf 10 volt	
10,000 µf 35 volt	50p	30 µf 10 volt	
2,000 µf 18 volt	20p	50 µf 10 volt	
60 µf + 200 µf 300 volt	30p	Axial leads.	
400 µf 275 volt	25p	250 µf 25 volt	10p
10 µf 6 volt	2p	500 µf 25 volt	13p
10 µf 25 volt	4p	1,000 µf 25 volt	18p
16 µf 250 volt	8p	2,000 µf 25 volt	25p
32 µf 275 volt	8p	400 µf 40 volt	20p

UNBEATABLE PRICE!!!!
LINEAR INTEGRATED CIRCUITS. Direct from manufacturer, all 100% to specification.

709C	35p	100 up	24p
741C	50p	100 up	35p

VEROBOARD
 2 1/2 in x 1 in x 0.15 in 6p 5 in x 3 1/2 in x 0.15 in 28p 3 1/2 in x 3 1/2 in x 0.15 in 24p
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 3 1/2 in x 3 1/2 in x 0.15 in 20p 17 in x 3 1/2 in x 0.15 in 74p 5 in x 3 1/2 in x 0.15 in 28p
 5 in x 2 1/2 in x 0.15 in 20p 3 1/2 in x 2 1/2 in x 0.15 in 21p
 Spot Face Cutter 38p. Pin Insert Tool 48p. Terminal Pins (0-1 or 0-15) 36 for 18p. Special Offer Pack consisting of 5 2 1/2 in x 1 in boards and a Spot Face Cutter—50p.

RECORD PLAYER CARTRIDGES. Well below normal prices!
 G90 Magnetic Stereo Cartridges, Diamond Needle, 6mV output, £2.75. ACOS GP 67/2 (Mono, Crystal) 75p. ACOS GP 91/3 (Compatible, Crystal) £1. ACOS GP 93/1 (Stereo, Crystal, Sapphire) £1.25. ACOS GP 93/1D (Stereo, Crystal, Diamond) £1.63. ACOS GP 94/1 (Stereo, Ceramic, Sapphire) £1.50. ACOS GP 94/1D (Stereo, Ceramic, Diamond) £1.88. ACOS GP 95/1 (Stereo, Crystal with two L.P./Stereo needles) £1.25.

TRANSISTORISED FLUORESCENT LIGHTS, 12 volt. All with reverse polarity protection. 8 watt type with reflector, suitable for tents, etc., £3. Postage/Packing 25p. 15 watt type, batten fitting for caravans £4. Postage/Packing 25p. 13 watt type, batten with switch, 2 1/2 in x 2 in x 1 in £5. Postage/Packing 25p. THESE CAN BE SENT ON APPROVAL AGAINST FULL PAYMENT.

MULLARD POLYESTER CONDENSERS
 1,000pf, 1,200pf, 1,500pf, 1,800pf, 2,200pf, 15p per dozen (all 400V working). 0.15µf, 0.22µf, 0.27µf, 30p per dozen (all 160V working). 25% discount for lots of 100 of any one type.

RESISTORS
 1/2 and 3/4 watt. Most values in stock. 75p per 100. 10p per dozen of any one value. **WIRE WOUND MAINS DROPPERS.** Hundreds of values from 0.7 ohm upwards. 1 watt to 50 watts. A large percentage of these are multi-tapped droppers for radio/television. Owing to the huge variety these can only be offered "assorted" at 50p per dozen.

SILVER MICA/CERAMIC/POLYSTYRENE CONDENSERS
 Large range in stock, 75p per 100 of any one value. 15p per dozen.

RECORDING TAPE BARGAIN! The very best British Made low-noise high-quality Tape! Sin Standard 38p. Long-play 45p, 5 1/2 in Standard 45p. Long-play 60p. 7 in Standard 60p. Long-play 82p. We are getting a fantastic number of repeat orders for this tape. Might we suggest that you order now whilst we still have a good stock at these low prices?

STOCKTAKING CLEARANCE! IMPOSSIBLE TO REPEAT!
 We have huge numbers of components in quantities too small to advertise individually. In order to "clear the decks" we have made up parcels containing a mixture of carbon and wire-wound resistors, electrolytic and paper condensers, controls, transistors, diodes etc., for a tiny fraction of normal price. It is emphasised that these are mixed parcels only—contents cannot be stipulated! Sold only by weight.
 Gross weight 2 lb. £1 (postage 20p)
 Gross weight 5 lb. £2 (postage 30p)

FANTASTIC OFFER!

4,000,000 DIODES TO CLEAR!

Germanium (OA 91 type)
 Gold Bonded Silicon (BA 144 type)
 Zener (400 mw. BZY 88 type)

300	50p	1,000	£1
10,000	£9		

OF ANY ONE TYPE

TANTALUM CAPACITORS. COMPARE THE PRICE—ONLY 10p EACH!!!!

Sub-miniature types		Miniature types		
-047µf 50 volts		-022µf 20 volts	5-6 µf 35 volts	
-056µf 50 volts		-033µf 20 volts	8-2 µf 10 volts	
-07 µf 20 volts		-047µf 20 volts	8-2 µf 35 volts	
-1 µf 20 volts		-068µf 35 volts	15 µf 35 volts	
-1 µf 50 volts		-12 µf 35 volts	18 µf 35 volts	
-18 µf 20 volts		-15 µf 35 volts	22 µf 15 volts	
-33 µf 35 volts		-22 µf 50 volts	27 µf 120 volts	
-47 µf 35 volts		-47 µf 50 volts	56 µf 15 volts	
-68 µf 20 volts		-68 µf 35 volts	56 µf 20 volts	
1-0 µf 15 volts		-68 µf 50 volts	150 µf 6 volts	
2-2 µf 3 volts		1-0 µf 35 volts		Standard
2-7 µf 15 volts		1-0 µf 75 volts	6-8 µf 50 volts	
2-7 µf 35 volts		1-8 µf 20 volts	7-5 µf 20 volts	
3-0 µf 12 volts		2-2 µf 20 volts	8-2 µf 150 volts	
10-0 µf 1.5 volts		2-7 µf 50 volts	12 µf 35 volts	
		3 µf 12 volts	12 µf 50 volts	
		3-3 µf 15 volts	39 µf 20 volts	
		4 µf 20 volts	82 µf 20 volts	
		4-7 µf 35 volts	150 µf 15 volts	
		5-6 µf 6 volts	270 µf 6 volts	

NEW! NEW! NEW! NEW!
 An aerosol spray providing a convenient means of producing any number of copies of a printed circuit both simply and quickly.
 Method: Spray copper laminate board with light sensitive spray. Cover with transparent film upon which circuit has been drawn. Expose to light. (No need to use ultra-violet.) Spray with developer, rinse and etch in normal manner. Light sensitive aerosol spray .. £1.00 plus
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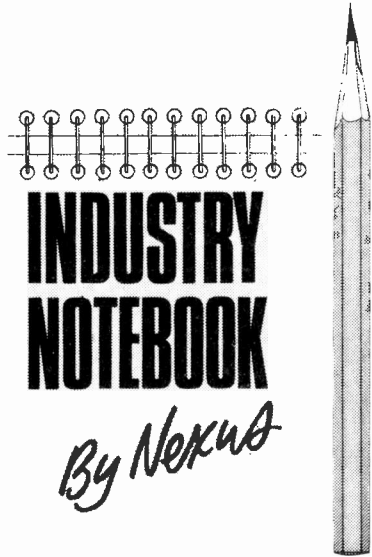
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MULLARD POLYESTER	100 50p	(1200V peak)	4 50p
COND.	50 50p	STC 3/4 Rectifiers	6 50p
SILVER MICA	100 50p	DIODES (OA 81 & OA 91)	40 50p
WIRE-WOUND 3-Watt		WIRE	
SLIDERS	15 50p	Solid Core, Insulated	100yds. 50p
VOLUME CONTROLS		Stranded ditto	50yds. 50p
Assorted	5 50p	SOLAR CELLS	
NUTS AND BOLTS. Mixed length/type		Large Selenium	2 50p
8 B.A.	100 50p	Small	3 50p
6 B.A.	100 50p	(6 cells will power a Micromat radio)	
4 B.A.	100 50p	CO-AXIAL CABLE	
2 B.A.	100 50p	Semi Air-spaced	15yds. 50p
METAL SPEAKER GRILLES		CRYSTAL TAPE RECORDER	
7 1/2 in. x 3 1/2 in.	6 50p	MIKES	1 50p
EARPIECES, MAGNETIC		CRYSTAL EARPIECES	
No Plug	6 50p	3-5mm Plug	1 50p
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VEROBOARD, TRIAL PACK	1 50p	TRANSISTORISED CAR REV. COUNTER KIT (Needs 1 ma. meter as indicator)	1 50p
5 BOARDS + CUTTER	50p		

G. F. MILWARD, Drayton Bassett, Tamworth, Staffs. Postage (minimum) per order 15p.

DRIVE IN EUROPE

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



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

AEROSPACE CONTRIBUTION

At another London conference, this time on Aerospace, Peter Hearne, joint general manager of Elliott Flight Automation, pointed out that Britain has been too lenient in the past in not insisting on major shares of the electronics systems contracts for aircraft being built under co-operative schemes in Europe. What has happened, he said, was that design leadership of systems has gone to European

partners ill-equipped to undertake such work with the consequence that they have depended too much on licensed U.S. designs. The Americans have got in, as it were, by the back door.

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

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

TRADING UPTURN

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

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

TTL PRICE WAR

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

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

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

BOOM FOR LEDs?

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

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

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

SCIENCE OF THE SEAS

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

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



PIONEER SPACECRAFT FOR JUPITER

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

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

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

THIRTEEN EXPERIMENTS

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

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

understanding of the nature of the sun and the effects of the heliosphere on Earth.

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

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

ENERGY RADIATION

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

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

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

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

INSTRUMENTATION

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

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

The rotation of the spacecraft will enable the instrument to scan narrow strips of the planet. These will be 0.3 degree wide so that a complete picture will be built up in about an hour.

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

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

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

METEOROID DETECTION

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

For meteoroid detection there are 5 sq ft of cells to register impact. A penetration 0.001in is equal to an impact of 10-9gr. There will be 216 cells in all.

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

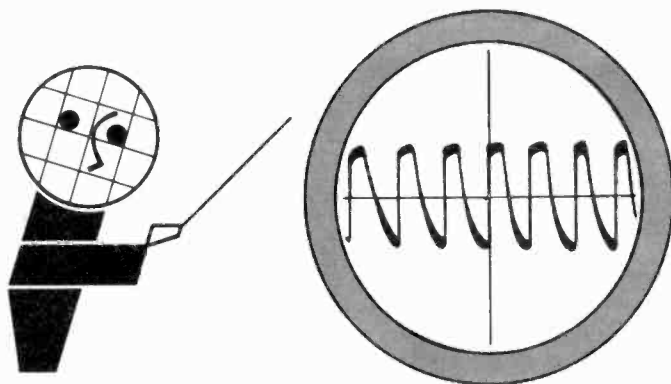
The craft will be powered by four radio-isotope thermoelectric generators producing 120 watts. These are mounted on booms that stand out from the spacecraft. The stabilisation is set at five revolutions per minute in the plane of the Earth's orbit so that the 9ft diameter aerial is always facing Earth.

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

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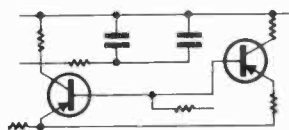
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1N3754	20p	2N3702	13p	40412	67p	AU139	33p	BC214L	16p	BYX38-	300-	OC25	42p
1N5199	21p	2N3703	13p	40430	140p	AF239	36p	BC257	9p	BYX38-	300-	OC28	70p
1N5402	28p	2N3704	13p	40432	185p	AL102	77p	BC258	8p	BYX38-	300R	OC29	76p
1N5407	45p	2N3705	13p	40512	195p	ASy26	27p	BC259	9p	300R	38p	OC35	60p
1544	9p	2N3706	13p	40602	52p	ASy27	36p	BC267	17p	C407	17p	OC36	65p
15940	5p	2N3707	13p	40669	140p	ASy28	27p	BC268	17p	C762	19p	OC41	43p
2N696	17p	2N3708	10p	AC107	46p	ASy29	36p	BC269	17p	E1412	102p	OC42	46p
2N697	18p	2N3709	11p	AC126	20p	AU111	97p	BC300	49p	E2512	164p	OC44	42p
2N706	12p	2N3710	10p	AC127	20p	B30C250	24p	DC301	37p	EA403	10p	OC45	38p
2N930	29p	2N3711	13p	AC128	20p	B30C550/	60p	EB383	10p	EC401	18p	OC70	21p
2N1131	29p	2N3731	120p	AC141H	34p	30C	34p	BCY30	60p	EC402	17p	OC71	38p
2N1132	29p	2N3794	15p	AC141HK	37p	B1912	66p	BCY31	75p	EC405	17p	OC72	38p
2N1302	19p	2N3819	23p	AC142H	25p	B5041	72p	BCY70	18p	ER900	54p	OC75	40p
2N1303	19p	2N3820	53p	AC142HK	29p	BA102	25p	BCY71	33p	MC140	25p	OC81	25p
2N1304	26p	2N3904	35p	AC153K	22p	BA130	22p	CCY72	15p	MJ481	120p	OC81D	25p
2N1305	26p	2N3906	35p	AC176	16p	BA145	27p	BD121	105p	MJ491	135p	OC83	25p
2N1306	33p	2N4036	55p	AC176K	17p	BA155	15p	BD123	105p	MJ371	108p	OC84	25p
2N1307	33p	2N4058	13p	AC187K	17p	BA156	13p	BD124	100p	MJ521	92p	P346A	26p
2N1308	36p	2N4059	10p	AC188K	23p	BAX13	13p	BD130	50p	MJ255	165p	SD1	10p
2N1309	36p	2N4060	11p	*AC187K/	40p	BB103/8	16p	BD131	79p	MJ5305	SC141D	SD1	10p
2N1596	102p	2N4061	11p	188H	40p	BB103	16p	BD132	86p	MPF102	37p	SC146D	247p
2N1599	122p	2N4062	12p	ACY17	31p	BC107	12p	BD135	38p	MP56531	35p	SD1	10p
2N1613	23p	2N4124	18p	ACY18	19p	BC108	11p	BD136	44p	MP56534	30p	SD4	12p
2N1711	26p	2N4126	27p	ACY19	23p	BC109	12p	BD141	227p	NKT211	25p	V763	28p
2N1893	54p	2N4284	24p	ACY20	20p	BC122	21p	BDY20	92p	NKT212	25p	W106B1	45p
2N2147	95p	2N4286	15p	ACY21	21p	BC125	15p	BF115	23p	NKT214	23p	W106D1	83p
2N2218	34p	2N4289	15p	ACY22	21p	BC126	23p	BF167	18p	NKT214	23p	WOZ	40p
2N2218A	34p	2N4291	15p	ACY39	63p	BC140	30p	BF173	19p	NKT217	50p	WPO2	95p
2N2219	38p	2N4292	15p	ACY40	17p	BC147	10p	BF177	25p	NKT261	21p	ZTX300	14p
2N2219A	53p	2N4410	24p	ACY41	18p	BC148	9p	BF178	31p	NKT271	18p	ZTX301	16p
2N2270	62p	2N4443	111p	ACY44	31p	BC149	10p	BF194	14p	NKT774	18p	ZTX302	22p
2N2369A	19p	2N4906	305p	AD140	63p	BC153	19p	BF195	15p	NKT725	23p	ZTX303	22p
2N2483	35p	2N4915	215p	AD142	50p	BC154	20p	BF244	30p	NKT403	65p	ZTX304	27p
2N2484	42p	2N4991	62p	AD149	58p	BC157	13p	BF254	14p	NKT404	61p	ZTX330	23p
2N2646	47p	2N5062	61p	AD150	50p	BC158	11p	BF255	15p	NKT405	79p	ZTX331	27p
2N2904	38p	2N5088	38p	AD161	33p	BC159	12p	BFX18	90p	NKT603F	30p	ZTX500	18p
2N2904A	42p	2N5163	25p	AD162	36p	BC167	11p	BFX29	31p	NKT613F	30p	ZTX501	21p
2N2905	44p	2N5172	18p	*AD161/	60p	BC168	10p	BFX84	25p	NKT674F	24p	ZTX502	25p
2N2905A	47p	2N5192	125p	162	60p	BC169	11p	BFX85	32p	NKT677F	22p	ZTX503	22p
2N2924	20p	2N5195	147p	AF114	24p	BC177	14p	BFX87	29p	NKT713	30p	ZTX504	52p
2N2925	23p	2N5457	49p	AF115	24p	BC178	13p	BFX88	26p	NKT773	25p	ZTX530	37p
2N2926	11p	2N5459	49p	AF116	22p	BC179	14p	BFY50	23p	OA47	8p	ZTX531	22p
2N3053	27p	40250	71p	AF117	22p	BC182L	11p	BFY51	20p	OA90	6p		
2N3054	70p	40251	89p	AF118	82p	BC183L	10p	BFY52	23p	OA91	5p		

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CC	1/8W	5%	4.7 Ω - 470K Ω	E24	1	0.8	0.7
CC	1/4W	10%	4.7 Ω - 10M Ω	E12	1	0.8	0.7
CC	1/2W	5%	4.7 Ω - 10M Ω	E24	1.2	1	0.9
CC	1W	10%	4.7 Ω - 10M Ω	E12	2.5	2	1.9
MO	1/2W	2%	10 Ω - 1M Ω	E24	4	3.5	3
WW	1W	10% ± 1/20 Ω	0.2 Ω - 3.9 Ω	E12	7	7	6
WW	3W	5%	12 Ω - 10K Ω	E12	7	7	6
WW	7W	5%	12 Ω - 10K Ω	E12	9	9	8

Codes: C = carbon film high stability low noise
MO = metal oxide ElectroSil TR5 ultra low noise
WW = wire-wound Plessey

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

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PATENTS REVIEW...

SLEEP DRIVING ALARM

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

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

BP 1 240 618

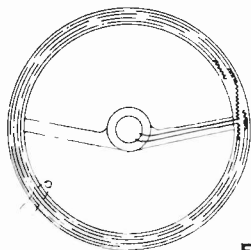


Fig. 1

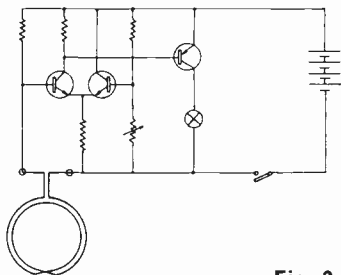


Fig. 2

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

longer shunted, and thus exhibits an increased resistance with consequential current flow drop.

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

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

BETTER CONTACTS FOR ROTARY AUTO-TRANSFORMERS

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

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

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

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

BP 1 241 274

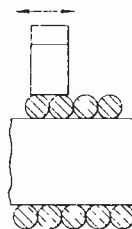
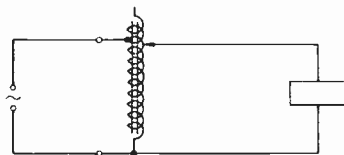


Fig. 3

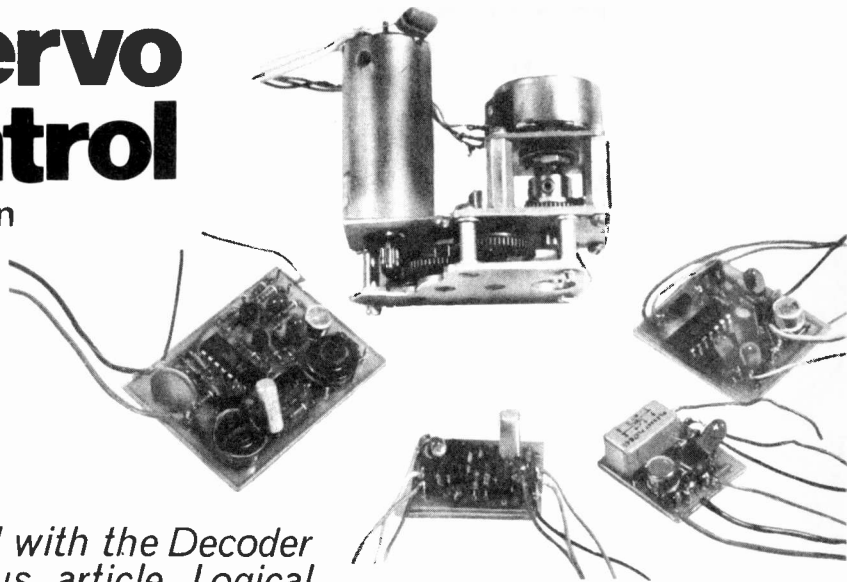
direction—the necessary directions will be obvious—and a suitable material is anisotropic graphite.

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

Model Servo Control

By A.J. Dunn

Part 1



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

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

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

TORQUE UNIT

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

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

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

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

Either mechanical end stops should be provided to prevent damage to the potentiometer or, preferably, a slipping clutch may be employed made simply

by making the final gear a slipping fit on the potentiometer spindle. The unit shown in the photograph is a heavy duty unit intended for large model boat operation: for aircraft use, the torque unit must be much lighter.

SERVO SYSTEM

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

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

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

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

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

INTEGRATING INPUT PULSES

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

Assuming that a response time associated with 10 pulses is used, a mid-range signal level of approximately 0.4V could change by approximately 70 per cent in CR seconds, equal to 50 milliseconds (cycle time) × 10 (pulse cycles) or 0.5 second. The rate of change is approximately $7/10 \times 0.4V \div 10$ per cycle and the peak-to-peak value of the a.c. component Fig. 1 is approximately 0.03V 8 per cent of the signal.

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

If a slower response is satisfactory, the product of R₁ C₁ can be increased reducing the a.c. component: the percentage width of the dead zone can be reduced and the resolution increased. If good resolution is required (narrow dead zone) coupled with a fast response time, then servo amplifier circuit "B" should be used and a compromise effected between system response time and battery drain.

SERVO AMPLIFIER "A"

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

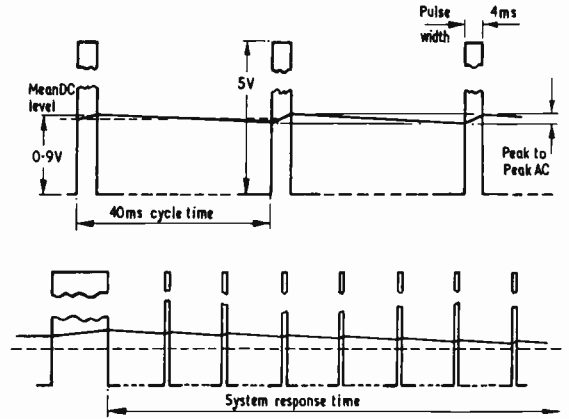


Fig. 1. The incoming pulses from the logic decoder is integrated by R1 and C1 and may look like this

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

The input signal from a decoder output is applied to point P7 and is integrated by R1 and C1 to give a d.c. range of approximately +0.05 to -0.9V with respect to 0V.

