PRACTICAL
ELECTRONICS
NOVEMBER 1976 40p

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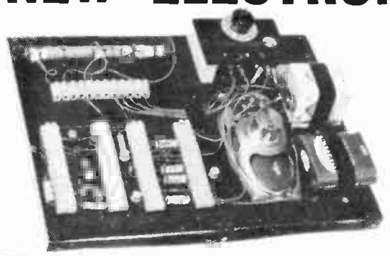
NEW ELECTRONIC MASTER KIT



Another completely solderless Electronic Construction Kit with many more projects, including transistor radios of various types and wavebands. Amplifiers, metronome, sound amplifier, transistor tester, signal generator, quick check component tester, tuners, crystal set, morse code practice oscillator with morse key, AF oscillator, etc. Also a special project VHF aircraft receiver!

And all these components: 2 interchangeable control panels (ready drilled); 4 solderless construction boards (ready drilled); large 13 × 9½in. baseboard (ready drilled); ready-wound medium wave, long wave, short wave and VHF coils; 7in. ferrite rod; quality 5 × 3in. loudspeaker; crystal earpiece. Also: knobs, dial, wire, sleeving, capacitors, resistors, transistors, battery straps, connector clips, screws, nuts and bolts, potentiometers, tuning capacitors, instruction manual and pictorial diagrams.

£14·99 Complete kit of parts including construction plans. Post, packing and insurance.

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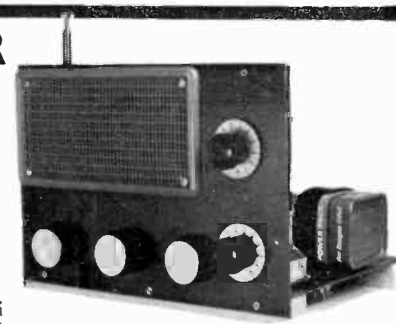
Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave or the long wave band and operating as shown in the instructions supplied free with all parts.

Uses a retractable chrome plated telescopic aerial, gain control, V.H.F. tuning capacitor, transistor, etc.

All parts including case and plans

£3·95 P.P. & Ins. 45p

NEW ROAMER TEN MODEL RK3



MULTIBAND V.H.F. AND A.M. RECEIVER.

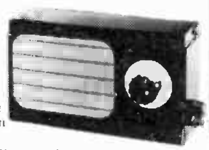
13 TRANSISTORS AND FIVE DIODES. QUALITY 5" × 3" LOUDSPEAKERS.

WITH Multiband V.H.F. section covering Mobiles, Aircraft, T.V. Sound, Public Service Band, Local V.H.F. Stations, etc. And Multiband A.M. section with Airspaced Slow Motion Drive Tuning Capacitor for easier and accurate tuning, covering M.W.1, M.W.2, L.W. Three Short Wave Bands S.W.1, S.W.2, S.W.3 and Trawler Band. Built-in Ferrite Rod Aerial for Medium Wave, Long Wave and Trawler Band, etc., Chrome Plated 7 section Telescopic Aerial, angled and rotatable for peak Short Wave and V.H.F. reception. Push Pull output using 600mW Transistors. Gain, Wave-Change and tone Controls. Plus two Slider Switches. Negative Feedback circuit and SPECIAL POWER BOOSTER SOCKET AND RESISTOR, to virtually double gain if required. Powered by P. P. 9 volt Battery.

Complete kit of parts including carrying strap, Building Instructions and operating Manuals. **£13·99** Inc. P. & P.

Case enclosure kit (if required), £1·80 inc. P.P. and Ins.

POCKET FIVE



Now with 3in Loudspeaker

3 tunable wavebands. MW. LW and trawler band. 7 stages, 5 transistors and 2 diodes, supersensitive ferrite rod aerial, attractive black and gold case. Size 5½in × 1¼in × 3½ in approx.

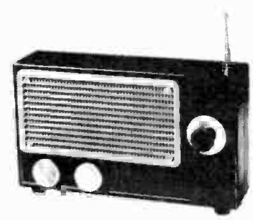
Complete kit of parts including construction plans.

Total Building Costs: **£4·50** P.P. and Ins. 60p

TRANS EIGHT 8 TRANSISTORS AND 3 DIODES

6 tunable wavebands: MW, LW, SW1, SW2, SW3 and trawler band. Sensitive ferrite rod aerial for MW and LW. Telescopic aerial for short waves. 3in speaker. 8 improved type transistors plus 3 diodes. Attractive case in black with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2¾in approx. Push-pull output. Battery economiser switch for extended battery life. Ample power to drive a larger speaker.

Complete kit of parts including construction plans **£7·50** P. & P. + Ins. 70p



ROAMER SIX

CASE AND LOOKS AS TRANS-EIGHT

6 tunable wavebands: MW, LW, SW1, SW2, trawler band plus an extra medium waveband for easier tuning of Luxembourg, etc. Sensitive ferrite rod aerial and telescopic aerial for short waves. 3in speaker. 8 stages—6 transistors and 2 diodes. Attractive black case with red grille, dial and black knobs with polished metal inserts. Size 9 × 5½ × 2¾in approx.

Complete kit of parts including construction plans **£7·10** P. & P. + Ins. 70p

ELECTRONIC CONSTRUCTION KITS

E.C.K. 2 Self Contained Multi-Band V.H.F. Receiver Kit.

8 transistors and 3 diodes. Push pull output. 3in loudspeaker, gain control, superb 9 section swivel ratchet and retractable chrome plated telescopic aerial, V.H.F. tuning capacitor, resistors, capacitors, transistors, etc. Will receive T.V. sound, public service band, aircraft, V.H.F. local stations, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).

Complete kit of parts **£7·95** P.P. and Ins. 70p

Including Construction Plans

E.C.K. 4

7 Transistors, 6 tuneable wavebands, MW, LW, Trawler Band, 3 Short Wave Bands. Receiver Kit.

With 5in × 3in loudspeaker. Push pull output stage, gain control, and rotary switch. 7 transistors and 4 diodes. 6 section chrome-plated telescopic aerial. 8in sensitive ready wound ferrite rod aerial, tuning capacitor, resistors, capacitors, etc. Operates from a 9 volt P.P. 7 battery (not supplied with kit).

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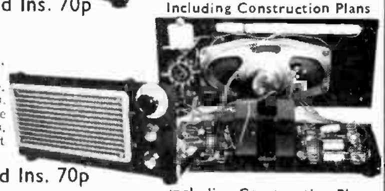

Including Construction Plans

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Components include: ● 24 Resistors ● 21 Capacitors ● 10 Transistors ● 3½" Loudspeaker ● Earpiece ● Mica Baseboard ● 3 12-way Connectors ● 2 Volume Controls ● 2 Slider Switches ● 1 Tuning Condenser ● 3 Knobs ● Ready Wound MW/LW/SW Coils ● Ferrite Rod ● 6½ yards of wire ● 1 yard of sleeving, etc.

Complete kit of parts including construction plans

£9·00 Total building costs. P.P. and Ins. 85p

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PRACTICAL ELECTRONICS

VOLUME 12 No. 11 NOVEMBER 1976

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

SPECIAL P.E. OFFER

Our December issue will be published on Friday, November 12, 1976
(for details of contents, see page 887)