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

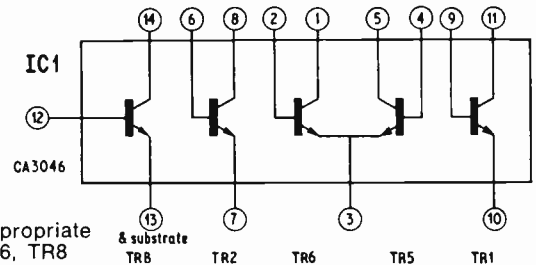
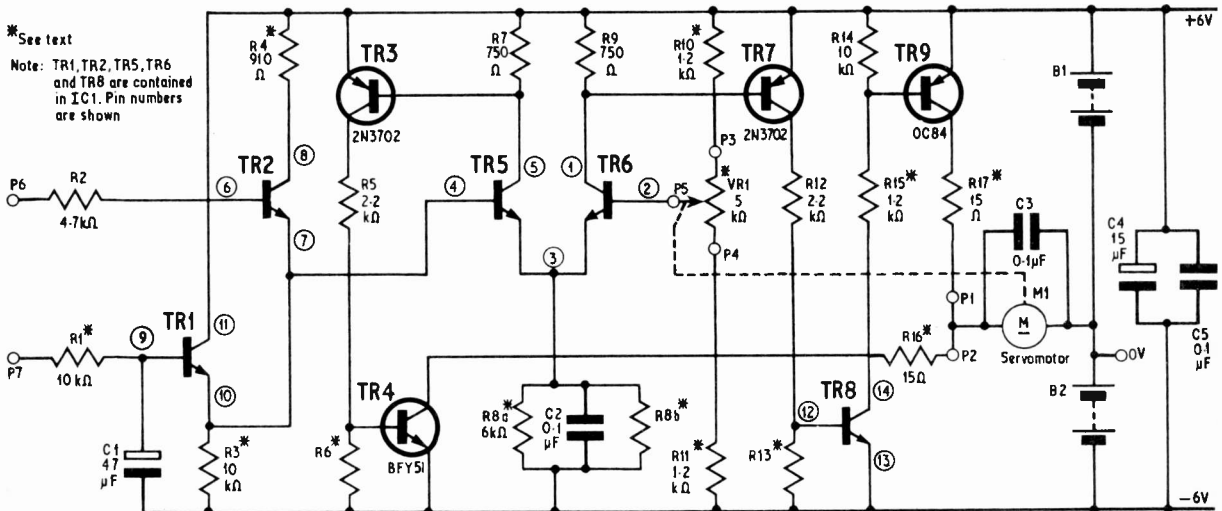
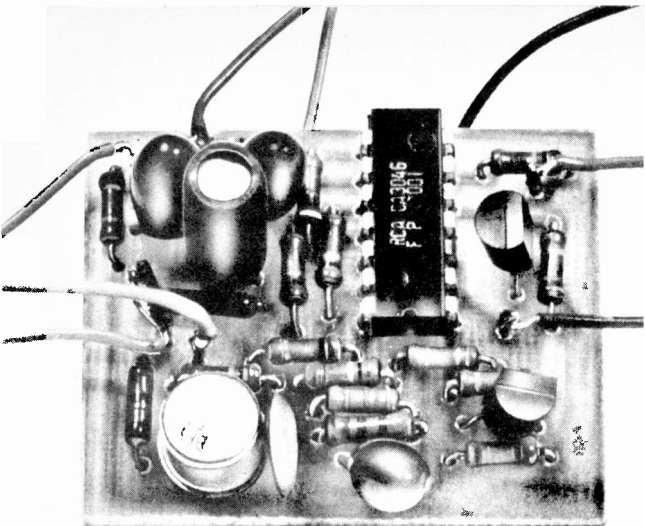


Fig. 2. The circuit diagram of servo amplifier "A" with appropriate integrated circuit pin connections (right) for TR1, TR2, TR5, TR6, TR8





Finished servo amplifier "C" board

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

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

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

REVERSE ACTION

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

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

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

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

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

COMPONENT VALUES

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

Capacitor C2 is 0.1 μ F and used to prevent h.f. oscillation; if a large value electrolytic capacitor is used, hunting of the torque unit is increased. VR1 may be of any convenient value bearing in mind that the active part of the track (according to the angle of rotation actually used) corresponds to approximately 1V and the remainder together with R10 and R11 to 11V.

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

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

which is equivalent to 1V or 330 ohms per volt; and R10 and R11 + 170 ohms or 11 \times 330 ohms or to the nearest preferred value for R10 and R11, 1.2 kilohms. In practice, R10 should be slightly larger than R11 and may be adjustable (small valued series potentiometer on torque unit) in order to centralise any mechanical control against battery or temperature variations if desired. Potentiometer VR1 should be a quality component of 500 to 5 kilohms capable of good service.

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

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

SUPPLY

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

CONSTRUCTION AND TESTING

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

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

SERVO AMPLIFIER "A"

Resistors

R1 10k Ω approx (see text)	R9 750 Ω
R2 4.7k Ω	R10 1.2k Ω approx (see text)
R3 10k Ω approx (see text)	R11 1.2k Ω approx (see text)
R4 910 Ω approx (see text)	R12 2.2k Ω
R5 2.2k Ω	R13 10k Ω
R6 10k Ω	R14 10k Ω
R7 750 Ω	R15 1.2k Ω approx (see text)
R8a 6k Ω	R16 15 Ω approx (see text)
R8b see text	R17 15 Ω approx (see text)

All $\pm 5\%$, $\frac{1}{10}$ W

Potentiometer

VR1 5k Ω linear carbon

Capacitors

C1 47 μ F tantalum (see text)
C2 0.1 μ F tantalum
C3 0.1 μ F polyester
C4 15 μ F tantalum
C5 0.1 μ F ceramic disc

Transistors and Integrated Circuit

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

Batteries

B1 and B1 6V (see text)

Miscellaneous

Fibreglass printed circuit board $1\frac{1}{2}$ in \times $1\frac{1}{2}$ in for etching
Solder pins and flexible connecting wire
Servo motor and gear train as required for model (see text)

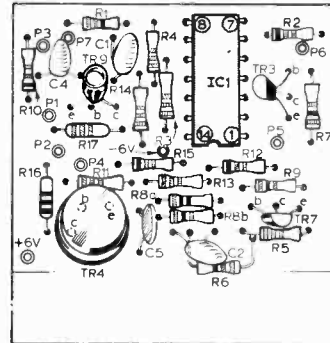


Fig. 3. Component layout on the printed circuit board of amplifier "A"

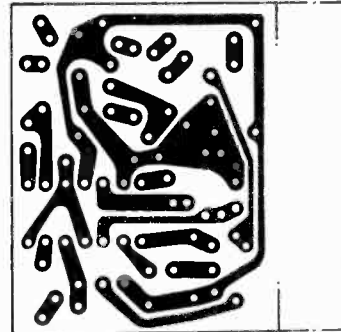


Fig. 4. Printed circuit pattern (full size) for amplifier "A"

Using any convenient potentiometers and $1\frac{1}{2}$ V dry cell, apply approximately $\frac{1}{2}$ V positive with respect to 0V to input P7 and switch on the +6V and -6V supplies. One lamp only should light and should be made to extinguish and the other lamp come on by rotating an uncoupled potentiometer for VR1. Note the approximate angle of the "dead zone"—both lamps extinguished.

Various values for R8b (approximately 6.2 kilohms) should be tried to determine the lowest safe value or the elimination point of the "dead zone".

Fit a value for R8b (approximately 8.2 kilohms) that corresponds to a dead zone of approximately 10 degrees mechanical rotation of the potentiometer and remove the test lamps. Connect the motor between 0V and points P1 and P2 as in Fig. 2, with VR1 mechanically coupled. Switch on the supplies and note whether the motor rotation stops, hunts or continues in one direction only with clutch slipping; in the latter case the motor connections are reversed.

If the motor hunts the supply current should be monitored and R16 and R17 increased in value.

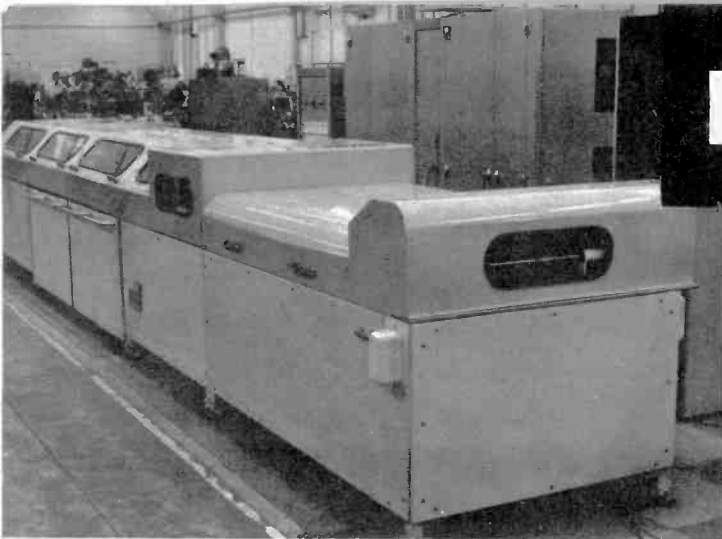
When satisfactory R8b should be reduced in value to determine the resolution possible consistent with operation over the required range of VR1 by varying the d.c. to point P7.

If the fail-safe circuit is to be used, point P7 should be connected to 0V, point P6 connected to +6V and R4 (approximately 8.2 kilohms) fitted, R3 being 10 kilohms. Tests should be made, adjusting the value of R4 until the torque unit centralises. The next test is to connect P7 to 0V and switch P6 between approximately -2V and the +6V supply, noting the time taken for the output gear to rotate to one end, then to centralise. A low leakage capacitor C1 is then fitted, such that the product of $C_1 R_1$ is greater than the value given earlier. The unit is finally tested with the decoder and coder, care being taken to connect the 0V point to the negative decoder supply.

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

ELECTRO

Computer Controlled Power

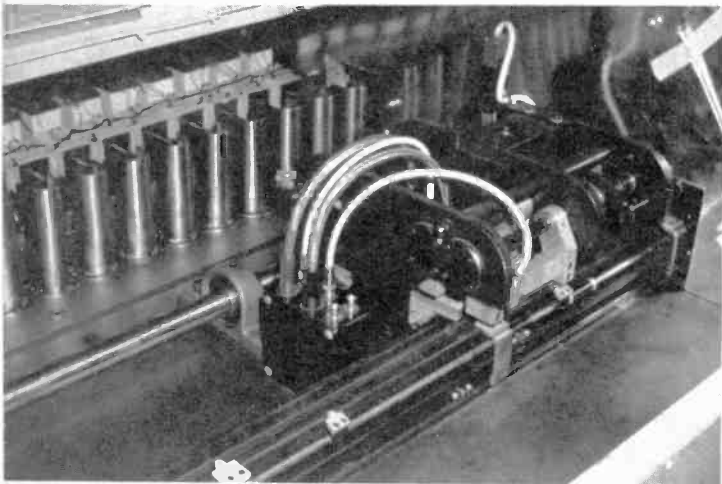


ENGINEERS at the Stockport semiconductor plant of Mullard Ltd have designed and built what is believed to be the first ever fully-automatic machine (top left) for testing and sorting power semiconductors. It handles a wide range of devices in many different out-lines. Known as "Apollo", the machine has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

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

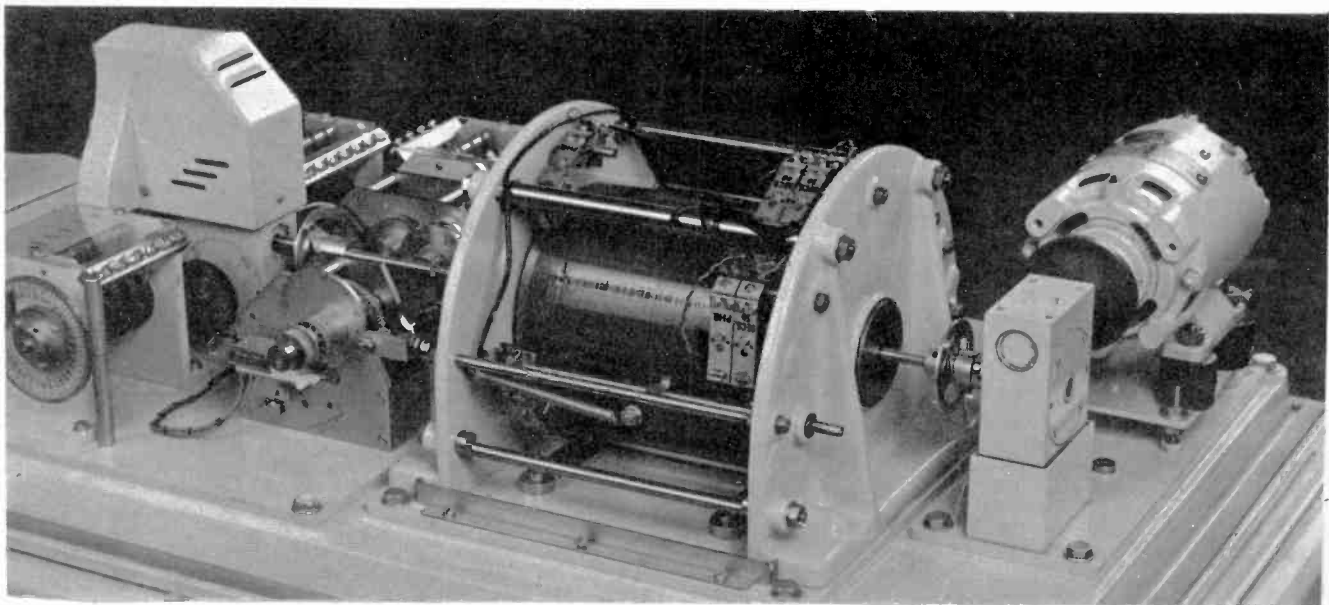
Test specifications will be compiled by the computer to generate a test control programme which will be stored on the disc file where it will be readily available for future use. The computer can calculate the yields of devices in any of the 36 categories (as requested by operator before testing commences)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

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



Post Office Speaking Clocks Due for Overhaul

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



NORAMA

Semiconductor Tester

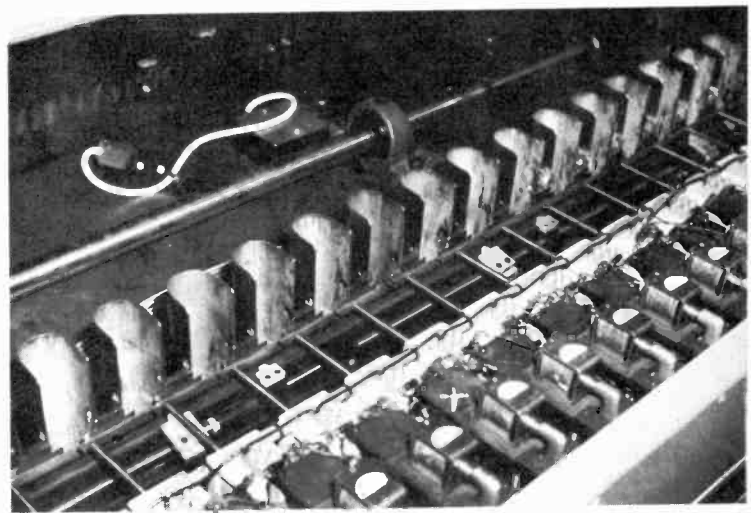
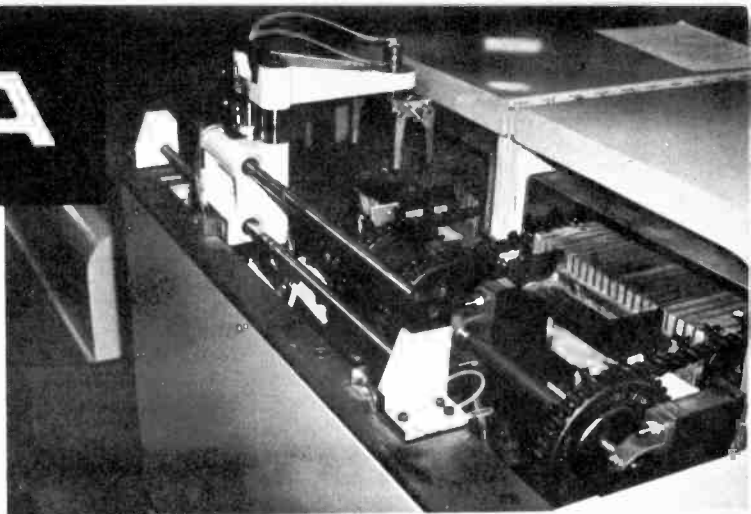
transported, in single file, past a number of measuring stations (left). At one preselected station, contact is made successively with the terminals of each device and all the scheduled tests are rapidly carried out.

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

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

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

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



AN EXCITING FUTURE

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

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

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

Imagine, if you will, an f.m. radio receiver made up with two or three i.c.s. no coils, ceramic filters the size of a transistor, and digital tuning. Or perhaps your television (in colour, of course) with a digital memory tuner, controlled by a pocket calculator style controller for programme selection and tuning, optical transmission

and reception, and flat "lineless" display using a semiconductor laser element screen and shift register sequence scanning.

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

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

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

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

the diodes is equalised. If OA47 diodes are used, then the current needs normally to be about 50mA. However, there are alternative diodes that can be used and in such cases the current may well be lower. The important parameter is that the forward resistance of the diode must be less than 5 ohms and the current that achieves this is the optimum.

INDIVIDUAL OR GROUP ACTIVITIES

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

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

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

THE SINGLE AERIAL SYSTEM

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

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

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

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

RADIO ASTRONOMY TECHNIQUES

BY F.W. HYDE · PART 9

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

HIGHER SENSITIVITY

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

Fig. 9.1a shows the circuit for a selective amplifier and phase sensitive detector. Examination of the switch generator and driver unit circuit given in Fig. 9.1b will show that the multivibrator formed by VIA, VIB feeds the grids of V4 and V5 in the phase sensitive detector shown in Fig 9.1a and at the same time energises the transistor driver unit TR1, TR2 which operates the diode switch. The transistors TR1 and TR2 can be balanced by adjustment of VR1 and VR2 so that the current through

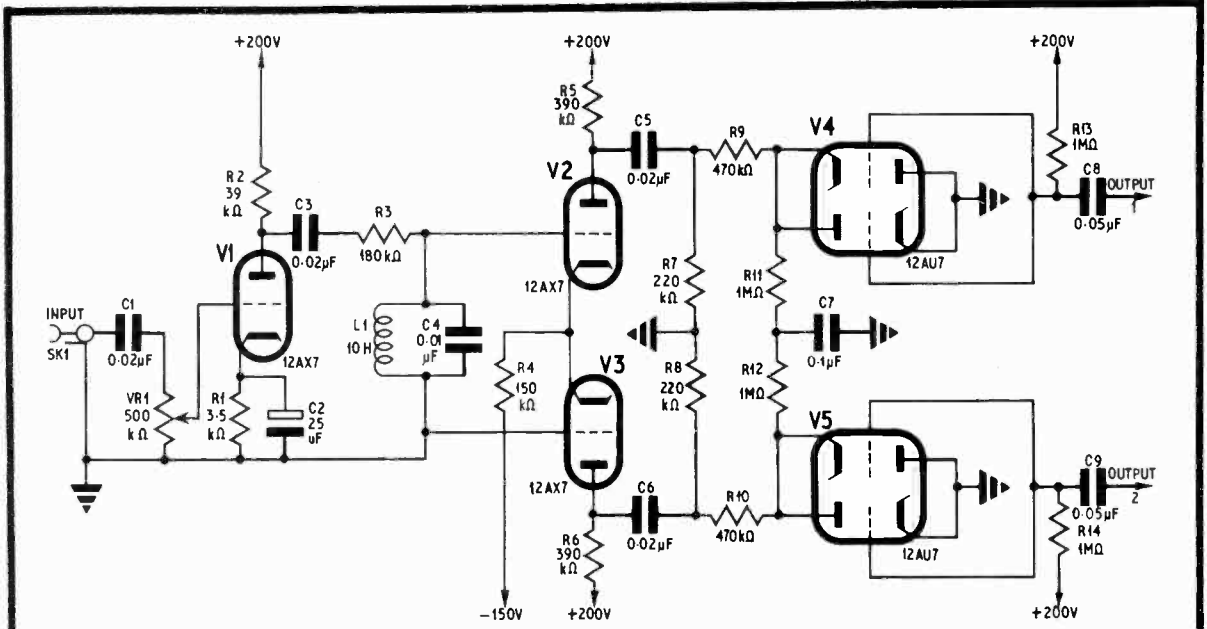


Fig. 9.1a. Circuit of the selective amplifier and phase sensitive detector

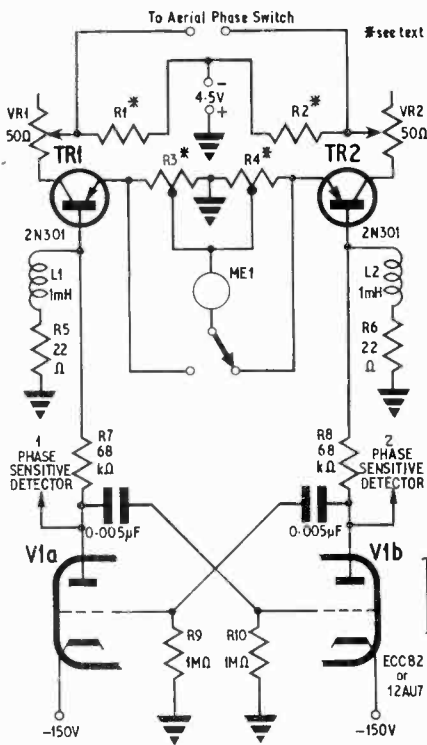


Fig. 9.1b. Circuit of the switch generator and driver unit

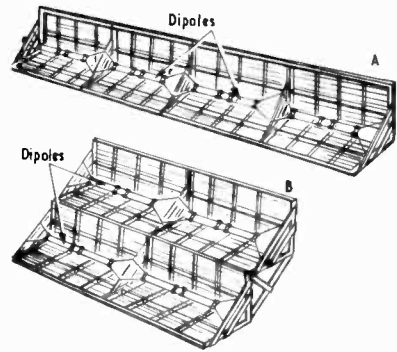


TABLE OF BEAM WIDTH		
VERTICAL	HORIZONTAL	Area of Combination
55°	14.3°	
30°	28°	

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

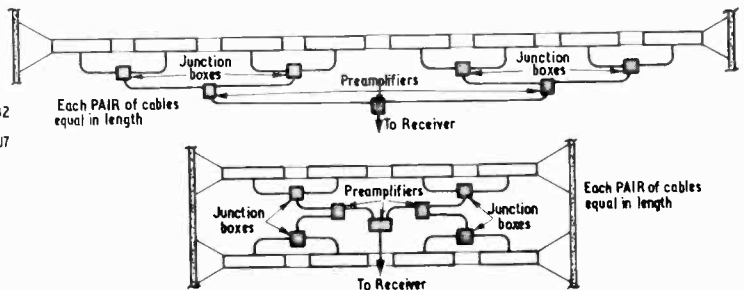


Fig. 9.3. Connections of the dipoles shown in the two arrangements in Fig. 9.2, (a) in line, (b) stacked

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

MAXIMUM LENGTH

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

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

$$\begin{aligned} \text{the width of beam at half power points} &= \\ &= \frac{\text{one wavelength}}{\text{number of wavelengths}} \times 57.3 \text{ degrees} \\ &= \frac{57.3}{4} = 14.3 \text{ degrees approx.} \end{aligned}$$

To accomplish this, eight half-wave units or four one-wavelength units are required. Since the details for a half-wave dipole unit have already been given

but it must be remembered that the more dipoles in line there are, the narrower will the width of the beam be. The beam width for each arrangement is given in the table in Fig. 9.2. The connection of the dipoles is shown in detail in Fig. 9.3.