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BF152	0·56	BSY25	*0·16	OC81	*0·16
BF153	0·46	BSY26	*0·16	OC81D	*0·16
BF154	0·46	BSY27	*0·16	OC82	*0·16
BF155	*0·71	BSY28	*0·16	OC82D	*0·16
BF156	*0·49	BSY29	*0·16	OC83	*0·20
BF157	*0·56	BSY38	*0·16	OC139	*0·20
BF158	0·56	BSY39	*0·19	OC140	*0·23
BF159	0·61	BSY40	*0·28	OC169	*0·26
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F198	0·12	MPF104	*0·28	ORP12/ NSL4931	*0·48
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F258	*0·38	OC20	*0·90	TIP29	*0·46
259	*0·46	OC22	*0·47	TIP30	*0·45
262	0·54	OC23	*0·49	TIP31A	*0·52
263	0·50	OC24	*0·57	TIP32A	*0·60
270	*0·36	OC25	*0·39	TIP41A	*0·65
271	*0·31	OC26	*0·38	TIP42A	*0·72
72	*0·81	OC28	*0·60	TIS43	*0·25
73	0·36	OC29	*0·60	UT46	*0·28
	0·38	OC35	*0·45	ZTX107	0·07
	*0·25	OC36	*0·51	ZTX108	0·07
	*0·10	OC41	*0·20	ZTX109	0·07
	*0·	OC42	*0·25	ZTX300	0·07
	12	OC44	*0·16	ZTX500	0·09
	12	OC45	*0·13	2N696	*0·10
	13	OC70	*0·10	2N697	*0·11
	13	OC71	*0·10	2N698	*0·20
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7402	0·11	0·10	0·09	7451	0·12	0·11	0·10	74141	0·60	0·58	0·56
7403	0·11	0·10	0·09	7453	0·12	0·11	0·10	74145	0·96	0·94	0·92
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7405	0·13	0·12	0·11	7460	0·12	0·11	0·10	74151	0·76	0·74	0·72
7406	0·25	0·24	0·23	7470	0·25	0·24	0·23	74153	0·95	0·93	0·91
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7410	0·09	0·09	0·08	7475	0·48	0·46	0·44	74157	0·95	0·93	0·91
7411	0·23	0·22	0·21	7476	0·25	0·24	0·23	74160	£1·00	0·98	0·96
7412	0·26	0·25	0·24	7480	0·50	0·48	0·46	74161	£1·00	0·98	0·96
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100V	0·60	0·60	0·70	0·70	0·78	0·78	0·83	0·83	1·01	1·01
200V	0·64	0·64	0·75	0·75	0·87	0·87	0·87	0·87	1·17	1·17
400V	0·77	0·78	0·80	0·83	0·97	1·01	1·13	1·19	1·70	1·74
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7417	0·27
7420	0·16
7427	0·27
7430	0·16
7432	0·27
7437	0·27
7441	0·75
7442	0·65
7445	0·85
7447	0·81
7448	0·75
7447A	0·95
7470	0·30
7472	0·25
7473	0·30
7474	0·32
7475	0·47
7476	0·32
7482	0·75
7485	1·30
7486	0·32
7489	2·92
7490	0·49
7491	0·65
7492	0·57
7493	0·45
7495	0·67
74100	1·08
74107	0·35
74121	0·34
74122	0·47
74141	0·78
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74154	1·62
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AC128	0·13	BC126	0·20*	BC327	0·16*	BDY62	0·55	BU105	1·80*	CRS3-60	0·85	TIP42A	0·72	2N3442	1·20
AC128K	0·25	BC141	0·28	BC328	0·16*	BF178	0·28	BU105/02	1·90*	MJ480	0·80	IN2069	0·14	2N3525	0·50
AC141	0·18	BC142	0·23	BC337	0·17*	BF179	0·30	BU126	1·60*	MJ481	1·05	IN2070	0·16	2N3570	0·80
AC141K	0·28	BC143	0·23	BC338	0·17*	BF194	0·10*	BU204	1·60*	MJ490	0·90	IN4001	0·04*	2N3702	0·10*
AC142	0·18	BC144	0·30	BCY30	0·55	BF195	0·10*	BU208	2·60*	MJ491	1·15	IN4002	0·05*	2N3703	0·10*
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AC176	0·16	BC148	0·09*	BCY32	0·60	BF197	0·12*	BY207	0·20*	MJE371	0·60	IN4004	0·07*	2N3705	0·10*
AC176K	0·25	BC149	0·09*	BCY33	0·55	BF224J	0·18*	BYX36–		MJE520	0·45	IN4005	0·08*	2N3706	0·10*
AC187	0·18	BC152	0·25*	BCY34	0·55	BF244	0·17*	300	0·12*	MJE521	0·55	IN4006	0·09*	2N3707	0·10*
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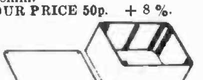

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Peerless KO10DT 4 or 8 ohm	£7·25
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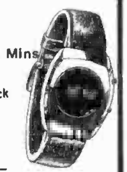

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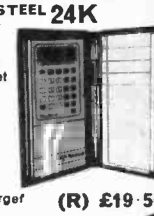

24K—Stainless-steel Slimline. Green display. Beautiful leatherette wallet to hold pen, note-pad and credit cards (all included). Full memory. √‾. Click-buttons. Rechargeable. Including recharger **(R) £19·50**

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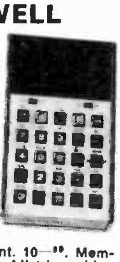

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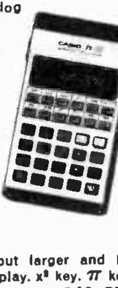
61R—Green display. 8-digits. All trig and log functions. **(R) £20·42**

CASIO



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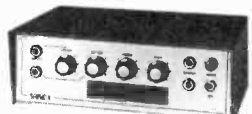

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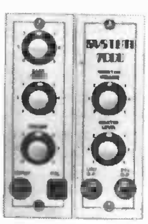

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First of all, one important fact must be acknowledged. Constructing activities isolate one from the family circle for long or longish periods. Such absences may be warmly approved, resignedly accepted, or vehemently resented, according to the individuals involved! Be this as it may, there are ample compensations for family and friends, no less than for the constructor himself, to be derived from such hermit-like activities.