AERIAL PRE-AMPLIFIERS

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

At the receiver end the front section would normally be tunable, but it could be advantageous to use a coupling unit which can match and tune. This is left to the individual again for it is part of the fun to do such modifications. So much for the aerials and resolution. The sensitivity of the overall system can be increased by the use of the unit given in

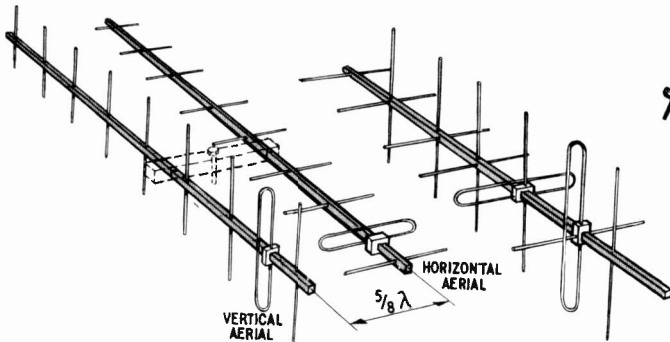


Fig. 9.4a. Separate vertical and horizontal Yagi arrays

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

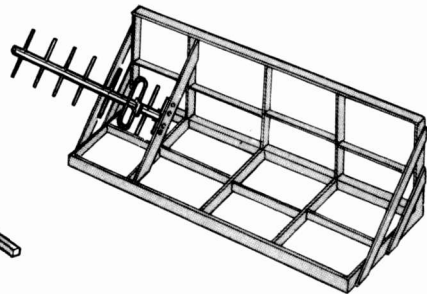


Fig. 9.4c. Combined corner reflector and Yagi array. The Yagi dipole is at right angles to the reflector dipole but in the same ground plane

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

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

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

Fig. 9.1a, with outputs 1 and 2 linked together and fed into the d.c. amplifier.

POLARISATION MEASUREMENTS

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

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

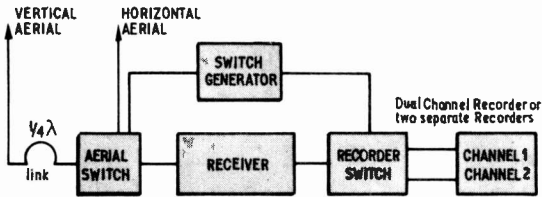


Fig. 9.5. Block diagram of set-up for polarisation measurement

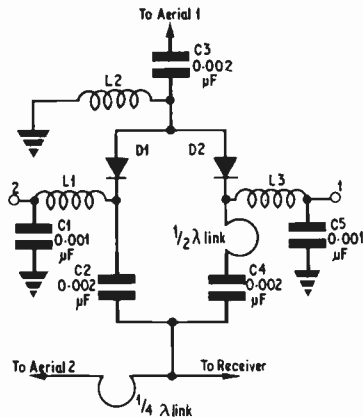


Fig. 9.6. Modified aerial switching circuit

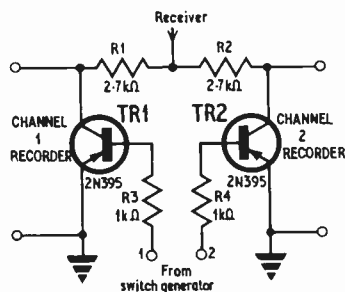


Fig. 9.7. Channel recorder switching circuit

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

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

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

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

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

RECORDER SWITCH CIRCUIT

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

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

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

HELICAL AERIALS

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

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

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

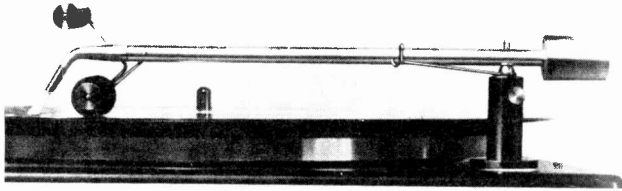
P. E. GEMINI

REPRINTS AVAILABLE

Because of the continuing interest in the "P.E. Gemini" Dual Purpose Stereo Amplifier it has been decided to reprint all articles (together with any appropriate amendments) in booklet form.

The price of this 32-page booklet is 55p, including postage. Orders for copies, with P.O. or cheque made payable to IPC Magazines Ltd., should be addressed as follows:

The Receiving Cashier (P.E. Gemini)
IPC Magazines Ltd.,
Tower House,
Southampton Street,
London, W.C.2.



Bib Groov-Kleen model 42

MARKET PLACE

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

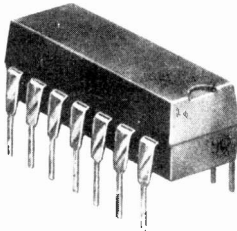
I.C. RELAY

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

For use with standard 5V 40mA drivers the D.I.P. relay is capable of switching 100V d.c. 0.25A, 10W. The contact material is high quality Rhodium and has a life of 10 to 100 million operations, depending on load conditions. The speed of operation is claimed to be 1ms and a release time of 0.5ms.

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

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



Dual-in-line relay from Keyswitch Relays

SOLDERING IRON CONTROLLER

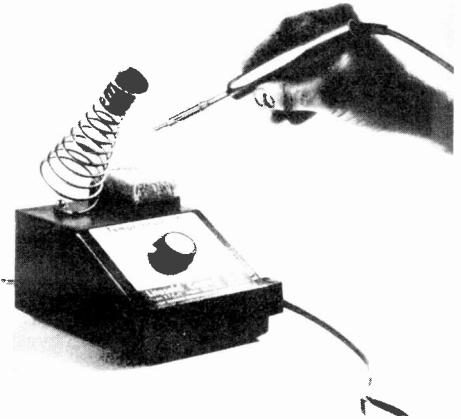
The latest product from **Light Soldering Developments Ltd** consists basically of a lightweight soldering iron fed from a solid state power control unit. The controller varies the temperature of the iron bit over a range of 150 to 400 degrees Centigrade.

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

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

RECORD CLEANER

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



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

stylus so improving reproduction and reducing record wear.

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

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

The Groov-Kleen has been designed to fit (by a self-adhesive base) practically any make of turntable or record changer, and retails at £1.99.

HI FI TIPS

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

BACK NUMBERS WANTED

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

June, July, August 1971

Mr. C. D. Grace, 22 Pixie Ridge Road, Burghfield Common, Berkshire.

December 1970, January, February, March 1971

Mr. J. A. Steven, "Andor", Skitten, Nr Wick, Caithness.

August 1971

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

September, November, December 1970, January to May 1971, November 1971

Mr. D. G. Harrington, 25 Poynter Road, Bush Hill Park, Enfield, Middlesex.

April to August 1971

Mr. P. Groome, "The Steps", Well Street, Loose, Kent.

December 1968

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

November 1965

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

June 1968

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

July, August, September 1971

Mr. P. B. Ayre, Moredun House, Carrington Road, Edinburgh, EH4 1QR.

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

January 1969

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

January, February, June, July, August, November 1968, March 1971

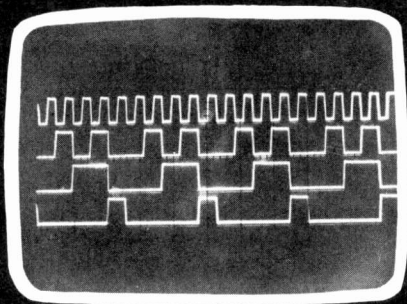
Mr. S-O Karolusson, Box 64, S-452 01 Strömstad, Sweden.

August, November 1971

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

February 1971

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



Oscilloscope beam splitter

By D. Burn Ph.D.

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

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

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

SYSTEM OPERATION

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

The whole system is controlled by a clock generator in the form of a multivibrator comprising TR1

and TR2. This runs at about 250-350Hz and its frequency can be controlled by adjusting VR1.

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

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

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

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

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

DIGITAL-TO-ANALOGUE CONVERTER

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

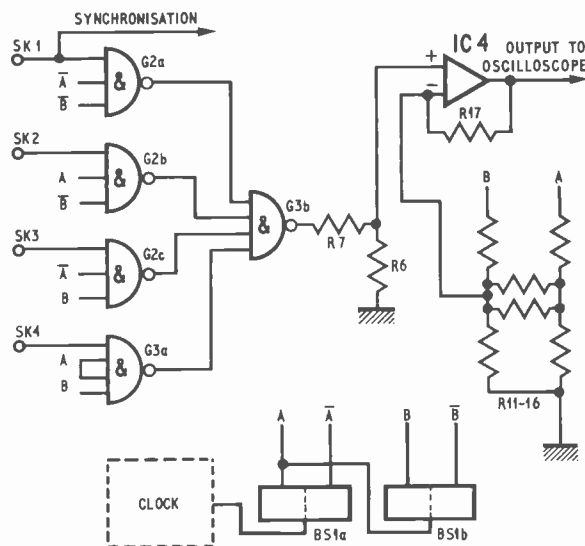
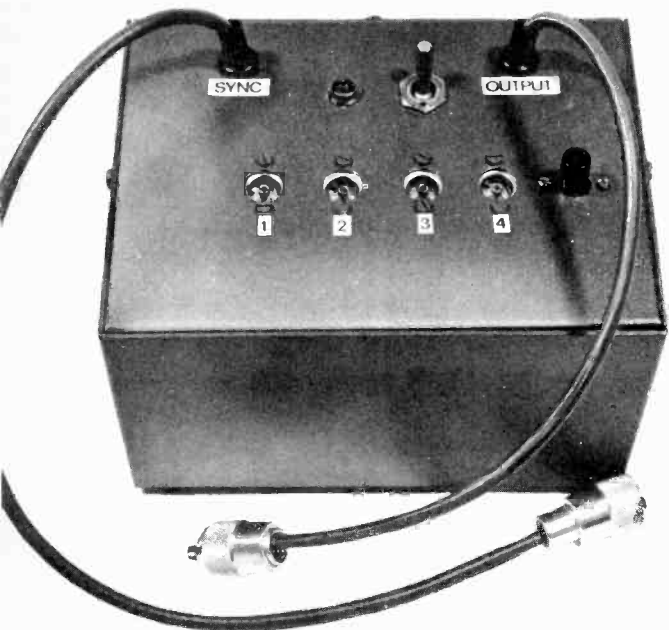


Fig. 1. Diagram of the complete system

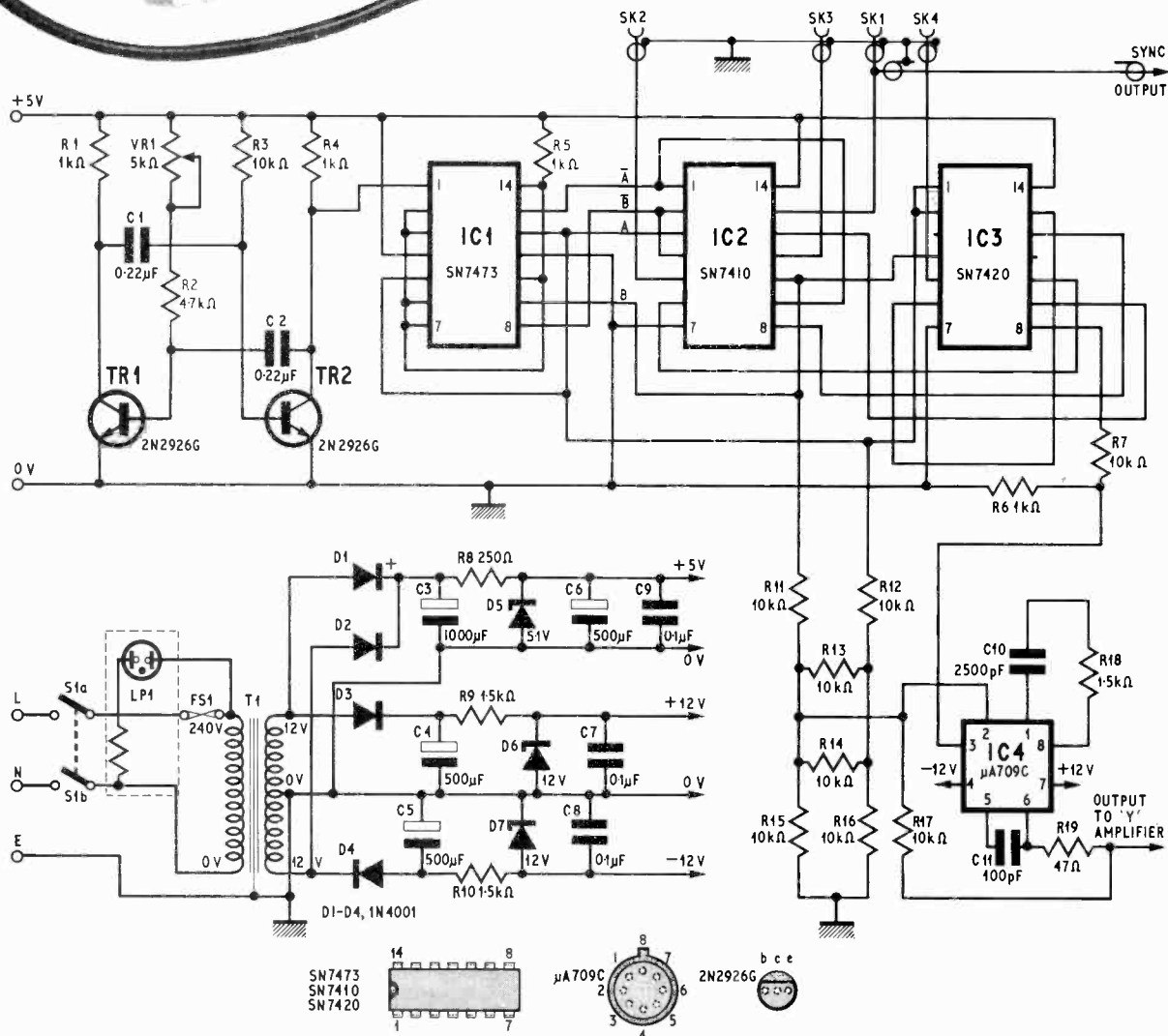


It consists simply of six 10 kilohm resistors, R11 to R16, connected between the counter "A" and "B" outputs. Its operation may be explained with the aid of Fig. 3.

The inputs to the resistor network (A and B) will be at either ground potential, or very near (logic "0"); or about +3.6 volts, the average TTL logical "1" voltage, depending upon the states of the bistables BS1a and BS1b, see Fig. 3a. Thus as the counter steps through its four possible states the inputs to the network adopt the values shown in Fig. 3b.

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

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



TOP VIEWS

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

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

SYNCHRONISATION

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

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

COMPONENTS...

Resistors

R1 1k Ω	R11 10k $\Omega \pm 5\%$
R2 4.7k Ω	R12 10k $\Omega \pm 5\%$
R3 10k Ω	R13 10k $\Omega \pm 5\%$
R4 1k Ω	R14 10k $\Omega \pm 5\%$
R5 1k Ω	R15 10k $\Omega \pm 5\%$
R6 1k Ω	R16 10k $\Omega \pm 5\%$
R7 10k Ω	R17 10k Ω
R8 250 Ω 5W	R18 1.5k Ω
R9 1.5k Ω	R19 47 Ω
R10 1.5k Ω	

All 10% $\frac{1}{4}$ W unless otherwise stated

Potentiometers

VR1 5k Ω preset

Capacitors

C1 0.22 μ F	C7 0.1 μ F
C2 0.22 μ F	C8 0.1 μ F
C3 1,000 μ F elect. 25V	C9 0.1 μ F
C4 500 μ F elect. 25V	C10 2,500 pF
C5 500 μ F elect. 25V	C11 100 pF
C6 500 μ F elect. 25V	

Integrated Circuits

- IC1 SN7473 (BP73) dual JK flip-flop
- IC2 SN7410 (BP10) triple 3-input gate
- IC3 SN7420 (BP20) dual 4-input gate
- IC4 μ A709C, BP709P or L709P (8-lead TO5)

Transistors

TR1, TR2 2N2926G or similar (2 off)

Diodes

- D1-D4 1N4001 or any 50 p.i.v. 1A diode (4 off)
- D5 5.1V 5W Zener
- D6, D7 12V 400mV Zener (2 off)

Miscellaneous

- T1 Mains transformer, 12-0-12V 1A secondary
- LP1 Mains neon with resistor
- S1 Double pole on-off mains switch
- SK1-SK4 Coaxial sockets (4 off)
- FS1 250mA fuse and fuses holder
- 6in \times 3 $\frac{1}{2}$ in 0.1in matrix s.r.b.p. board and terminal pins
- 7in \times 5in \times 4in metal case
- Coaxial cable, plugs and test probes (4 off)
- Grommets, solder tags, metal for brackets, single-core insulated wire

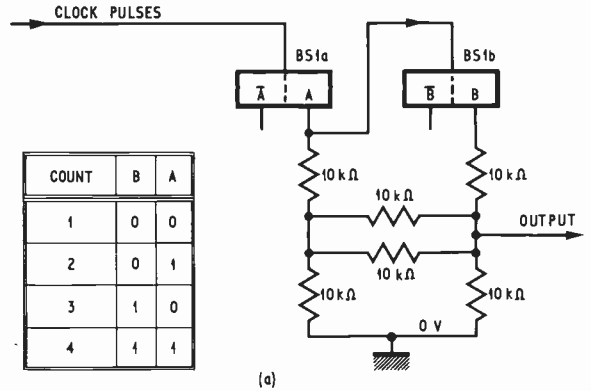


Fig. 3a. The circuit of the digital-to-analogue converter

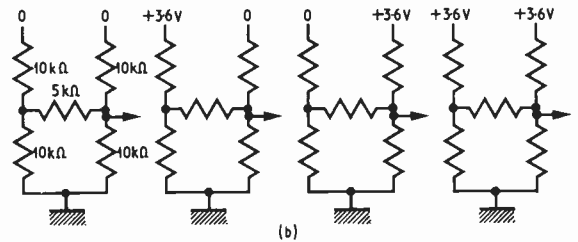


Fig. 3b. Actual voltages for different states of the counter

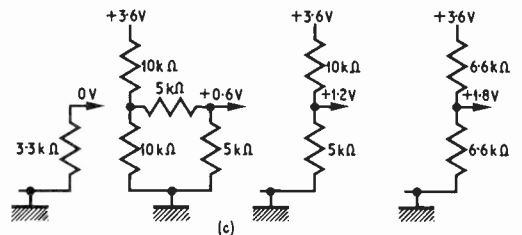


Fig. 3c. Equivalent circuits and corresponding output voltages

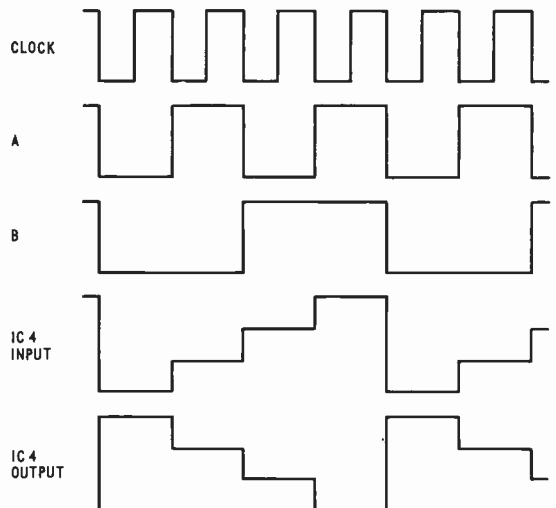


Fig. 4. Waveforms produced by the digital-to-analogue converter

BEAM SPLITTER CIRCUIT BOARD

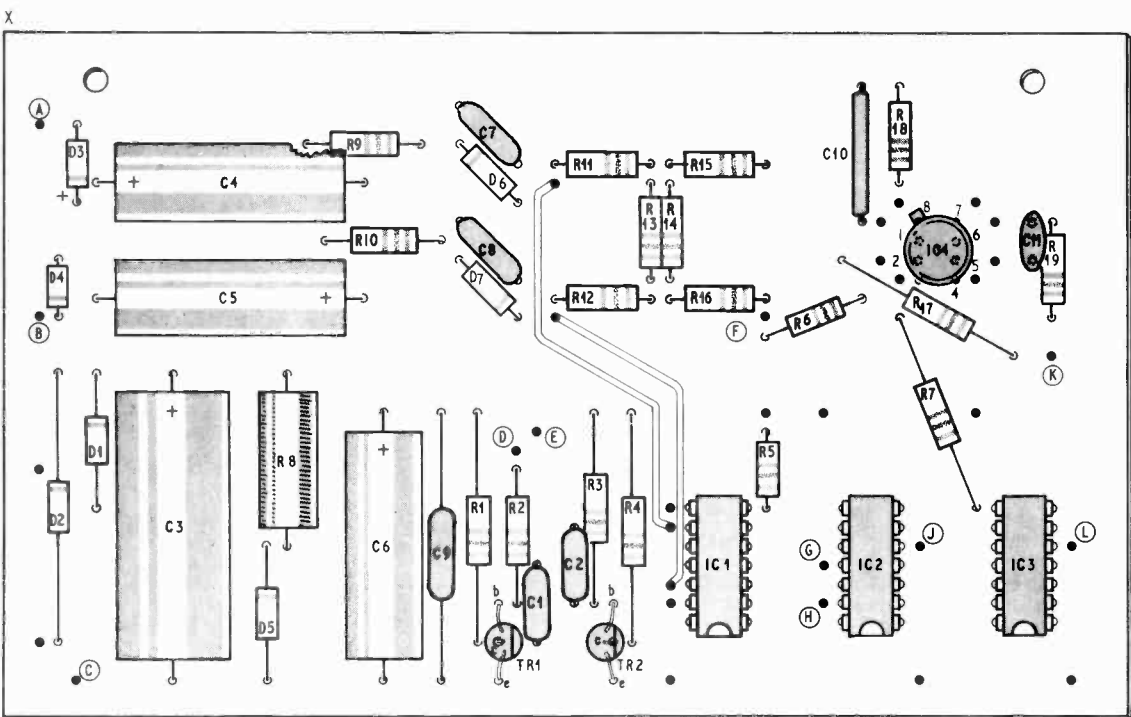
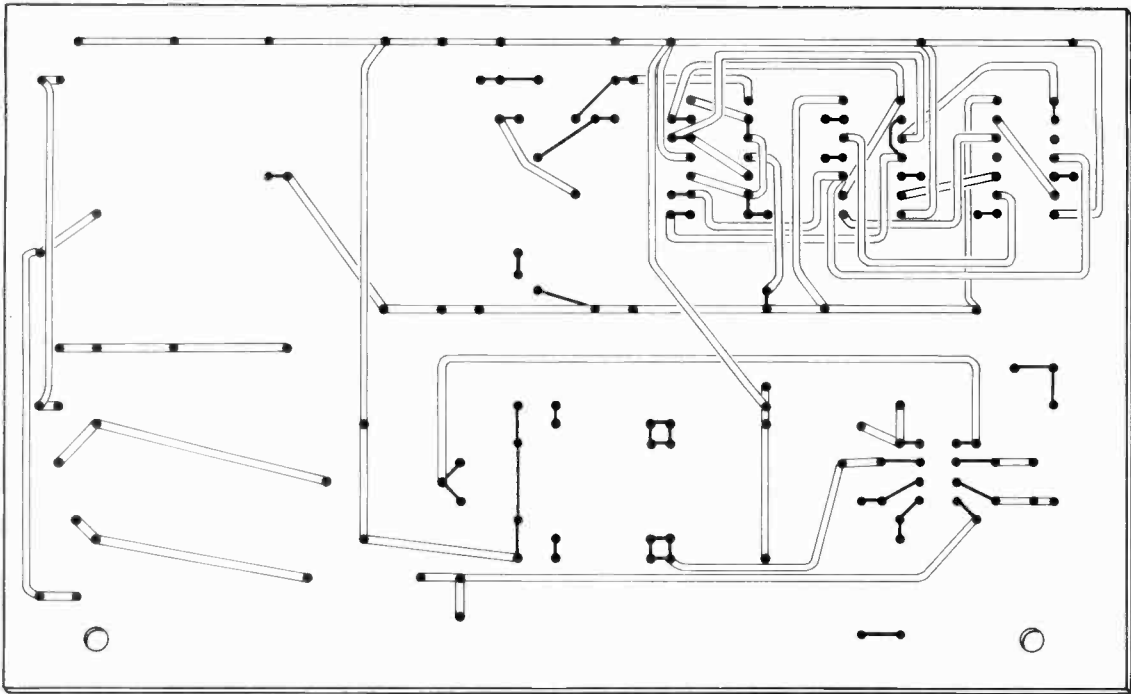


Fig. 5. Layout of the components on the perforated board

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CAPACITORS

2.2pF	500V	S/M	7½p	0.0022µF	1,000V	MDC	6p
3.3pF	500V	S/M	7½p	0.0027µF	500V	S/M	15p
5pF	500V	S/M	7½p	0.0033µF	125V	P.S.	3p
10pF	125V	P.S.	5p	0.0033µF	500V	Poly.	6p
10pF	500V	S/M	7½p	0.0033µF	1,000V	MDC	6p
15pF	125V	P.S.	5p	0.0036µF	500V	S/M	15p
15pF	500V	Cer.	5p	0.0047µF	125V	P.S.	9p
18pF	500V	S/M	7½p	0.0047µF	500V	Poly.	6p
22pF	125V	P.S.	5p	0.0047µF	500V	S/M	20p
22pF	500V	S/M	7½p	0.0047µF	1,000V	MDC	6p
25pF	500V	S/M	7½p	0.0051µF	100V	Mylar	8p
27pF	500V	Cer.	4p	0.0051µF	500V	Cer.	5p
33pF	125V	P.S.	5p	0.0068µF	125V	P.S.	10½p
33pF	500V	S/M	7½p	0.0068µF	500V	S/M	30p
39pF	500V	S/M	7½p	0.0082µF	500V	Poly.	10½p
47pF	125V	P.S.	5p	0.0082µF	125V	Poly.	30p
47pF	500V	Cer.	4p	0.01µF	12V	Disc	4p
50pF	500V	S/M	7½p	0.01µF	125V	P.S.	10½p
56pF	500V	S/M	7½p	0.01µF	160V	Poly.	4p
68pF	125V	P.S.	5p	0.01µF	250V	M.F.	3p
68pF	500V	S/M	7½p	0.01µF	400V	Poly.	3p
75pF	500V	S/M	7½p	0.01µF	500V	Cer.	3p
82pF	500V	S/M	7½p	0.01µF	500V	S/M	30p
100pF	125V	P.S.	5p	0.01µF	500V	Paper	6p
100pF	500V	S/M	7½p	0.01µF	1,000V	MDC	9p
100pF	500V	Cer.	5p	0.015µF	160V	Poly.	3p
120pF	500V	S/M	7½p	0.015µF	400V	Poly.	3p
150pF	125V	P.S.	5p	0.02µF	100V	Mylar	3p
150pF	500V	S/M	7½p	0.02µF	18V	Disc	3p
150pF	500V	Cer.	5p	0.02µF	250V	M.F.	3p
180pF	500V	S/M	7½p	0.02µF	400V	Poly.	3p
200pF	500V	S/M	7½p	0.02µF	600V	MDC	7½p
220pF	125V	P.S.	5p	0.02µF	1,000V	MDC	9p
220pF	500V	Cer.	5p	0.033µF	250V	M.F.	4p
250pF	500V	S/M	7½p	0.033µF	400V	Poly.	4p
270pF	500V	Cer.	5p	0.047µF	12V	Disc	3p
300pF	500V	S/M	8p	0.047µF	160V	Poly.	3p
330pF	125V	P.S.	5p	0.047µF	250V	M.F.	3p
330pF	500V	S/M	8p	0.047µF	400V	Poly.	4p
390pF	500V	S/M	8p	0.047µF	500V	Paper	8p
470pF	125V	P.S.	5p	0.047µF	1,000V	MDC	10p
470pF	750V	Disc	5p	0.1µF	30V	Disc	6p
500pF	500V	S/M	8p	0.1µF	250V	M.F.	6p
560pF	500V	S/M	8p	0.1µF	400V	Poly.	5p
680pF	125V	P.S.	6p	0.1µF	600V	MDC	10p
680pF	500V	S/M	8p	0.1µF	1,000V	MDC	13p
820pF	500V	S/M	8p	0.15µF	250V	M.F.	5p
0.001µF	100V	Mylar	3p	0.22µF	160V	Poly.	6p
0.001µF	125V	P.S.	3p	0.22µF	250V	M.F.	6p
0.001µF	400V	Poly.	3p	0.22µF	400V	Foil	10p
0.001µF	500V	S/M	10p	0.22µF	1,000V	MDC	15p
0.001µF	500V	Cer.	5p	0.33µF	250V	M.F.	8p
0.001µF	1,000V	MDC	6p	0.47µF	250V	M.F.	8p
0.0015µF	400V	Poly.	3p	0.47µF	400V	Foil	15p
0.0015µF	500V	S/M	10p	0.47µF	1,000V	MDC	20p
0.0015µF	500V	Cer.	5p	1.0µF	250V	M.F.	15p
0.0018µF	500V	S/M	10p				
0.002µF	100V	Mylar	3p				
0.002µF	400V	Paper	7p				
0.002µF	500V	Cer.	5p				
0.0022µF	125V	P.S.	6p				
0.0022µF	500V	S/M	10p				

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

RESISTORS

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

LOW Ω RESISTORS

2½ watt wire-wound. 1 Ω.
1.8 Ω, 2.7 Ω, 3.3 Ω, 3.9 Ω.
4.7 Ω, 5.6 Ω, 6.8 Ω, 8.2 Ω.

10p

CONTROLS, Log. or Lin.

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

FUSES

1¼in glass—2½p
60, 100, 150, 250, 500, 750mA; 1, 1.25, 1.5,
2, 2.5, 3, 5, 7.5, 10, 15 amp.

¼in glass—2½p
100, 250, 500mA; 1, 2 amp.

Anti-surge 1¼in—8p
250, 500, 750, 850mA; 1, 1.5, 2, 3 amp.

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

ELECTROLYTICS

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

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TRANSISTORS

AC127	17p	BC109	11p	BFX29	38p	5T141	23p
AC128	18p	BC147	12p	BFX84	25p	UT46	35p
AC176	22p	BC148	12p	BFX88	30p	2N696	15p
AC187	28p	BC149	12p	BFY50	21p	2N706A	12p
AC188	28p	BC157	15p	BFY51	21p	2N2926G	14p
AC189	27p	BC158	14p	BFY52	22p	2N2926Y	13p
ACV19	23p	BC159	14p	MAT100	25p	2N2926O	12p
AD149	47p	BD131	75p	MAT101	29p	2N3053	25p
AD161/162	72p	BD132	75p	MAT120	25p	2N3054	60p
ADT140	62p	BF115	25p	MAT121	29p	2N3055	72p
AF118	45p	BF178	32p	OC28	58p	2N3702	15p
AF124	22p	BF179	56p	OC35	48p	2N3703	14p
AF125	19p	BF180	30p	OC44	12p	2N3704	15p
AF126	20p	BF181	32p	OC45	12p	2N3705	14p
AF127	19p	BF184	30p	OC71	11p	2N3706	14p
AF178	67p	BF185	32p	OC72	12p	2N3706	14p
AF179	66p	BF194	14p	OC75	20p	2N3711	14p
AF180	66p	BF195	14p	OC200	27p	2N3819	35p
AF239	32p	BF196	28p	OC201	38p	2N4058	17p
BC107	11p	BF197	15p	OCPT1	60p	2N5459	60p
BC108	11p	BFV10	70p	5T140	15p		

MINIATURE ELECTROLYTICS

1µF	25V	30µF	15V
2.5µF	64V	50µF	15V
4µF	40V	100µF	15V
5µF	64V		
8µF	15V		
8µF	40V		
10µF	15V		
16µF	40V		
25µF	25V		

7p

DIODES

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

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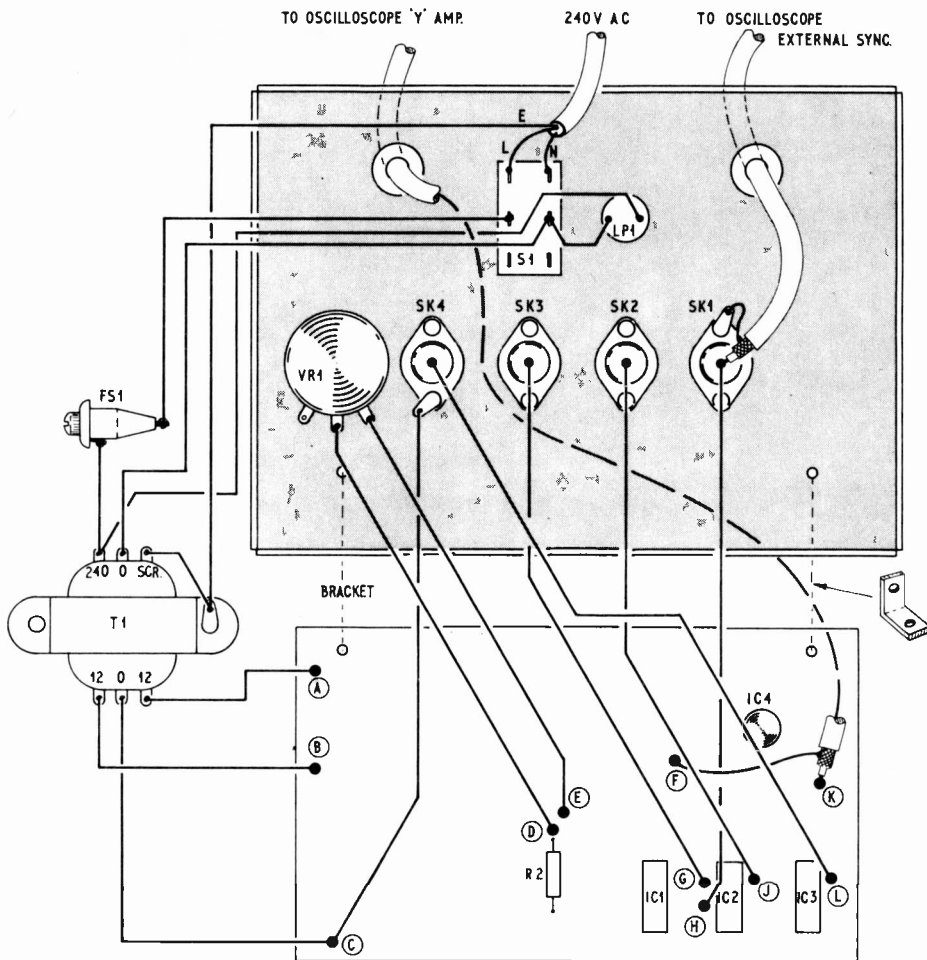


Fig. 6. Interwiring diagram of the completed unit and general layout of components on rear of the front panel. The hole for the sync lead is not necessary if a double beam oscilloscope is to be used (see text)

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

POWER SUPPLIES

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

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

CONSTRUCTION

Apart from the transformer T1, all the components are mounted on a single piece of 0.1in matrix perforated board, about 6in \times 3½in. A suitable layout, although this is not critical, is shown in Fig. 5. The components are held in place by passing their

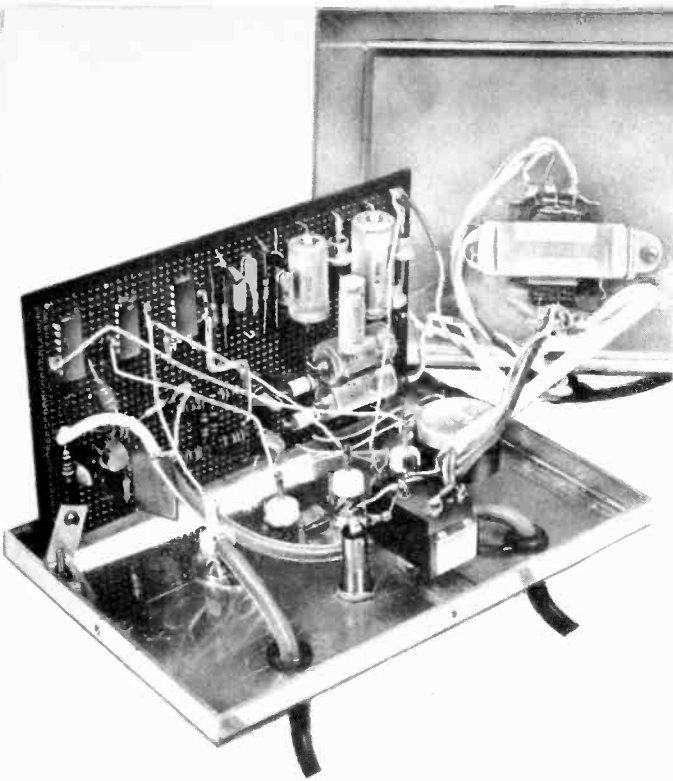
leads through conveniently placed holes, using the leads for the great majority of the wiring.

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

The eight leads of IC4 (TO5 can) are passed through the board and anchored to eight, well-spaced, terminal pins. The pin numbering for the i.c.s is shown in the main circuit diagram. The 5 watt resistor, R8, quickly warms up and is mounted about ¼ to 1in from the board to avoid heating adjacent components.

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

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



THE UNIT IN USE

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

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

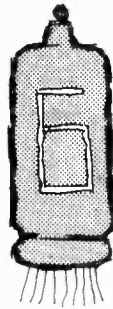
If the timebase is then allowed to free-run, i.e. without synchronisation, at a higher frequency, four equally spaced horizontal lines will be displayed, their spacing being determined by the oscilloscope Y-gain. Typical values for the prototype were 1.8 volts as the spacing between the traces and 1.4 volts as the amplitude of each trace. Thus a setting of 2V/cm will be a suitable Y-gain for most small or medium sized oscilloscope tubes.

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

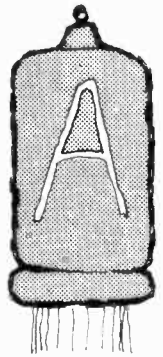
The signals to be examined are then applied to the inputs and the timebase adjusted to display a convenient number of pulses. The methods of obtaining the necessary synchronisation have already been described. With the oscilloscope timebase set to below 1ms/cm flicker becomes annoying. Thus only waveforms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

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

MARCH



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**PRACTICAL
ELECTRONICS**

ON SALE FRIDAY FEBRUARY 11

Photo-Print Process Control Unit

By A. WOODROW

PART TWO

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

COMPONENT BOARD

The construction of the control unit is quite straightforward. The majority of the components are mounted on a $5\text{in} \times 3\frac{1}{2}\text{in}$ Veroboard panel, the remainder being mounted directly onto the case.

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

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

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

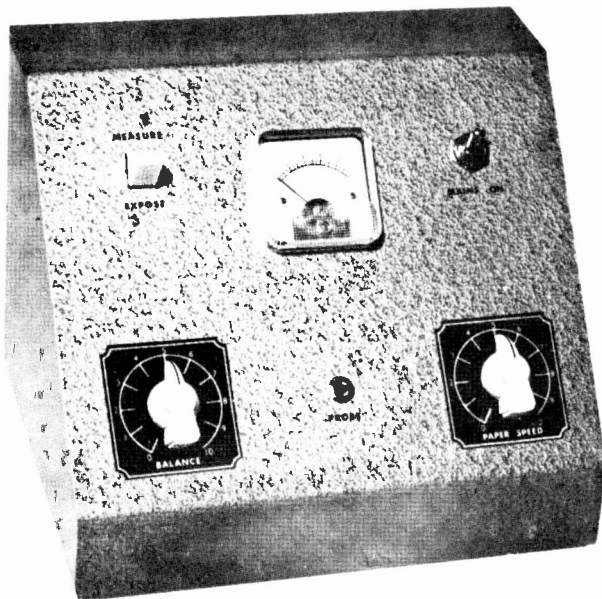
MOUNTING OF COMPONENTS

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

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

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

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



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

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

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

THE PROBE

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

The lead, with a 3.5mm jack plug on one end, is connected at the other end to the l.d.r. This lead should not be too stiff, as it may pull the probe out of position from the enlarger baseboard; audio screened lead is suitable. Extra weight may be added to the probe head, so that it will stay where it is placed on the baseboard. A few pieces of Plasticine

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07	20	1 11	7 × 6 × 6.5	1.40	30
61	100	5 12	10.2 × 8.9 × 8.3	2.28	52
62	250	12 4	9.5 × 12.7 × 11.4	5.05	67
63	500	27 0	17.1 × 11.4 × 15.9	9.74	*
92	1000	40 0	17.8 × 17.1 × 21.6	17.94	*
128	2000	63 0	24.1 × 21.6 × 15.2	29.66	*
129	3000	84 0	21.6 × 21.6 × 20.3	46.38	*
190	6000	178 0	31.1 × 35.6 × 17.1	76.11	*

AUTO SERIES (NOT ISOLATED)

Ref. No.	VA (Watts)	Weight lb oz	Size cm.	Auto Taps	£	P & P
113	20	1 11	7.3 × 4.3 × 4.4	0-115-210-240	0.74	20
64	75	1 14	7.0 × 6.4 × 6.0	0-115-210-240	1.44	30
4	150	3 0	8.9 × 6.4 × 7.6	0-115-200-220-240	1.74	36
66	300	6 0	10.2 × 10.2 × 9.5	"	3.38	52
67	500	12 8	14.0 × 10.2 × 11.4	"	5.03	67
84	1000	16 0	11.4 × 14.0 × 14.0	"	9.12	82
93	1500	28 9	13.5 × 14.9 × 16.5	"	13.22	*
95	2000	40 0	17.8 × 16.5 × 21.6	"	17.26	*
73	3000	45 8	17.4 × 18.1 × 21.3	"	23.47	*

TOTALLY ENCLOSED 115V AUTO TRANSFORMER
115V 500 Watt totally enclosed auto transformer, complete with mains lead and two 115V outlet sockets, £6.85. P & P 67np.

LOW VOLTAGE SERIES (ISOLATED)

PRIMARY 200-500 VOLTS 12 AND/OR 24 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Windings	£	P & P	
111	0.5	0.25	12	7.6 × 5.7 × 4.4	0-12V at 0.25A × 2	0.74	22
213	1.0	0.5	1	8.3 × 5.1 × 5.1	0-12V at 0.5A × 2	0.88	22
71	2	1	1	7.0 × 6.4 × 5.7	0-12V at 1A × 2	1.16	22
18	4	2	1	8.3 × 7.0 × 7.0	0-12V at 2A × 2	1.62	36
70	6	3	2	12.0 × 7.6 × 8.6	0-12V at 3A × 2	1.95	42
72	10	5	6	3 7.9 × 10.8 × 10.2	0-12V at 5A × 2	2.56	52
17	16	8	7	8 12.1 × 9.5 × 10.2	0-12V at 8A × 2	3.95	52
115	20	10	11	13 12.1 × 11.4 × 10.2	0-12V at 10A × 2	5.03	67
187	30	15	16	12 13.3 × 12.1 × 12.1	0-12V at 15A × 2	9.28	82
226	60	30	34	0 17.0 × 14.5 × 12.5	0-12V at 30A × 2	17.05	*

30 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P	
112	0.5	1	4	8.3 × 3.7 × 4.9	0-12-15-20-24-30V	0.88	22
79	1.0	2	0	7.0 × 6.4 × 6.0	"	1.18	36
3	2.0	3	2	8.9 × 7.0 × 7.6	"	1.75	36
20	3.0	4	6	10.2 × 8.9 × 8.6	"	2.16	42
21	4.0	6	0	10.2 × 10.0 × 8.6	"	2.56	52
51	5.0	6	8	12.1 × 10.0 × 8.6	"	3.18	52
17	6.0	7	8	12.1 × 10.0 × 10.2	"	3.79	52
89	10.0	12	2	14.0 × 10.2 × 11.4	"	6.21	67

50 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P	
102	0.5	1	1	7.0 × 7.0 × 5.7	0-19-25-33-40-50V	1.16	30
103	1.0	2	10	8.3 × 7.3 × 7.0	"	1.69	36
104	2.0	5	0	10.2 × 8.9 × 8.6	"	2.34	42
105	3.0	6	0	10.2 × 10.2 × 8.3	"	3.18	52
106	4.0	9	4	12.1 × 11.4 × 10.2	"	4.20	52
107	6.0	12	4	12.1 × 11.1 × 13.3	"	6.21	67
118	8.0	18	9	13.3 × 13.3 × 12.1	"	8.10	97
119	10.0	19	12	16.5 × 11.4 × 15.9	"	10.15	97

60 VOLT RANGE

Ref. No.	Amps.	Weight lb oz	Size cm.	Secondary Taps	£	P & P	
124	0.5	2	4	8.3 × 9.5 × 6.7	0-24-30-40-48-60V	1.18	36
126	1.0	3	0	8.9 × 7.6 × 6.0	"	1.64	36
127	2.0	5	6	10.2 × 8.9 × 8.6	"	2.56	42
125	3.0	8	0	11.9 × 9.5 × 10.0	"	3.90	52
123	4.0	10	6	11.4 × 9.5 × 11.4	"	5.03	67
120	6.0	16	12	13.3 × 12.1 × 12.1	"	7.28	82
122	10.0	23	2	16.5 × 12.7 × 16.5	"	12.05	*

*Carriage via B.R.S.

LEAD ACID BATTERY CHARGER TYPES

PRIMARY 200-250 VOLT

FOR CHARGING 6 OR 12 VOLT BATTERIES

Ref. No.	Amps.	Weight lb oz	Size cm.	£	P & P
45	1.5	1 9	7.0 × 6.0 × 6.0	1.17	30
5	4.0	3 11	10.2 × 7.0 × 8.3	1.77	42
86	6.0	5 12	10.2 × 8.9 × 8.3	2.67	52
146	8.0	6 4	8.9 × 10.2 × 10.2	3.04	52
50	12.5	11 14	13.3 × 10.8 × 12.1	4.52	67

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

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Ready made tested. 2-stage with triode pentode valve, 3 watts output. Tone and volume controls. Isolated mains transformer. Knobs, loudspeaker, valves ECL82, EZ30/81. Response **£4** Post 25p. 50-12,000 cps. Sensitivity 200mV.

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Comprising a fine example of a Woofer 10" 6in. 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 3in. 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

RAW Ferrite Aerial... Spare Cores... Driver Trans... Printed Circuit, PCAI... J.B. Tuning Gang... Weyrad Booklet... OPTI... Mullard Ferrite Rod

VOLUME CONTROLS

80ohm Coax 4p yd. BRITISH AERIALITE AERIAL-AIR SPACED 40 yd. £1-40; 6 yd. £2. FRINGE LOW LOSS 10p yd. Edge 5K. S.P. Transistor 25p. £1-625 and colour yd

VEROBOARD 0-15 MATRIX

2 1/2 x 5in. 29p; 2 1/2 x 3in. 38p; 3 1/2 x 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 2 1/2in wide 3p per lin., 3 1/2in wide 4p per lin.; 5in. wide 5p per lin. (up to 17in.). S.R.B.P. undrilled 1/4in. Board 10 x 8in. 15p.

BLANK ALUMINIUM CHASSIS

18 s.w.t. 2 1/2in. sides 6 x 4in. 45p; 8 x 6in. 53p; 10 x 7in. 85p; 12 x 8in. 85p; 14 x 9in. 90p; 16 x 6in. 90p; 12 x 3in. 50p. ALUMINIUM PANELS 18 s.w.t. 6 x 4in. 9p; 8 x 6in. 15p; 14 x 3in. 18p; 10 x 7in. 19p; 12 x 5in. 20p; 12 x 8in. 28p; 16 x 6in. 28p; 14 x 9in. 34p; 12 x 12in. 40p.

1 1/2inch DIAMETER WAVELENGTH SWITCHES

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

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

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8/450V	14p	1000/25V	35p	80+100/350V	58p
16/450V	15p	1000/50V	47p	32+32/250V	18p
32/450V	20p	8+8/450V	20p	32+32/450V	35p
2/25V	10p	16/450V	20p	350+50/25V	50p
50/50V	10p	16+16/450V	25p	32+32+32/350V	48p
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 5p; 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, 2-2-500pF 8p; 500-2.200pF 10p; 2.700-5.800pF 20p; 6.800pF-0.01, mid 30p each. TWIN GANG. "0-0" 800pF+178pF, 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. CHEMIE TELESCOPE AERIALS 23in. Swivel base 20p. TURNING Solid dielectric, 500pF, 35p each. TRIMMERS. Compression 30, 50, 70pF, 5p; 100pF, 150pF, 8p; 250pF, 10p; 600pF, 750pF, 10p; 1250pF, 10p. SILICON REC. 40- LUCAS 2D5500 Bridge 70v. 5 amp £1. RECTIFIERS CONTACT COOLED half wave 60mA 38p; 55mA 48p. SILICON BYZIS 30p; BY1300p; BY127 30p. Full wave Bridge Rectifier 500mA, 150mA 98p. EX-GOVT. RECTIFIERS 250V 200mA 30p. NEON PANEL INDICATORS 250V AC/DC Red or Amber 20p. RESISTORS, 1/2 w.; 1 w.; 2 w.; 2 1/2 w.; 5 w.; 10 w.; 10 to 10M. HIGH STABILITY, 1 w.; 2 w.; 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; 2 1/2 watt, 1 ohm to 8.2 ohms 10p.

SCOOP! METAL PLINTH AND PLASTIC COVER

Cut out ready for Garrard or B.S.R. Will play with cover in position. Latest design. Covered in black leatherette. Antimagnetic. **£5.50** Post 25p

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. 2 a. 6.3 v. 1 a. or 5 v. 2 a.	£2
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MINIATURE 200 v. 20 mA, 6.3 v. 1 a. 2 1/2 x 2 1/2 in.	75p
MIDGET 220 v. 45 mA, 6.3 v. 2 a. 2 1/2 x 2 1/2 in.	90p
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AUTO TRANSFORMERS. 115v to 230v or 230v to 115v. Input/Output, 150w., £2; 500w., £5; 1000w., £12	
CHARGE TRANSFORMERS. Input 200/250v. Output for 8 or 12v., 1 amp; £1-20; 2 amp £1-50; 4 amp, £2	
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With twin tweeters. £4
And crossover, 10 watt. £4
State 3 or 8 ohm. As illustrated. Post 15p
With flared tweeter cone and ceramic magnet, 10 watt. Bass res. 45-80 cps. Flux 10,000 gauss. £2-25
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Recommended Teak Cabinet Size 16 10 9in. Post 25p. £5

LOW MINI-MODULE LOUSPEAKER KIT

Triple speaker system combining on ready cut baffle, 1 in. chipboard 15 in. 8 1/2 in. Separate Bass, Middle and Treble loudspeakers and crossover condenser. The heavy duty 5 in. Bass Woofer unit has a low resonance cone. The Mid-Range unit is specially designed to add drive to the middle register and the tweeter recreates the top end of the musical spectrum. Total response 20-15,000 cps. Full instructions for 30 15 ohm. TEAK VENEERED BOOKSHELF ENCLOSURE. 16x10x9in. Modern design, with Fluted Wood Front. Highly recommended. **£5** Post 25p

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Module kit, 30-17,000 c.p.s. with tweeter, crossover, baffle and instructions. **£11-50**

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Group 25'	Group 35'	Group 50'
12 inch 12 watt	12 inch 35 watt	15 inch 50 watt
3 or 8 or 15 ohm	3 or 8 or 15 ohm	3 or 8 or 15 ohm

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Fluted wood front. For 12in. dia. speaker 20 x 13 x 9in. £8 Post 25p
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LOUDSPEAKER CABINET WIDENING 18in. wide, 15p ft


GOODMANS HI-FI 6 1/2in. WOOFER

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



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The moving coil diaphragm gives a good radiation pattern to the highest frequencies and a smooth extension of total response from 1,000 cps to 18,000 cps. Size 3 1/2 x 3 1/2 in. deep. Rating 10 watt, 3 ohm or 15 ohm models. **£1-90** Post 10p



Horn Tweeters 2-16Kcs, 10W 8 ohm or 15 ohm £1-50. De Luxe Horn Tweeters 2-18 Kcs, 15W, 8 ohm 23p. TWO-WAY 3,000 c.p.s. CROSSOVERS 3 or 8 or 15 ohm 95p. SPECIAL OFFER! 80 ohm, 2 1/2 in. dia.; 35 ohm, 2 1/2 in. 25 ohm, 2 1/2 in. dia.; 3 in. dia.; 8 in.; 8 in. £1 EACH 15 ohm, 3 1/2 in. dia.; 7 1/2 in.; 8 in. TYPE 8 ohm, 3 x 4 in.; 8 ohm, 2 1/2 in. 3 in. 5 in. 5 in. 7 1/2 in. 4 in. LOUSPEAKERS P.M. 3 OHMS, 6 in. £1-10; 8 x 5 in. £1-25; 8 x 2 1/2 in. 60p; 8 in. £1-75; 10 x 6 in. £1-90. 5in. WOOFER 3 w. max. 20-10,000 cps. 8 or 15 ohm £1-80. ELAC 10in. 10w. Twin Cone. De Luxe Ceramic 8 ohm 24p. RICHARD ALLAN TWIN CONE LOUSPEAKERS 8in. dia. 4 watt; 10in. dia. 5 watt; 12 in. dia. 6 watt, 8 ohm, 3 or 15 ohm models £1-95 each. Post 15p. OUTPUT TRANS. EL84, etc. 25p. MIKE TRANS. 50:1 25p. SPEAKER COVERING MATERIALS. Samples Large S.A.E. GOODMANS OUTPUT TRANSFORMER 5 watt push pull for valves EL84, etc., 3, 8 and 15 ohms 85p. Post 20p.

BAKER 100 WATT ALL PURPOSE POWER AMPLIFIER

4 inputs speech and music. Mixing facilities. Response 10-30,000 cps. Matches all loudspeakers. A.C. 200/250V. Separate Treble and Bass controls. Guaranteed. Details S.A.E. **£39** Post 25p



ALL EAGLE PRODUCTS

BARGAIN AM TUNER. Medium Wave. Transistor Superhet. Ferrite aerial. 9 volt. **£4**
BARGAIN 4 CHANNEL TRANSISTOR MONO MIXER. Add musical highlights and sound effects to recordings. Will mix Microphone, records, tape and tuner with separate controls into single output. 9 volt. Stereo version of above. **£4-25**
BARGAIN FM TUNER 88-108 Mc/s Six Transistor. 9 volt. Printed Circuit. Calibrated slide dial tuning. Walnut Cabinet. Size 7 1/2 x 5 x 4 inch **£10**
BARGAIN FM TUNER as above. **£7-50** Chassis only, less cabinet.
BARGAIN 3 WATT AMPLIFIER. 4 Transistor Push-Pull Ready built, with volume control. 9v. **£3-50**
COAXIAL PLUG 8p. PANEL SOCKETS 6p. LINE 18p. OUTLET BOXES. SURFACE FLUSH 25p. BALANCED TWIN FEEDERS 5p. 80 ohms or 300 ohms. JACK SOCKET Std. open-circuit 14p. closed circuit 23p. Chrome Lead Socket 45p. Phone Plug 5p. Phone Socket 5p. JACK PLUGS Std. Chrome 15p; 3-5mm Chrome 14p. DIN SOCKETS Chassis 3-pin 10p; 5-pin 10p. DIN SOCKETS Lead 3-pin 18p; 5-pin 15p. DIN PLUGS 3-pin 15p; 5-pin 25p. VALVE HOLDERS, 8p; CERAMIC 5p; CANS 5p.
E.M.I. TAPE MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 135mA Spindle 0.187"-0.75in. Size 3 x 1 1/2" 2 1/2 x 2 1/2 in. (illustrated). Post 15p. **£1-25**
BALFOUR GRAM. MOTORS. 120v. or 240v. AC. 1,200 r.p.m. 4 pole 500mA. Spindle 1/2 x 3/20. Size. 2 1/2 x 2 1/2 x 1 1/2 in. Post 15p. **85p**

PHOTO-PRINT PROCESS CONTROL CIRCUIT BOARD

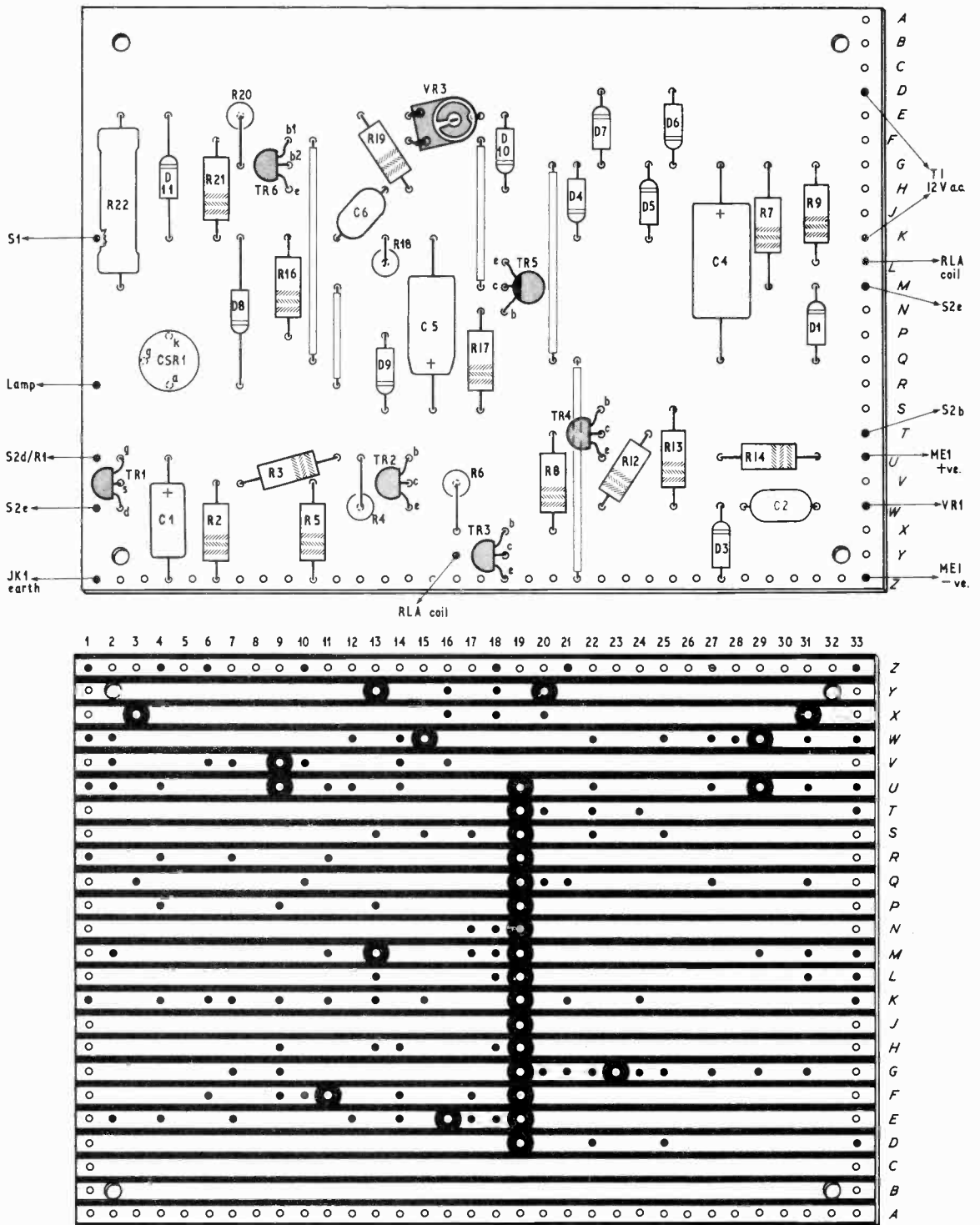


Fig. 4. Layout of components and underside of circuit board showing breaks in copper strips

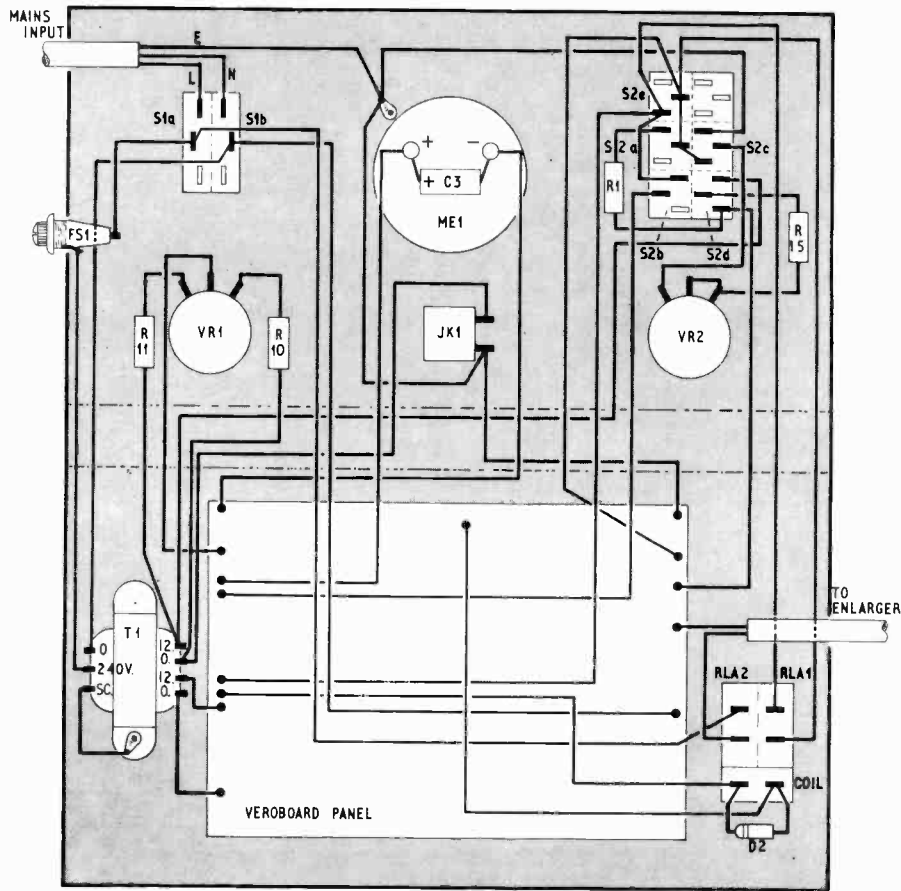


Fig. 5. Interwiring details and layout of components in case

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

THE DIFFUSER PLATE

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

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

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

be attached to one of the mounting holes of a suitable capacitor clamp, the clamp then being fitted to the lens barrel.

FILTERS

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

INITIAL CHECKS

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

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

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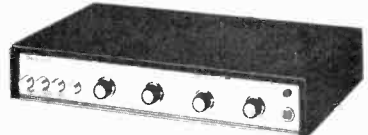
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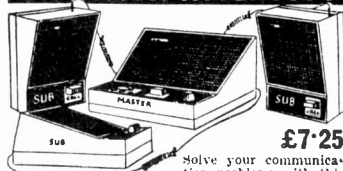
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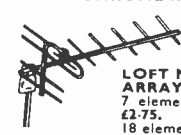
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The meter should also deflect, and an adjustment to either the balance or paper speed controls will vary the reading.

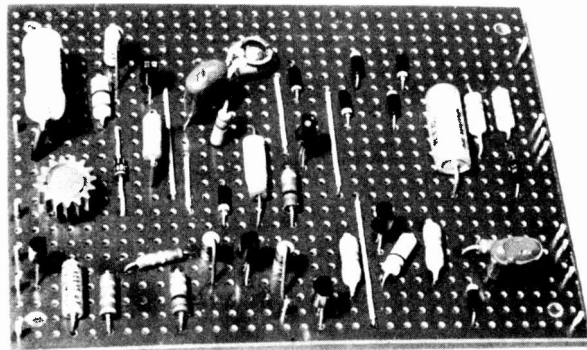
Under conditions of daylight or bright room lighting, it is unlikely that the meter can be balanced, but shading the l.d.r. from direct light should produce a minimum reading on the meter at some setting of the controls. Returning the function switch to the centre position will de-energise the relay,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

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

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

VARIATION OF MAINS VOLTAGE

The testing and setting-up of the lamp stabiliser requires the use of a variable voltage mains supply—actually, two mains voltages are needed, with a



Completed wiring board, ready for assembly into case means of switching between them. The lower voltage should be about 220–225V, the higher about 240–245V.

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

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

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

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

SETTING UP

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

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

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

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

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

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

The two readings should be identical, or very close. If necessary, readjust VR3 to obtain the smallest difference between the two readings. Referring to the scales used on the prototype, a difference of not more than 0.1 should be obtainable.

PILOT LIGHT

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

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

PRINTING MONOCHROME

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

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

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

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

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

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

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

USING OTHER NEGATIVES

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

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

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

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

PRINTING COLOUR

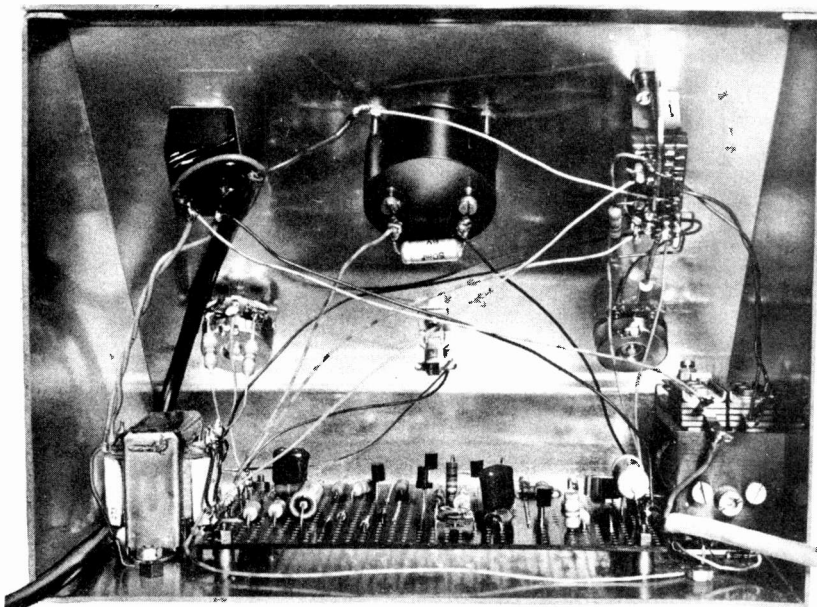
As with monochrome printing, the first step in colour work is to produce a good print by trial and error methods. The negative chosen for this print should conform to the requirements of the black and white negative; in addition, this one should have a full range of colours, with approximately equal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

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

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



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



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

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VARIABLE 0.260V

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(Panel Mounting) ½ amp, £4.75. 2.5 amp, £7.00. 2 amp, £8.05. All carriage paid.

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

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

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

6-12V D.C. MINI-MOTOR

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

MINIATURE LEVEL METER

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

VENNER Electric Time Switch

200/250V Ex. GPO. Tested. Manually set 2 on, 2 off every 24h. Override switch: 15A £3.25, 20A £3.75. P. & P. 20p. Also available with solar dial ON dusk OFF dawn. Price as above.

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

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



STROBE! STROBE! STROBE!

Build a Strobe Unit, using the latest type Xenon white light flash tube. Solid state timing and triggering circuit. 230/250V a.c. operation.
EXPERIMENTERS' ECONOMY KIT
Speed adjustable 1 to 36 Flash per sec. All electronic components including Veroboard S.C.R. Unijunction Xenon Tube and instructions £6.30, plus 25p P. & P.

NEW INDUSTRIAL KIT
Ideally suited for schools, laboratories, etc. Roller in printed circuit. New trigger coil, plastic thyristor. Speed adjustable 1-80 f.p.s. Price £10.50. P. & P. 50p.
HY-LYGT STROBE MK III
This strobe has been designed and produced for use in large rooms, halls and the photographic field and utilises a silica plug-in tube for longer life expectancy, printed circuit for easy assembly, also a special trigger coil and output capacitor. Speed adjustable 0-30 f.p.s. Light output approx. 4 joules. £12.00. P. & P. 50p. **SPECIALLY DESIGNED, FULLY VENTILATED METAL CASE.** For industrial or Hy-Light. Including reflector. £4.00 P. & P. 45p. Post paid with kit.

THE 'SUPER' HY-LYGT KIT

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

Never before a Strobe Kit with so HIGH an output at so LOW a price. **ONLY £20 plus 75p P. & P.**
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7-inch POLISHED REFLECTOR
Ideally suited for above Strobe kits. Price 53p. P. & P. 13p or post paid with kits.

INSULATION TESTERS NEW!

Test to I.E.E. Spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L. 8in. W. 4in. H. 6in. weight 6lb. 1,000V, 1,000 megohms, £34.00 carriage paid.



MOTOROLA MAC 11/6 PLASTIC TRIAC 400 PIV. 10 AMP

Now available **EX STOCK.** Supplied with full data and applications sheet. Price £1.05. P. & P. 7p. Suitable DIAC (RCA 40583) 30p each.

G.E.C. 12 WAY 15 AMP CONNECTORS

NEW in makers carton. BAKELITE £1.25 per doz. FLEXIBLE £1.50 per doz. Post paid (Minimum 1 doz).



PROGRAMME TIMERS

(Mfg. by Magnetic Devices Ltd.). 240v A.C. 5 r.p.m. 'Crouzet' motor. Drives 15 cams, each operating a 10 amp c/o micro switch. Cams are individually variable, allowing innumerable combinations. Ideally suited for machinery control automation, etc. Also in the field of entertainment, for chaser lights, animated displays, etc. **NEW PRICE £5.75. P. & P. 25p.**



D.C. AMMETERS NEW!

1A, 5A, 15A, 20A, £1.75, incl. P. & P. 0-300V a.c., £1.90, incl. P. & P.



230V A.C. SOLENOID

Extremely powerful with approx. 14lb pull, 1in travel. Fitted with mounting feet. Size: 4in long, 2½ in wide, 3in high. £2.00 incl. P. & P.



230-250 VOLT A.C. SOLENOID

Manufactured by Vestool Ltd. (similar in appearance to above illustration). Approx. 1½lb pull. Feet size 1½ in 1½ in. Price 85p incl. P. & P.

Superior Quality Precision Made NEW POWER RHEOSTATS



100 WATT. 1 ohm, 10A; 5 ohm, 4.7A; 10 ohm, 3A; 25 ohm, 2A; 50 ohm, 1.4A; 100 ohm, 1A; 250 ohm, 0.7A; 500 ohm, 0.45A; 1 kΩ, 280 mA; 1.5 kΩ, 230mA; 2.5 kΩ, 2A; 5 kΩ, 140mA. Diameter 3½ in. Shaft length ¾ in, dia. ¼ in. All at £1.50 each. P. & P. 5p.
50 WATT. 1/5/10/25/50/100/250/500/1/1/1/5/2/5/5kΩ. All at £1.12 each. P. & P. 11p.
25 WATT. 10/25/50/100/250/500/1/1/1/5/2/5/5kΩ. All at 78p each. P. & P. 15p.

RELAYS SIEMENS, PLESSEY, Etc.

MINIATURE RELAYS COMPETITIVE PRICES

Col. (1)	1	2	3	4
Coil ohms				
Col. (1)	45	6-9	2 HD M	50p
Col. (2)	185	12-18	4 c/o	73p
Working d.c. volts	280	9-12	2 c/o	73p
Col. (3)	700	16-24	4H 2B	63p
Contracts	700	12-24	2 c/o	63p
Col. (4)	700	15-35	2 c/o HD	73p
HD =	700	16-24	6M	65p
Heavy duty	1,250	24-36	4 c/o	63p
*Incl. Base	2,500	36-45	6M	63p
All post	2,400	30-48	4 c/o	50p
paid.	5,800	40-70	2 c/o	63p
	9,000	40-70	4 c/o	50p
	15k	85-110	6M	50p

12 VOLT D.C. RELAY

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



DIAMOND H' 230 VOLT A.C. RELAYS (Used)

Three sets c/o contacts rated at 5 amps. PRICE: 50p. P. & P. 10p. (100 lots £40 including P. & P.)

'KEY SWITCH' 230 VOLT A.C. RELAYS

One set c/o contacts rated at 7.5 amps. Boxed. PRICE: 40p. P. & P. 5p. (100 lots £32 including P. & P.)

UNISELECTOR SWITCHES

NEW 4 Bank 25 Way
24V d.c. operation. £5.88, P. & P. 12p.
6 Bank 25 Way
24V d.c. operation. £6.50, P. & P. 12p.
8 Bank 25 Way, 24V d.c. operation. £7.62 plus 22p. P. & P.



230 VOLT A.C. SOLENOID OPERATED FLUID VALVE

Adjustable flow control, all metal construction. Will handle hot or cold liquids, water, oil, paraffin, etc. Available with ½ in inlet/outlet or ¾ in inlet/outlet. Either type £1.50. P. & P. 20p.



LIGHT SOURCE AND PHOTO CELL MOUNTING

Precision engineered light source with adjustable lens assembly and ventilated lamp housing, to take MBC bulb. Separate photo cell mounting assembly for ORP12 or similar cell. Both units are single hole fixing. Price per pair £2.75. P. & P. 18p.



LIGHT SENSITIVE SWITCHES

Kit includes ORP.12 Photocell, Relay Transistor Circuit. For 6 or 12V D.C. operation. Price £1.50 plus 12p P. & P. ORP. 12 and Circuit 63p post paid.



'HONEYWELL' PUSH BUTTON, PANEL MOUNTING MICRO SWITCH ASSEMBLY

Each bank comprises a c/o rated at 10 amps 240V. A.C. Black knob 1in. Fixing hole ¾ in. ONE bank 30p; TWO bank 40p; THREE bank 55p; incl. P. & P.



'HONEYWELL' LEVER OPERATED MICRO SWITCH

15 amps 250 volt A.C. c/o contacts. NEW in maker's carton. PRICE: 10 for £1.90 including P. & P.



MICRO SWITCH

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



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AC128 20p	BDY38 85p	OC35 60p	2N2147 75p
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AC197 85p	BF101 80p	OC43 60p	2N2218 20p
AC198 25p	BF102 80p	OC45 15p	2N2218A 20p
AC199 25p	BF103 80p	OC70 15p	2N2219 25p
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AC21 20p	BF151 35p	OC72 30p	2N2220 25p
AC22 10p	BF152 35p	OC73 25p	2N2220A 25p
AC23 10p	BF153 35p	OC75 25p	2N2221 20p
AC24 10p	BF154 35p	OC76 25p	2N2221A 20p
AC25 10p	BF155 35p	OC77 40p	2N2221B 20p
AC26 10p	BF156 35p	OC81 20p	2N2222 20p
AC27 10p	BF157 35p	OC81D 20p	2N2222A 20p
AC28 10p	BF158 35p	OC82 40p	2N2369 15p
AC29 10p	BF159 35p	OC83 25p	2N2369A 15p
AC30 10p	BF160 35p	OC84 25p	2N2369B 15p
AC31 10p	BF161 35p	OC85 25p	2N2369C 15p
AC32 10p	BF162 35p	OC86 25p	2N2369D 15p
AC33 10p	BF163 35p	OC87 25p	2N2369E 15p
AC34 10p	BF164 35p	OC88 25p	2N2369F 15p
AC35 10p	BF165 35p	OC89 25p	2N2369G 15p
AC36 10p	BF166 35p	OC90 25p	2N2369H 15p
AC37 10p	BF167 35p	OC91 25p	2N2369I 15p
AC38 10p	BF168 35p	OC92 25p	2N2369J 15p
AC39 10p	BF169 35p	OC93 25p	2N2369K 15p
AC40 10p	BF170 35p	OC94 25p	2N2369L 15p
AC41 10p	BF171 35p	OC95 25p	2N2369M 15p
AC42 10p	BF172 35p	OC96 25p	2N2369N 15p
AC43 10p	BF173 35p	OC97 25p	2N2369O 15p
AC44 10p	BF174 35p	OC98 25p	2N2369P 15p
AC45 10p	BF175 35p	OC99 25p	2N2369Q 15p
AC46 10p	BF176 35p	OC100 25p	2N2369R 15p
AC47 10p	BF177 35p	OC101 25p	2N2369S 15p
AC48 10p	BF178 35p	OC102 25p	2N2369T 15p
AC49 10p	BF179 35p	OC103 25p	2N2369U 15p
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AC52 10p	BF182 35p	OC106 25p	2N2369X 15p
AC53 10p	BF183 35p	OC107 25p	2N2369Y 15p
AC54 10p	BF184 35p	OC108 25p	2N2369Z 15p
AC55 10p	BF185 35p	OC109 25p	2N2370 10p
AC56 10p	BF186 35p	OC110 25p	2N2370A 10p
AC57 10p	BF187 35p	OC111 25p	2N2370B 10p
AC58 10p	BF188 35p	OC112 25p	2N2370C 10p
AC59 10p	BF189 35p	OC113 25p	2N2370D 10p
AC60 10p	BF190 35p	OC114 25p	2N2370E 10p
AC61 10p	BF191 35p	OC115 25p	2N2370F 10p
AC62 10p	BF192 35p	OC116 25p	2N2370G 10p
AC63 10p	BF193 35p	OC117 25p	2N2370H 10p
AC64 10p	BF194 35p	OC118 25p	2N2370I 10p
AC65 10p	BF195 35p	OC119 25p	2N2370J 10p
AC66 10p	BF196 35p	OC120 25p	2N2370K 10p
AC67 10p	BF197 35p	OC121 25p	2N2370L 10p
AC68 10p	BF198 35p	OC122 25p	2N2370M 10p
AC69 10p	BF199 35p	OC123 25p	2N2370N 10p
AC70 10p	BF200 35p	OC124 25p	2N2370O 10p
AC71 10p	BF201 35p	OC125 25p	2N2370P 10p
AC72 10p	BF202 35p	OC126 25p	2N2370Q 10p
AC73 10p	BF203 35p	OC127 25p	2N2370R 10p
AC74 10p	BF204 35p	OC128 25p	2N2370S 10p
AC75 10p	BF205 35p	OC129 25p	2N2370T 10p
AC76 10p	BF206 35p	OC130 25p	2N2370U 10p
AC77 10p	BF207 35p	OC131 25p	2N2370V 10p
AC78 10p	BF208 35p	OC132 25p	2N2370W 10p
AC79 10p	BF209 35p	OC133 25p	2N2370X 10p
AC80 10p	BF210 35p	OC134 25p	2N2370Y 10p
AC81 10p	BF211 35p	OC135 25p	2N2370Z 10p
AC82 10p	BF212 35p	OC136 25p	2N2371 10p
AC83 10p	BF213 35p	OC137 25p	2N2372 10p
AC84 10p	BF214 35p	OC138 25p	2N2373 10p
AC85 10p	BF215 35p	OC139 25p	2N2374 10p
AC86 10p	BF216 35p	OC140 25p	2N2375 10p
AC87 10p	BF217 35p	OC141 25p	2N2376 10p
AC88 10p	BF218 35p	OC142 25p	2N2377 10p
AC89 10p	BF219 35p	OC143 25p	2N2378 10p
AC90 10p	BF220 35p	OC144 25p	2N2379 10p
AC91 10p	BF221 35p	OC145 25p	2N2380 10p
AC92 10p	BF222 35p	OC146 25p	2N2381 10p
AC93 10p	BF223 35p	OC147 25p	2N2382 10p
AC94 10p	BF224 35p	OC148 25p	2N2383 10p
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AC113 10p	BF243 35p	OC167 25p	2N2402 10p
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AC152 10p	BF282 35p	OC206 25p	2N2441 10p
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AC186 10p	BF316 35p	OC240 25p	2N2475 10p
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AC196 10p	BF326 35p	OC250 25p	2N2485 10p
AC197 10p	BF327 35p	OC251 25p	2N2486 10p
AC198 10p	BF328 35p	OC252 25p	2N2487 10p
AC199 10p	BF329 35p	OC253 25p	2N2488 10p
AC200 10p	BF330 35p	OC254 25p	2N2489 10p
AC201 10p	BF331 35p	OC255 25p	2N2490 10p
AC202 10p	BF332 35p	OC256 25p	2N2491 10p
AC203 10p	BF333 35p	OC257 25p	2N2492 10p
AC204 10p	BF334 35p	OC258 25p	2N2493 10p
AC205 10p	BF335 35p	OC259 25p	2N2494 10p
AC206 10p	BF336 35p	OC260 25p	2N2495 10p
AC207 10p	BF337 35p	OC261 25p	2N2496 10p
AC208 10p	BF338 35p	OC262 25p	2N2497 10p
AC209 10p	BF339 35p	OC263 25p	2N2498 10p
AC210 10p	BF340 35p	OC264 25p	2N2499 10p
AC211 10p	BF341 35p	OC265 25p	2N2500 10p
AC212 10p	BF342 35p		

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

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

COMPARISON WITH STANDARD

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

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

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

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

Any neutral density is subtracted from the result. The filter pack resulting from this sum is the correct one for printing the unknown negative.

The calibration for exposure is the same as for monochrome printing. The exposure time for the standard negative is set up on the control unit by adjustment to the balance control. With the filter pack used for the standard print in place, and the diffuser under the lens, adjust the paper speed control for balance.

With the unknown negative in the enlarger, and the previously determined filter pack in place, set the paper speed control to the position just found. With the diffuser plate and probe in the light beam, balance the bridge with the balance control. Remove the diffuser and probe, place a sheet of paper on the baseboard, and depress the function switch to expose the print.

A NUMERICAL EXAMPLE

Although the process may seem complicated, a numerical example may help in following it. When a few negatives have been analysed, the procedure becomes simpler.

The standard negative gives the following readings:

Red filter 0 Green filter 5.6
Blue filter 7.2 Paper speed control setting 3.7

This negative gave a successful print using a filter pack of 00 30 40 (this referring to yellow-magenta-cyan in that order), on paper with basic filters of 00 20 20.

To obtain the correct time exposure with the control unit, the paper speed setting was 5.8.

Filter pack for standard print	00 30 40
Subtract basic filter pack	00 20 20

Standard filter pack	00 10 20
----------------------	----------

Set paper speed to 3.7

The unknown negative to be printed initially gave readings of:

Red filter 0 Green filter 4.7 Blue filter 6.8

To correct the low green reading, add magenta filters.

To correct the low blue reading, add yellow filters.

With a filter pack of 00 30 10 in place, the readings obtained were identical with those of the standard negative. The print is to be made on paper having a basic filter pack 20 00 30.

The calculation is then made:

Standard filter pack	00 10 20
Correction filters	00 30 10
Basic filter pack of paper	20 00 30

New filter pack	20 40 60
-----------------	----------

Subtract neutral density	20 20 20
--------------------------	----------

Filter pack required for print	00 20 40
--------------------------------	----------

With this filter pack in place, and the paper speed control set to 5.8, the balance control is adjusted for minimum meter deflection, and the print made as normal.

When a few negatives have been treated in this way, the experience gained will make the task considerably easier for future work. It is easy to become discouraged initially, but persistence in the first few attempts will later result in considerable savings in time and materials.

L.D.R. STABILISATION

When working at low light levels, the light dependent resistor will take a short time to adjust its resistance. For this reason, whenever exposures of 30 seconds or more are needed, the cell should be given a few seconds to stabilise before readings are taken. This effect is particularly noticeable when colour negatives are being analysed.

When readings are taken through the green and blue filters, the lower sensitivity of the l.d.r. to these colours may necessitate a delay of a minute or so before the cell reaches its final resistance.

A further point to be considered when very low light levels are being measured is the position of the darkroom safelight. If the safelight is too close to the enlarger, the l.d.r. may be affected, producing incorrect readings. This effect is not too important in colour measurements, when the red, green and blue filters will reduce the cell sensitivity, but monochrome measurements may be affected. ★

Tape Noise Limiter

ALTHOUGH vast improvements in the quality of cassette recorders has taken place since their introduction in 1963, one key problem has remained, that of tape noise, increasingly apparent at decreasing tape speeds. The Dutch laboratories of Philips have now developed a circuit, which can either be a separate unit or built into new recorders, which provides hiss free replay of musical signals. They designed the circuit to be effective only during replay so that all users of cassette recorders could benefit. The system, known as the Dynamic Noise Limiter (DNL), can also be used with other sound sources such as record players or tape recorders.

CRITERIA OF DESIGN

When music is played softly it consists almost entirely of pure tones in the low and middle frequency ranges with hardly any harmonics. It is during these soft passages that tape hiss is particularly noticeable. When instruments are played loudly many harmonics are produced which mask tape hiss.

Thus the problem the designers faced was that of producing a low-pass filter which would only come into operation during passages with low amplitude, high frequency signals, i.e. when hiss is most apparent.

CIRCUIT OF THE DNL

The DNL acts as a steep low pass filter tripped by high frequency signals in such a way that high frequency signals above a certain level will bypass the filter action. The circuit diagram of the final unit is shown below.

The first stage, formed by TR1 and associated components, is a phase-splitter producing two identical signals in antiphase containing all the

elements of the music as well as tape hiss. One signal goes through an audio pass filter formed by C2 and R5 and is fed to the output via VR1.

The other signal is fed to an active high pass filter formed by TR2 and associated components. This only allows frequencies above 4 kHz to pass on to the next stage which is simply an amplifier formed by TR3 and TR4. The gain of this stage is limited by diodes D1 and D2. The amplified high frequency signal is then fed to a signal dependent attenuator formed by D3 to D6 and C8 and C9.

The overall effect is that when high amplitude, high frequency signals are present large attenuation takes place, whilst low amplitude signals are hardly affected.

The "processed" and "unprocessed" signals are then combined at the junction of C10 and C11. Because they are in antiphase the "processed" signal is in fact subtracted from the "unprocessed". Thus tape hiss is amplified and subtracted from the original signal, whilst high amplitude, high frequency signals are attenuated by the processor so subtraction leaves the original virtually unaltered.

PERFORMANCE

The designers claim that the result is a more pure clean sound with all the noise in the soft passages suppressed. The louder passages retain all their brilliance and character. Unweighted measurements show that the DNL provides a signal to noise ratio improvement of more than 10dB at 6kHz and 20dB at 10kHz.

The Philips DNL will be available as an accessory suitable for all existing cassette recorders. In late 1972 there will also be available a stereo cassette recorder and deck with a switchable DNL facility built-in as part of the unit. ★

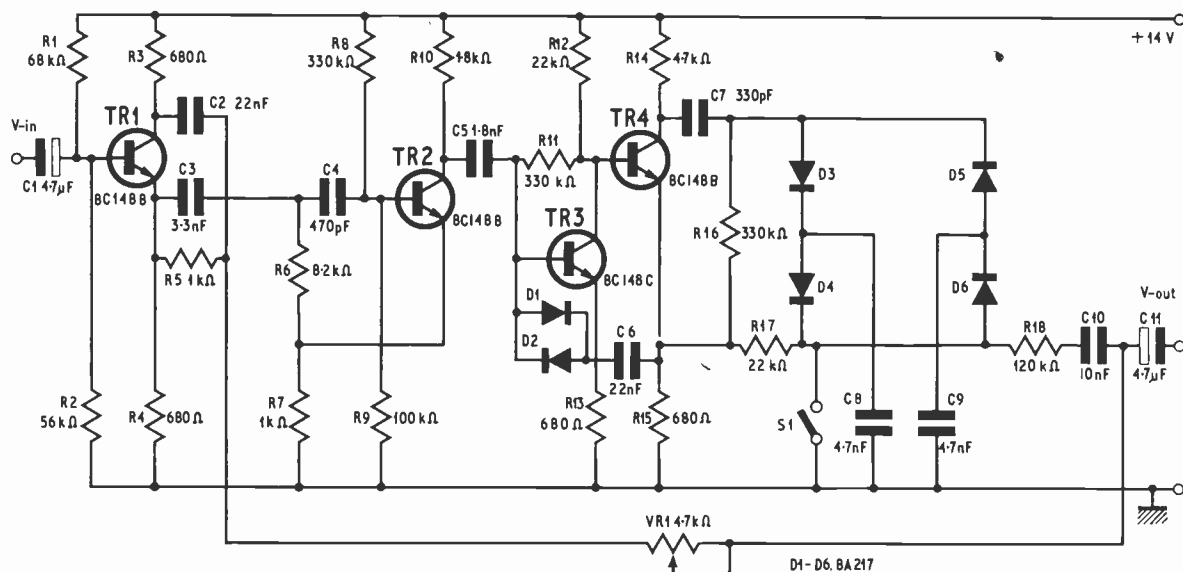
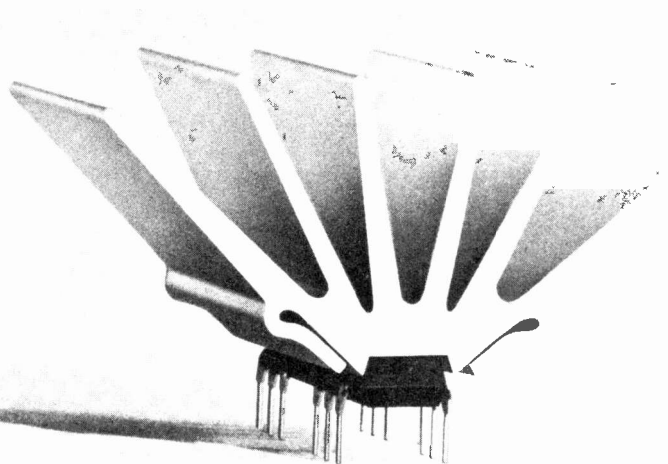


Fig. 1. Circuit diagram of the Philips dynamic noise limiter

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 \pm 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.

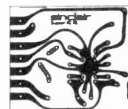
Supply Voltage 6 to 28 volts (Sinclair PZ-5 or PZ-6 power supplies ideal).

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

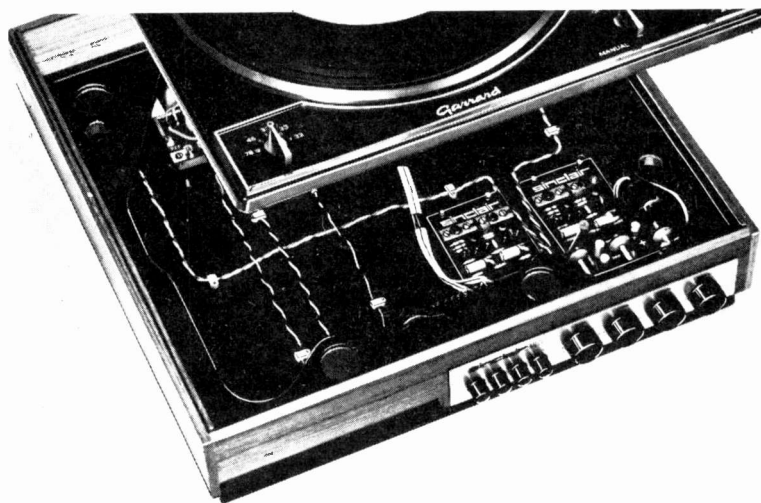
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Project 605

The easy way to buy and build Project 60

Sinclair Project 605 Amplifier



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Project 605 is one pack containing . one PZ.5, two Z30's, one Stereo 60 and one Masterlink. This new module contains all the input sockets and output components needed together with all necessary leads cut to length and fitted with neat little clips to plug straight on to the modules. Thus all soldering and hunting for the odd part is eliminated. You will be able to add further Project 60 modules as they become available adapted to the Project 605 method of connecting.

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All you need for a superb 30 watt high fidelity stereo amplifier.

Sinclair Radionics Limited, London Road, St. Ives, Huntingdonshire PE17 4HJ. Tel. St. Ives (048 06) 4311

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Project 60 offers more advantage to the constructor and user of high fidelity equipment than any other system in the world.

Performance characteristics are so good they hold their own with any other available system irrespective of price or size.

Project 60 modules are more versatile – using them you can have anything from a simple record player or car radio amplifier to a sophisticated and powerful stereo tuner-amplifier. Either power amplifier can be used in a wide variety of applications as well as high fidelity. The Stereo 60 pre-amplifier control unit may also be used with any other power amplifier system, as can the AFU filter unit. The stereo FM tuner operates on the unique phase lock loop principle to provide the best ever standards of sensitivity and audio quality. Project 60 modules are very easily connected together by following the 48 page manual supplied free with all Project 60 equipment. The modules are great space savers too and are sold individually boxed in distinctive white and black cartons. With all these wonderful advantages, there remains the most attractive of all – price. When you choose Project 60 you know you are going to get the best high fidelity in the world, yet thanks to Sinclair's vast manufacturing resources (the largest in Europe) prices are fantastically low and everything you buy is covered by the famous Sinclair guarantee of reliability and satisfaction.

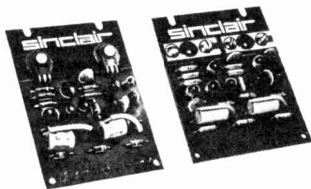
Typical Project 60 applications

System	The Units to use	together with	Cost of Units
Simple battery record player	Z.30	Crystal P.U., 12V battery volume control	£4.48
Mains powered record player	Z.30, PZ.5	Crystal or ceramic P.U., volume control etc.	£9.45
20 + 20 W. stereo amplifier for most needs	2 x Z.30s, Stereo 60, PZ.5	Crystal, ceramic or mag. P.U., F.M. Tuner, etc.	£23.90
20 + 20 W. stereo amplifier with high performance spkrs.	2 x Z.30s, Stereo 60, PZ.6	High quality ceramic or magnetic P.U., F.M. Tuner, Tape Deck, etc	£26.90
40 + 40 W. R.M.S. de-luxe stereo amplifier	2 x Z.50s, Stereo 60 PZ.8, mains trnsfrmr	As above	£34.88
Indoor P.A.	Z.50, PZ.8, mains transformer	Mic., guitar, speakers, etc., controls	£19.43

F.M. Stereo Tuner (£25) & A.F.U. Filter Unit (£5.98) may be added as required.

from a simple amplifier to a complete stereo tuner amplifier with Project 60 modules

Z.30 & Z.50 power amplifiers



The Z.30 and Z.50 are of advanced design using silicon epitaxial planar transistors to achieve un-surpassed standards of performance. Total harmonic distortion is an incredibly low 0.02% at full output and all lower outputs. Whether you use Z.30 or Z.50 amplifiers in your Project 60 system will depend on personal preference, but they are the same size and may be used with other units in the Project 60 range equally well.

SPECIFICATIONS (Z.50 units are interchangeable with Z.30s in all applications).

Power Outputs

Z.30 15 watts R.M.S. into 8 ohms using 35 volts; 20 watts R.M.S. into 3 ohms using 30 volts.

Z.50 40 watts R.M.S. into 3 ohms using 40 volts; 30 watts R.M.S. into 8 ohms using 50 volts.

Frequency response: 30 to 300,000Hz \pm 1dB.

Distortion: 0.02% into 8 ohms.

Signal to noise ratio: better than 70dB unweighted

Input sensitivity: 250mV into 100 Kohms.

For speakers from 3 to 15 ohms impedance.

Size: 14 x 80 x 57 mm.

Z.30

Built, tested and guaranteed with circuits and instructions manual. **£4.48**

Z.50

Built, tested and guaranteed with circuits and instructions manual. **£5.48**

Project 60 Stereo F.M. Tuner



First in the world to use the phase lock loop principle

The phase lock loop principle was used for receiving signals from space craft because of its vastly improved signal to noise ratio. Now, Sinclair have applied the principle to an F.M. tuner with fantastically good results. Other original features include varicap diode tuning, printed circuit coils, an I.C. in the specially designed stereo decoder and squelch circuit for silent tuning between stations. Good reception is possible in difficult areas, and often a few inches of wire are enough for an aerial. In terms of a high fidelity this tuner has a lower level of distortion than any other tuner we know. Stereo broadcasts are received automatically as the tuning control is rotated, a panel indicator lighting up as the stereo signal is tuned in. This tuner can also be used to advantage with any other high fidelity system.

SPECIFICATIONS—Number of transistors: 16 plus 20 in I.C. **Tuning range:** 87.5 to 108 MHz. **Capture ratio:** 1.5dB. **Sensitivity:** 2 μ V for 30dB quieting, 7 μ V for lock-in over full deviation. **Squelch level:** 20 μ V. **A.F.C. range:** \pm 200 KHz. **Signal to noise ratio:** > 65dB. **Audio frequency response:** 10 Hz – 15 KHz (\pm 1dB). **Total harmonic distortion:** 0.15% for 30% modulation. **Stereo decoder operating level:** 2 μ V. **Cross talk:** 40dB. **Output voltage:** 2 x 150mV R.M.S. **Operating voltage:** 25-30 VDC. **Indicators:** Power on/tuning/stereo. **Size:** 93 x 40 x 207 mm.

Built and tested Post free

£25

Stereo 60 Pre-amp/control unit

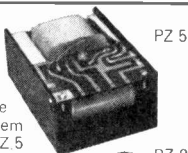


Designed for Project 60 range but suitable for use with any high quality power amplifier. Again silicon epitaxial planar transistors are used throughout, achieving a really high signal-to-noise ratio and excellent tracking between channels. Input selection is by means of push buttons and accurate equalisation is provided for all the usual inputs.

SPECIFICATIONS—Input sensitivities: Radio – up to 3mV, Mag. p.u. 3mV, correct to R.I.A.A curve -1dB 20 to 25,000 Hz. Ceramic p.u. – up to 3mV; Aux – up to 3mV. **Output:** 250mV. **Signal to noise ratio:** better than 70dB. **Channel matching:** within 1dB. **Tone controls:** TREBLE \pm 15 to -15dB at 10 KHz. BASS \pm 15 to -15dB at 100Hz. **Front panel:** brushed aluminium with black knobs and controls. **Size:** 66 x 40 x 207 mm. **£9.98**

Built, tested and guaranteed.

Power Supply Units



PZ.5

Designed special for use with the Project 60 system of your choice. Use PZ.5 for normal Z.30 assemblies and PZ.6 where a stabilised supply is essential.

PZ.5 30 volts un stabilised £4.98

PZ.6 35 volts stabilised £7.98

PZ.8 45 volts stabilised

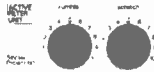
(less mains transformer) £7.98

PZ.8 mains transformer £5.98



PZ.8

A.F.U. High & Low Pass Filter Unit



For use between Stereo 60 unit and two Z.30s or Z.50s, and is easily mounted. It is unique in that the cut-off frequencies are continuously variable, and as attenuation in the rejected band is rapid (12dB/octave), there is less

loss of the wanted signal than has previously been possible. Amplitude and phase distortion are negligible. The A.F.U. is suitable for use with any other amplifier system. Two filter stages – rumble (high pass) and scratch (low pass). Supply voltage – 15 to 35V. Current – 3mA. H.F. cut-off (-3dB) variable from 28KHz to 5KHz. L.F. cut-off (-3dB) variable from 25Hz to 100Hz. Distortion at 1KHz (35V. supply) (0.02% at rated output. **Size:** 66 x 40 x 90 mm. **£5.98**

Built tested and guaranteed.

The Sinclair Guarantee

If within 3 months of purchasing Project 60 modules directly from us, you are dissatisfied with them, we will refund your money at once. Each module is guaranteed to work perfectly and should any defect arise in normal use we will service it at once and without any cost to you whatsoever provided that it is returned to us within 2 years of the purchase date. There will be a small charge for service thereafter. No charge for postage by surface mail. Air-mail charged at cost.

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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.

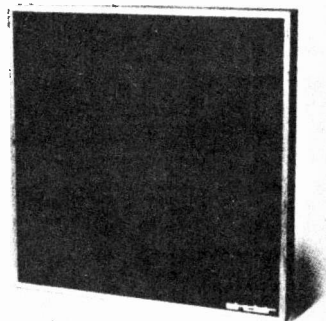
Input Impedance: 8 ohms.

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 $\frac{1}{2}$ 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.

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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.**

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10W 13in 8in — two 2-2 1/2in tweeters and cross-over. All wired and ready for use. This ever-popular 450 in 3-8-15 ohm imp.
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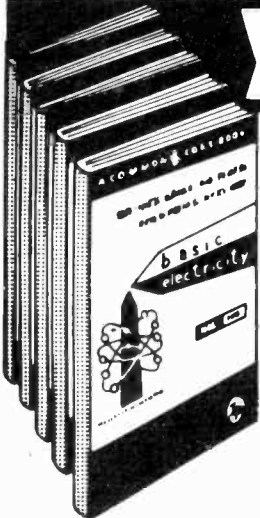
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Three Channel: Bass—Middle—Treble. Each channel has its own sensitivity control. Just connect the input of this unit to the loudspeaker terminals of an amplifier, and connect three 250V up to 600W lamps to the output terminals of the unit, and you produce a fascinating sound-light display. (All guaranteed)
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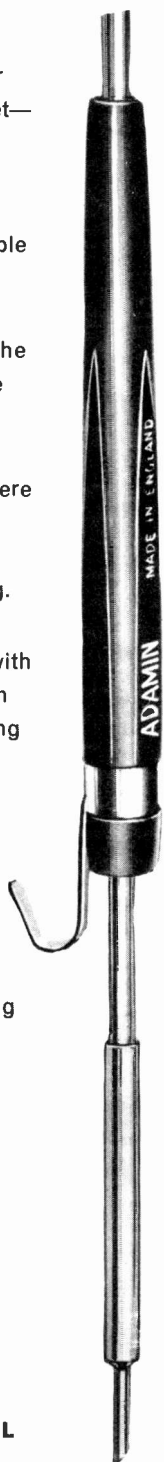
Use the mains version at home or clip the 12 volt model to the car battery or 12 volt power unit (consumption only 1.25A).

Send for HOBBY PACK 37 consisting of Model 15 iron with four bits, ¼in, ⅜in, ½in and tube of Bit Lubricant. State voltage required—12V or 220/240V.

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L709C	DIL 0.45 0.40 0.35
L710C	TO5 0.47 0.42 0.37
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L711C	TO5 0.49 0.44 0.39
L711C	DIL 0.45 0.40 0.35
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SN7404	0.20 0.18
SN7405	0.20 0.18
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CA3000V1	1.80 1.60
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CA3002	1.80 1.60
CA3002V1	1.80 1.60
CA3004	1.80 1.60
CA3005	1.17 1.05
CA3006	2.80 2.50
CA3007	2.83 2.34
CA3008	1.80 1.60
CA3008A	2.96 2.64
CA3010	1.37 1.23
CA3010A	2.53 2.25
CA3011	0.74 0.65
CA3011PRE	
	0.74 0.65
CA3012	0.89 0.79
CA3012V1	0.89 0.79
CA3013	1.05 0.94
CA3014	1.24 1.10
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CA3015A	3.40 3.08
CA3016	2.46 2.19
CA3016A	3.73 3.33
CA3018	0.84 0.75
CA3018A	1.10 0.99
CA3019	0.84 0.75
CA3020	1.28 1.13
CA3020A	1.60 1.48
CA3021	1.56 1.29
CA3021V1	1.56 1.29
CA3022	1.30 1.16
CA3023	1.26 1.13
CA3026	1.00 0.90
CA3026PRE	
	1.00 0.90
CA3028A	0.74 0.65
CA3028B	1.05 0.94
CA3029	0.87 0.77
CA3029A	1.65 1.47
CA3030	1.87 1.23
CA3030A	2.53 2.25
CA3033	2.53 2.25
CA3033A	4.28 4.08
CA3033V	4.28 4.08
CA3034	1.23 1.10
CA3035	1.65 1.47
CA3036	1.65 1.47
CA3037	1.09 0.97
CA3037A	1.37 1.23
CA3038	1.24 1.07
CA3038A	1.24 1.07
CA3038V1	1.24 1.07
CA3039	0.84 0.75
CA3040	2.40 2.14
CA3041	1.09 0.97
CA3042	1.09 0.97
CA3043	1.37 1.23
CA3044	1.20 1.07
CA3044V1	1.20 1.07
CA3045	1.23 1.09
CA3046	0.89 0.80
CA3047	1.37 1.23
CA3047A	2.85 2.25
CA3048	2.04 1.81
CA3049	1.60 1.43
CA3050	1.84 1.64
CA3051	1.34 1.20
CA3052	1.65 1.47
CA3053	1.65 1.47
CA3054	1.09 0.97
CA3055	1.69 1.51
CA3056	1.20 1.07
CA3056A	3.19 2.85
CA3059	1.83 1.46
CA3060	4.91 4.37
CA3062	0.85 0.27
CA3064	1.20 1.07
CA3065	1.20 1.07
CA3066	2.11 1.88
CA3067	2.18 1.94
CA3068	2.43 2.18
CA3070	1.70 1.51
CA3071	1.62 1.44
CA3072	1.66 1.48
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BLACK LIGHT



THE OUT OF SIGHT LIGHT



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The unit performs in a similar fashion to the fluorescent tube type units in use in some discotheques but instead uses a 3-pin B.C. lamp fitted into a high intensity spot-fitting, with fully adjustable swivel bearing. The reflector is also fully adjustable and the unit may be mounted in any position and focused as desired.

White shirts and dresses glow "Whiter than white". Paint scenes on walls, etc., with our special fluorescent paint, focus the black-light from across the room and switch-on. The pictures glow brilliantly as if by magic!

Full kit includes lamp, reflector, control-gear, generous samples of five different colours of fluorescent paint and full instructions. Price £25 carr. paid. S.A.E. with all inquiries.

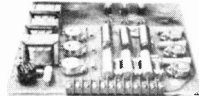
PRACTICAL ELECTRONICS "SCORPIO" ELECTRONIC IGNITION SYSTEM

This Capacitor-Discharge Electronic Ignition system was described in the November and December issues of Practical Electronics. It is suitable for incorporating in any 12V ignition system in cars, boats, go-karts, etc., of either pos. or neg. earth and up to six cylinders. The original coil, plugs, points and contact-breaker capacitor fitted in the vehicle are used. No extra or special components are required.

Helps to promote easier starting (even under sub-zero conditions), improved acceleration, better high-speed performance, quicker engine warm-up and improved fuel economy. Eliminates excessive contact-breaker point burning and the need to adjust point and spark-plug gaps with precision.

Construction of the unit can easily be completed in an evening and installation should take no longer than half an hour. A complete complement of components is supplied with each kit together with ready-drilled roller-tinned professional quality fibre-glass printed-circuit board, custom-wound transformer and fully-machined die-cast case. All components are available separately. Case size 7 1/2 in x 4 1/2 in x 2 in approx. Complete assembly and wiring manual 25p, refundable on purchase of kit. Price: £10.50 plus 50p P. & P. S.A.E. with all enquiries.

PSYCHEDELIC LIGHTING UNIT Mk. 3



This unit represents a natural progression from our phenomenally successful Mk. 1 and 2 Units. As before the drive voltage is derived directly from the amplifier output or across the speakers. The unit converts the audio frequency signals into a three-coloured light display; the colour depending on the frequency of the signal and the intensity on the loudness of the audio source.

The unit is constructed on professional fibre-glass printed-circuit board material and uses latest full-wave triac circuitry. There is a master-level control, together with independent sensitivity controls for each channel. The original minimum ambient light level controls have been redesigned permitting their use as faders; allowing dimming from max. to zero at the turn of a knob. R.F.I. suppression is now incorporated as standard as well as provision for D.J. "Pulse-Flash" controls. The choice of two inputs enables operation from both high and low power amplifiers. Max. power 1.5kW per channel at 240V a.c.

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0-01	350V	2p	2500MFD 6V	10p
0-022	30V	2p	2500MFD 12V	12p
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Electrolytic Mullard C426 Range		DIODES		
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16MFD	40V	4p	INS054 (1kV)	10p
32MFD	10V	4p	IN4009	2p
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AT indicates open universal fixing with tags; CT is open U-clamp fixing with tags; CS is open U-clamp fixing with P.C. spalls; * with interwinding screen; † untapped 240V Primary; ‡ Primary tapped at 210-240V; other Primaries tapped at 200-220-240V.

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AC126	0-13	OC171	0-23
AC127	0-17	OC200	0-25
AC128	0-13	OC201	0-25
AC176	0-25	2G301	0-13
AC177	0-15	2G303	0-13
AF139	0-37	2N711	0-30
AF186	0-50	2N1302-3	0-20
AF139	0-37	2N1304-5	0-25
BC154	0-25	2N1306-7	0-30
BC107	0-13	2N1308-9	0-35
BC108	0-13	2N3819FET	0-45
BC109	0-14		
BF194	0-15	Power Transistors	
BF274	0-15	OC20	0-50
BFY50	0-20	OC23	0-30
BSY25	0-57	OC25	0-25
BSY26	0-13	OC26	0-25
BSY27	0-13	OC28	0-30
BSY28	0-13	OC35	0-30
BSY29	0-13	OC36	0-37
BSY95A	0-15	AD149	0-30
OC41	0-13	AUY10	1-25
OC44	0-13	25034	0-25
OC45	0-13	2N3055	0-63
OC71	0-13		
OC72	0-13	Diodes	
OC81	0-13	AAY42	0-10
OC81D	0-13	OA95	0-19
OC83	0-20	OA79	0-09
OC139	0-13	OA81	0-09
OC140	0-17	IN9114	0-07

F.E.T. PRICE BREAKTHROUGH !!

This field effect transistor is the 2N3823 in a plastic encapsulation, coded as 3823E. It is also an excellent replacement for the 2N3819. Data sheet supplied with device. 1-10 30p each, 10-50 25p each, 50+ 20p each.



BULK BUYING CORNER

NPN/PNP Silicon Planar Transistors, mixed, untested, similar to 2N706/6A/8, BSY26-29, BSY95A, BCY70, etc. £4-25 per 500; £8 per 1,000.

Silicon Planar NPN Plastic Transistors, untested, similar to 2N3707-11, etc., £4-25 per 500; £8 per 1,000.

Silicon Planar Diodes, DO-7 Glass, similar to OA200/202, BAY31-36, £4-50 per 1,000.

NPN/PNP Silicon Planar Transistors, Plastic TO-18, similar to BC113/4, BC153/4, BF153/160, etc., £4-25 per 500; £8 per 1,000.

OC44, OC55 Transistors fully marked and tested, 500+ at 8p each; 1,000+ at 6p each.

OC71 Transistors, fully marked and tested, 500+ at 6p each; 1,000+ at 5p each.

3823E Field effect Transistors. This is the 2N3823 in Plastic Case, 500+ 13p each; 1,000+ 10p each.

1 amp Miniature Plastic Diodes:

IN4001, 500+ at 4p each; 1,000+ at 3p each.
IN4004, 500+ at 3p each; 1,000+ at 5p each.
IN4006, 500+ at 6p each; 1,000+ at 5p each.
IN4007, 500+ at 8p each; 1,000+ at 7p each.

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BB105 Varicap Diodes	10p	8p	6p
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Matched Sets 1-OC44 and 2-OC45's. Per Set.	5p	5p	4p
Matched Sets of OC45's 1st and 2nd IF	25p	20p	15p
OA47 Gold-Bonded Diodes, Marked and Tested	15p	12p	10p
1-watt Zener Diodes 7.5, 24, 27, 30, 36, 43 Volts	3p	3p	2p
10-watt Zener Diodes 5-1, 8-2, 11, 13, 16, 24, 30, 100 Volts	5p	4p	3p
Micro Switches, S/P, C/O	20p	17p	15p
1-amp Bridge Rec's 25-volt	25p	22p	20p

INTEGRATED CIRCUITS

SL403D Audio Amp, 3-Watts	2-00	1-95	1-80
709C Linear Opp. Amp.	50p	40p	35p
Gates, Factory Marked and Tested by A.E.I.	25p	22p	20p
J. K. Flip-Flops Factory, Marked and Tested by A.E.I.	40p	35p	30p
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DRILL CONTROLLER NEW 1KW MODEL

Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. **£1.50** plus 13p post and insurance. Made up model also available, **£2.25** plus 13p post and p.

MAINS OPERATED CONTACTOR 220/240V.

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

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Double Leaf Contact. Very slight pressure closes both contacts. **6p** each, **60p** doz. Plastic push-rod suitable for operating. **5p** each, **45p** doz.

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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.

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

MINIATURE WAFER SWITCHES

2 pole, 2 way—4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole 6 way—1 pole, 12 way. All at **18p** each, **£1.80** dozen, your assortment.

WATERPROOF HEATING ELEMENT

26 yards length 70W. Self-regulating temperature control. **50p** post free.

BLANK SWITCH

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

CAR ELECTRIC PLUG

Fits in place of cigarette lighter. Useful method for making a quick connection into the car electrical system. **35p** each or **10** for **£3.42**.

TREASURE TRACER

Complete kit (except wooden battery) to make the metal detector as the circuit in Practical Wireless August issue. **£2.50** plus 20p post and insurance.

QUICK CUPPA

Mini Immersion Heater, 350W 200/240V. Boils full cup in about two minutes. Use any socket or lamp holder. Have at bedside for tea, baby's food, etc. **£1.25**, post and insurance 14p. 12V car model also available same price. Jug heater **£1.50** plus P. & P. 14p.

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Rated 5A 240V. Made by Arrow. Type fitted in the handles of electric drills, vacuum, etc. **5p** each, **10** for **45p**.

NUMICATOR TUBES

For digital instruments, counters, timers, clocks, etc. Hi-vac X.N. 3. Price **99p** each, **10** for **£9**.

12 WAY SUB-MINIATURE MULTI-CORE CABLE

7-0076 copper cores, each core P.V.C. insulated and of different colour. P.V.C. covered overall and approx. 3/16in thick. Price **20p** per yard.

LIGHT CELL

Almost zero resistant in sunlight increases to 10 K Ohms in dark or dull light, epoxy resin sealed. Size approx. 1in dia. by 1/2in thick. Rated at 500 MW, wire ended. **45p** with circuit.

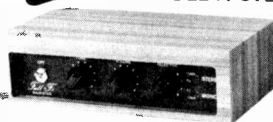
IGNITION BOOSTER as featured in this issue Send S.A.E. for list of parts



2kW FAN HEATER

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

THE FULL-FI STEREO SIX

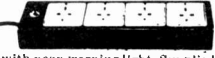


THE AMPLIFIER SENSATION OF THE YEAR

You will be amazed at the fullness of reproduction and at the added qualities your records or tuner will reproduce. Built into metal cabinet elegantly styled in simulated teak finished to blend with modern furnishings, this amplifier uses an integrated solid state circuit with an output power of 6W R.M.S. split over the two channels. The amplifier is ideal for use with normal pick-ups and tuners, it has a double wound mains transformer and ganged volume and tone controls—also switching for Mono to Stereo, tuner or pick-up. UNREPEATABLE PRICE is **£9** plus 38p post and insurance.

DISTRIBUTION PANELS

Just what you need for work bench or lab. 4 x 13 amp sockets in metal box to take standard 13 amp fused plugs to take complete with 7 feet of heavy rubber cable to work, **£2** less plug. **£2-25** with fitted 13 amp plug; **£2-40** with fitted 15 amp plug, plus 25p P. & I.



THIS MONTH'S SNIP



Smiths 24-hour 2 on/2 off Time Switch—this is the popular model as used in the Autoset and Morphy-Richards time switches. Only needs a case and an output socket. 230V 50 cycle. Contacts switch up to 13A. Price **£2.75**.

TANGENTIAL HEATER UNITS

This heater unit is the very latest type, most efficient, and quiet running, is as fitted in Hoover and blower heaters costing £15 and more. We have a few only. Comprises motor, impeller, 2kW element and 1kW element allowing switching 1 and 2kW and with thermal safety cut-out. Can be fitted into any metal case or cabinet. Only need control switch. **£3.50**, 2kW. Model as above except 2 kilowatts **£2.50**. Don't miss this. Control Switch **35p**, P. & P. 40p.

POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electronics. Tests polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), **30p** or 2 for **50p**. Post paid.



COMPUTER TAPE

2,400ft of the Best Magnetic Tape money can buy—users claim good results with Video and sound. 1in wide **£1.00** plus 33p post and insurance, with cassette. 1in wide **£1.00** plus 30p post and insurance with cassette. 1/2in wide **75p** plus 25p post and insurance with cassette. Spare spools and cassettes—1in 75p, 1/2in 75p each plus 20p post and insurance.

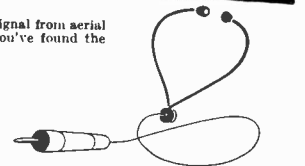
1 HOUR MINUTE TIMER

Made by famous Smiths company, these have a large clear dial, size 4 1/2 x 3 1/2, which can be set in minutes up to 1 hour. After preset period the bell rings. Ideal for processing, a memory jogger or, by adding simple lever, would operate micro-switch. **£1.15**.



RADIO STETHOSCOPE

Easiest way to fault find—traces signal from aerial to speaker—when signal stops you've found the fault. Use it on Radio, TV amplifier, anything—complete kit comprises two special transistors and all parts including probe tube and crystal earpiece. **£2**—twin stethoscope instead of earpiece **75p** extra—post and ins. 20p.



SOLDER GUN

A must for every busy man, gives almost instant heat also illuminates job. Dual heat 100/140 watt **£3.75** plus post and ins. 20p. BIG JOB 250 watt model **£4.75** plus post and ins. 40p.

CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient and reliable was first described in the *Wireless World* improves and even more efficient version. Price **£25** plus 30p post. When ordering please state whether for positive or negative systems.

Type 25 Relays. These are miniature relays. Size approx. 1 1/2in high x 1 1/2in wide x 1/2in deep. 4 changeover silver/gold contacts. Contact rating lamp 100V d.c. Fitted with a plastic cover. Coil operates approx. 250MW d.c. Available with the following coils:
 28Ω for 4V-7.5V 45Ω for 1V-2.5V 52Ω for 4.5V-8V
 90Ω for 5.5V-11.5V 130Ω for 10V-15V 530Ω for 17V-36V
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 75p each. 10 for **£6.75**. Also one with 16,500 ohm coil but this has only 2 heavy duty changeover gold contacts. Price **£1.45**.

Veroboard. We are now stocking this in various sizes. Prices as follows:

Inches	0-1	0-15
2 1/2 x 3 1/2	22p	16p
2 1/2 x 5	24p	24p
3 1/2 x 5 1/2	24p	24p
3 1/2 x 5	27p	27p
17 x 2 1/2	75p	57p
17 x 3 (plain)	—	52 1/2p
17 x 2 1/2 (plain)	—	37 1/2p
17 x 3 (plain)	100p	75p
2 1/2 x 5 (plain)	—	17 1/2p
2 1/2 x 3 (plain)	—	15p
Pin intersection tool	—	47 1/2p
Spot face cutter	—	37 1/2p
Pkt. 50 pins	—	20p

FLOUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20W **£1**. Kit B—30-40W **£1**. Kit C—80W **£1.20**. Kit E—65W **£1.20**. Kit F for 8ft 125W tube **£1.75**. Kit MF1 is for 6in, 9in and 12in miniature tube **£1**. Kit MF2 for 2 1/2in 13W miniature tube **£1**. Postage on Kits A and B 23p for one or two kits then 25p for each two kits ordered. Kits C, D and E 23p on first kit then 18p for each kit ordered. Kit F 33p then 23p for each kit ordered. Kit MF1 18p on first kit then 15p on each two kits ordered.

0-8 AMMETER

2 in. square full vision for flush mounting. Moving iron instrument. Ideal for charger. Price **43p** each. 10 for **£3.90**.

Box Sign for Window Display. at home, office or shop, 2ft wide x 14in high x 3in deep. This is an illuminated box sign made from sheet metal hammer finish enamel with a clear plastic window. You simply have your message printed or written on poster board or thick card. (Or use stick down letters available at most stationers.) You will then have a box sign normally costing anything between £10-15. Illumination is by a 2ft fluorescent tube with control gear enclosed. Message card can be changed quite easily from hinged top back. Price **£3** each, plus 65p post, etc.

Motivated Illuminated Box Sign. As previous item but with geared motor moving the message making it change eight times a minute. Very attention arresting. To use this for your own messages you would have to have each sign written on card then cut this up in strips which could be glued to the one supplied with the box sign. Price **£4.50**, plus 65p post and service.

Geared Motor with take off socket. The gear train is driven by normal type induction motor and gives a final speed of 6 r.p.m. The motor is mounted behind a chrome plate through which the take off drive protrudes and was originally intended to drive a spit for cooking, is also ideal for driving models or for driving a colour changing disc for the local dance hall, discotheque, etc. Really well made assembly. Price **£1.75** plus 20p post, etc.

Dry Film Lubricant. In aerosol can for easy application and for putting lubricant into places where the normal oil cannot reach. Home and everyday uses. We have purchased a large quantity of these from the Liquidator and are able to offer them to you at about half of the original list price. **30p** per (8oz) can or 12 cans for **£3** post paid. The lubricant is I.C.T. Fluon L188.

REED SWITCHES

Glass encased, switches operated by external magnet—gold welded contacts. We can now offer 3 types:
Miniature. 1in long x approximately 1/2in diameter. Will make and break up to 1A up to 300V. Price **13p** each, **£1.20** dozen.
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Small ceramic magnets to operate these reed switches **9p** each, **80p** dozen.
Dry Reed Relays. Solenoids on moulded bobbins within magnetic shields—printed circuit or panel mounting.

Ref.	Coil Resistance	Reed Switches	Price
71005	2 K	1 normally open	25p
81916	3 K	1 normally open, 1 normally closed	75p
05003	4 K	1 normally open	25p
62040 1500 & 500 ohms	1 normally open	25p	
Multiple Reed Relay, Ref. 53001.	Contains 13 normally open reeds within a solenoid. Operates on 600mW. Coil resistance 9K ohms. Price £1.95 each.		
Multiple Reed Relay, Ref. 631.	2 normally open 1 normally closed coil resistance 30 ohms. Price 75p .		

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.

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500,000 SILICON PLANAR NPN-PNP PLASTIC AND TRANSISTORS METAL CAN TYPES

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

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

TYPE STP18. Silicon Planar Transistors npn TO-18 Metal Can. Types similar to: BCY70-72, 2N2906-7, 2N2411 and BC185-7. Also used as complementary to the above npn type device type STN18.
Price: 500 £9; 1,000 £15

TYPE STN5. Silicon Planar Transistors npn TO-5 Metal Can. Types similar to: BFY50-51-52 and 2N2192-92.
Price: 500 £9.50; 1,000 £16

TYPE STPL. As above but in npn and similar to types 2N5354-56, 2N4058-2N4061 and 2N3702-3. Also used as complementary to the above npn devices type STNL.
Price: 500 £7.50; 1,000 £13

TYPE STNK. Silicon Planar Plastic Transistor npn with TO-18 pin circular lead configuration, I.C. 200mA, 300mW and similar to BC107-B-9, BC170, BC173, BC182-184, BC237-B-9 and BC337-8.
Price: 500 £9.50; 1,000 £16

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

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Clearance of npn Silicon Transistors from the 2S300 (TO-5) and 2S320 (SO-2) range and similar to the GC200-205 and BCY30-34 series. Ideal for Amateur Electronics, Radio Hams and for experimental use in Schools, Colleges and Industry.

Approximate cost by weight:
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500 off—£2.50 (plus p. & p. 17p)
1,000 off—£4 (plus p. & p. 25p)
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100	£1.50	10,000	£90.00
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1,000	£10.00	100,000	£625.00

LINEAR INTEGRATED CIRCUIT 709/PC S.G.S.

TO-5 can 8 lead. Full specification high gain Operational Amplifier data supplied. Lowest ever price.

QUANTITY: 1-9, 10-24, 25-99, 100-999
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1N21	0-17	AC126	0-20	BF173	0-25	GJ4M	0-88	OC43	0-40										
1N23	0-20	AC127	0-25	BF181	0-35	GJ5M	0-25	OC44	0-17										
1N85	0-88	AC128	0-20	BF184	0-20	GJ7M	0-37	OC44M	0-17										
1N253	0-60	AC187	0-25	BF185	0-20	HJ1005	0-50	OC45	0-12										
1N256	0-60	AC188	0-25	BF194	0-17	H8100A	0-20	OC45M	0-18										
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	0-80	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	0-80	OC59	0-60										
18021	0-20	ACY21	0-20	BF898	0-28	MJE250	0-87	OC86	0-55										
18113	0-15	ACY22	0-10	BF186	0-20	MJE255	0-50	OC86	0-55										
18130	0-18	ACY27	0-25	BFX13	0-25	MJE3055	0-87	OC71	0-12										
18131	0-13	ACY28	0-17	BFX29	0-25	NKT128	0-85	OC72	0-20										
18202	0-23	ACY30	0-60	BFX30	0-25	NKT129	0-30	OC73	0-30										
2G240	1-97	ACY39	0-15	BFX35	0-98	NKT211	0-25	OC74	0-80										
2G301	0-20	ACY41	0-15	BFX63	0-60	NKT213	0-25	OC75	0-25										
2G302	0-22	ACY44	0-25	BFX84	0-25	NKT214	0-15	OC76	0-25										
2G308	0-22	AD140	0-50	BFX86	0-30	MJE216	0-37	OC77	0-40										
2G371	0-22	AD149	0-50	BFX86	0-25	NKT217	0-35	OC78	0-20										
2G381	0-25	AD161	0-87	BFX87	0-25	NKT218	1-13	OC79	0-22										
2G414	0-80	AD162	0-87	BFX88	0-20	NKT219	0-88	OC81	0-20										
2G417	0-22	AF106	0-30	BFY10	1-00	NKT222	0-20	OC81D	0-20										
2N244	0-48	AF114	0-25	BPY11	1-25	NKT224	0-22	OC81M	0-20										
2N247	0-26	AF115	0-25	BPY17	0-25	NKT251	0-24	OC81M	0-18										
2N250	0-50	AF116	0-25	BPY18	0-25	OC81Z	0-25	OC81Z	0-25										
2N404	0-20	AF117	0-25	BPY19	0-25	NKT272	0-25	OC82	0-25										
2N697	0-15	AF118	0-82	BPY24	0-45	NKT273	0-15	OC82D	0-25										
2N698	0-40	AF119	0-20	BPY44	1-00	NKT274	0-20	OC83	0-25										
2N706	0-10	AF124	0-25	BPY50	0-22	NKT275	0-25	OC84	0-25										
2N708A	0-12	AF125	0-20	BPY61	0-20	NKT277	0-20	OC114	0-88										
2N708	0-15	AF126	0-17	BPY92	0-22	NKT278	0-25	OC122	0-25										
2N709	0-27	AF127	0-20	BFY88	0-17	NKT301	0-40	OC123	0-25										
2N711	0-37	AF139	0-30	BFY64	0-42	NKT304	0-75	OC139	0-25										
2N987	0-58	AF178	0-65	BPY90	0-65	NKT403	0-75	OC140	0-88										
2N1090	0-80	AF179	0-65	BSX27	0-50	NKT404	0-55	OC141	0-60										
2N1091	0-33	AF180	0-62	BSX60	0-98	NKT878	0-65	OC169	0-20										
2N1131	0-25	AF181	0-62	BSX76	0-18	NKT713	0-25	OC170	0-25										
2N1132	0-25	AF186	0-40	BSY26	0-18	OC173	0-25	OC171	0-80										
2N1302	0-18	AFY19	1-13	BSY27	0-17	NKT777	0-38	OC200	0-40										
2N1303	0-18	AFZ11	0-60	BSY51	0-50	078B	0-38	OC201	0-70										
2N1304	0-22	AFZ12	1-00	BSY95A	0-12	0A5	0-20	OC202	0-80										
2N1305	0-22	ASV26	0-25	BSY95	0-12	0A6	0-12	OC203	0-40										
2N1306	0-25	ASV27	0-32	BT102/500R	0-75	0A7	0-10	OC204	0-40										
2N1307	0-25	ASV28	0-25	0A70	0-10	OC205	0-75	OC206	0-90										
2N1308	0-25	ASV29	0-30	BTY42	0-92	0A71	0-10	OC207	0-90										
2N1309	0-25	ASV36	0-25	BTY79/100R	0-75	0A73	0-10	OC207	0-90										
2N1420	0-93	ASV60	0-17	0A74	0-10	OC460	0-80	OC470	0-80										
2N1507	0-28	ASV51	0-40	BTY79/400R	0-75	0A79	0-10	OC470	0-80										
2N1526	0-38	ASV33	0-20	1-25	0A81	0-08	OCPF1	0-57	0R12	0-25									
2N1909	2-25	ASV65	0-20	BY100	0-15	0A85	0-12	ORP60	0-40										
2N2147	0-75	ASV62	0-25	BY126	0-16	0A86	0-15	ORP61	0-42										
2N2148	0-60	ASV96	0-33	BY127	0-17	0A90	0-08	ORP61	0-42										
2N2160	0-60	ASZ21	0-42	BY182	0-85	0A91	0-07	S19T	0-30										
2N2218	0-20	ASZ23	0-75	BY182	0-85	0A95	0-07	SAC40	0-25										
2N2219	0-20	AUY10	0-98	BY213	0-25	0A200	0-07	SFT308	0-88										
2N2287	1-03	AU101	1-60	BYZ10	0-85	0A202	0-10	SFT722	0-38										
2N2287	0-20	BC107	1-10	BYZ11	0-82	0A210	0-25	SFT731	0-25										
2N2369A	0-15	BC108	0-10	BYZ12	0-80	0A211	0-80	SX68	0-20										
2N2444 P on A		BC109	0-10	BYZ13	0-25	OAZ200	0-55	SX631	0-40										
2N2613	0-28	BC113	0-15	BYZ13	0-25	OAZ201	0-50	SX635	0-40										
2N2646	0-45	BC115	0-20	BYZ15	1-00	OAZ202	0-42	SX640	0-50										
2N2712	0-25	BC116	0-25	BYZ16	0-82	OAZ203	0-42	SX641	0-55										
2N2784	0-60	BC116A	0-80	BYZ88C3V3		OAZ204	0-80	SX642	0-60										
2N2846	0-75	BC119	0-25	C111	0-15	OAZ205	0-42	SX644	0-75										
2N2948	0-45	BC121	0-20	C111	0-85	OAZ206	0-42	SX645	0-75										
2N2904	0-90	BC122	0-20	CRS1/05	0-25	OAZ207	0-47	V15/30P	0-70										
2N2904A	0-85	BC125	0-80	CRS1/40	0-47	OAZ208	0-32	V30/201P	0-50										
2N2906	0-20	BC126	0-85	CS4B	2-60	OAZ209	0-32	V60/201	0-50										
2N2907	0-28	BC140	0-55	CS10B	3-13	OAZ210	0-32	V60/201P	0-75										
2N2924	0-23	BC147	0-15	DD000	0-15	OAZ211	0-32	XA101	0-10										
2N2925	0-15	BC148	0-15	DD003	0-15	OAZ222	0-45	XA102	0-18										
2N2926	0-10	BC149	0-15	DD006	0-18	OAZ223	0-45	XA151	0-15										
2N3054	0-60	BC157	0-15	DD007	0-40	OAZ224	0-45	XA152	0-15										
2N3055	0-75	BC158	0-12	DD008	0-38	OAZ241	0-22	XA161	0-25										
2N3702	0-10	BC160	0-68	GD3	0-38	OAZ242	0-28	XA162	0-25										
2N3705	0-10	BC169	0-18	GD4	0-05	OAZ244	0-22	XB101	0-48										
2N3706	0-28	BCY31	0-85	GD5	0-33	OAZ246	0-28	XB102	0-10										
2N3707	0-12	BCY32	0-60	GD6	0-25	0290	0-38	XB103	0-25										
2N3709	0-10	BCY32	0-65	GD12	0-05	OC16	0-60	XB103	0-25										
2N3710	0-10	BCY33	0-25	GET102	0-80	OC16T	0-88	XB113	0-18										
2N3711	0-10	BCY34	0-80	GET103	0-22	OC19	0-87	XB121	0-48										
2N3819	0-35	BCY38	0-40	GET113	0-20	OC20	0-85	ZR24	0-68										
2N3820	0-60	BCY39	1-00	GET114	0-15	OC22	0-60	ZB170	0-10										
2N3823	0-75	BCY40	0-50	GET115	0-45	OC23	0-80	ZB271	0-18										
2N5927	0-45	BCY42	0-75	GET120	0-25	OC29	0-60	ZB271	0-18										
2N6088	0-33	BCY70	0-15	GET120	0-25	OC25	0-37	ZT31	0-25										
28005	1-00	BCY71	0-20	GET872	0-80	OC26	0-25	ZT43	0-25										
28178 P on A		BCZ10	0-85	GET875	0-25	OC28	0-60	ZTX107	0-15										
28301	0-60	BCZ11	0-65	GET880	0-87	OC28	0-60	ZTX108	0-12										
28304	0-75	BD121	0-65	GET881	0-25	OC29	0-60	ZTX300	0-12										
28501	0-37	BD123	0-80	GET882	0-25	OC30	0-40	ZTX304	0-25										
28703	0-48	BD124	0-75	GET885	0-25	OC35	0-50	ZTX304	0-15										
AA129	0-20	BDY11	1-62	GEX44	0-08	OC36	0-60	ZTX500	0-17										
AAZ12	0-80	BF115	0-25	GEX45/1	0-10	OC41	0-25	ZTX503	0-16										
AAZ13	0-12	BF117	0-65	GEX94/1	0-15	OC42	0-30	ZTX531	0-25										
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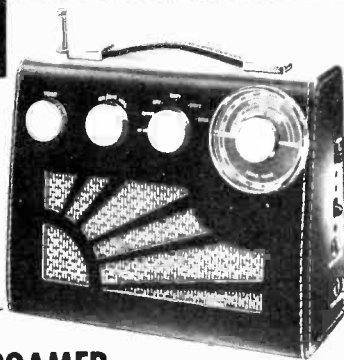
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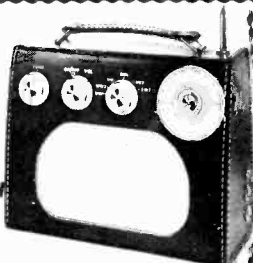
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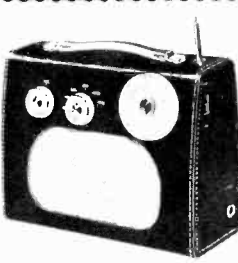
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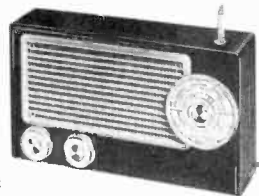


ROAMER SIX

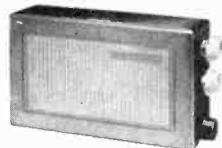
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Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages—6 transistors and 2 diodes including micro-alloy R.F. transistors, etc. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9in x 5 1/2in x 2 1/2in 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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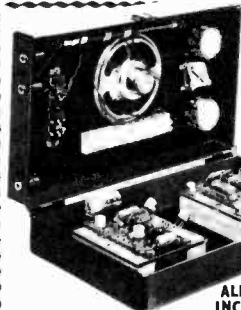
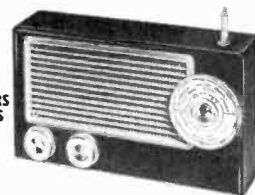
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8 TRANSISTORS AND 3 DIODES

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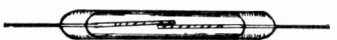
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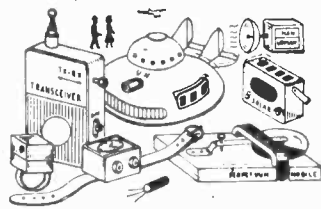
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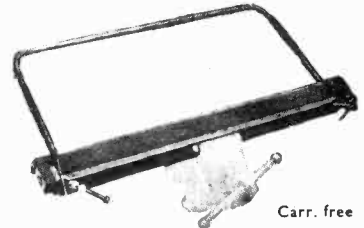
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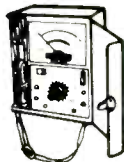
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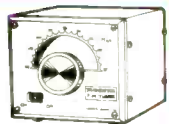
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