To prove this let us set down a three-part recipe for preserving harmony in the home, for establishing a good reputation in local society, and finally for looking after number one. What is more, all the essential ingredients are to be found within this month's issue.

To maintain good family relations, to demonstrate that all those hours spent closeted in den or workshop are not just wasted, we recommend the PE Orion Tuner. As fine an instrument as you could wish to grace chiffonier, sideboard or music centre. It will be a permanent testimony to the constructor's skill; an object for all to admire and to enjoy.

To further one's reputation outside the home, we recommend the Discostrobe. It's bound to be a winner, a real wow at the club or church hall on Friday night. Only trouble is the inevitable demand for the donor's services on this, that, and every other evening of the week. Firmness is required here. Fame may bring in its train demands upon valuable spare time that could severely restrict building activities. However gratifying public acclaim may be, don't let it upset your sense of proportion. One simply has to be selfish at times.

And thinking of number one, how about that Hazard Flasher for the car. It won't take long to make and what a blessing it might prove to be one day. (Non-motorists substitute any other "shorty" project from past, present, or future PE's, according to fancy.)

Other interesting recipes to suit particular occasions can be concocted from the great variety of designs offered in PE, month by month. With careful choice of ingredients, one is certain to achieve success at home and away. So don't feel guilty about it when you retreat to workshop or den with PE under your arm. Walk to your hobby head high, as befits one whose altruism is not at all in doubt.

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Build this companion to the P.E. Orion Stereo Amplifier

PART 1

F.M. STEREO TUNER

By D.S. GIBBS & I.M. SHAW

THE Orion Stereo Tuner was designed to complement the P.E. Orion Amplifier, which was published in PRACTICAL ELECTRONICS in January/February 1975. (See Advertisement on page 913.)

The same design philosophy has been used in that this tuner has been designed to give a very high standard of performance at modest cost and with easy construction. The overall cost of parts is in the region of £25–30 at the time of writing.

The circuit is very simple and can be aligned without any instruments, although it is advantageous if a voltmeter is available.

TUNER HEAD

Whilst it is possible to construct one's own tuner head, a high degree of constructional skill is required and optimum results cannot be obtained without the use of elaborate and expensive test equipment. To overcome this problem we have used a ready-made tuner head in this design. The tuner head used is a Mullard LP1186, which is readily available from various firms advertising in PRACTICAL ELECTRONICS.

With a tuning voltage supply of 13·5 volts the LP1186 (Fig. 1.1) will tune from 87·5 to 105MHz and it provides a gain of 30dB with input and output impedances of 75 ohms. A particularly useful feature is the built-in 10·7MHz bandpass filter. This provides a useful amount of selectivity at 10·7MHz and permits the use of only one ceramic filter element in the i.f. amplifier, which reduces costs and eliminates the need for matched ceramic filters.

I.F. AMPLIFIER

Transistor TR1 provides a voltage gain of about 20dB, with an output impedance of 330 ohms to match the Vernitron FM4 ceramic filter. There are some cheaper 10·7MHz ceramic filters available but we have found that these tend to have inferior selectivity to the Vernitron type.

SPECIFICATION

Sensitivity: 1·5μV for 20dB quieting. 2μV for 30bB quieting

Tuning Range: 87·5 to 105MHz

Signal to Noise Ratio: 60bB unweighted for inputs over 50μV

Distortion: Less than 0·5% at 100% modulation, 1kHz

Output: 200mV r.m.s. at 100% modulation

Selectivity: 3dB down at $\pm$100kHz bandwidth
30dB down at $\pm$200kHz bandwidth

Image Rejection: 40dB

I.F. Rejection: 65dB

Stereo Separation: 30dB at 1kHz

Aerial Impedance: 75 ohms

The selectivity curve of the tuner head and i.f. amplifier is shown in Fig. 1.2 and it can be seen that the output remains relatively constant over a bandwidth of $\pm$100kHz, but falls off rapidly outside this band. At $\pm$200kHz the attenuation is 30dB to give good rejection of adjacent channels.

Fig. 1.3 shows the output level and signal-to-noise ratio of the tuner against aerial voltage. The tuner has a sensitivity of 1·5μV for 20dB signal-to-noise ratio and 2·0μV for 30dB, for mono reception. On stereo operation signal levels some 20dB higher are necessary to obtain the same signal-to-noise ratio because of the very much greater bandwidth of the stereo signal.

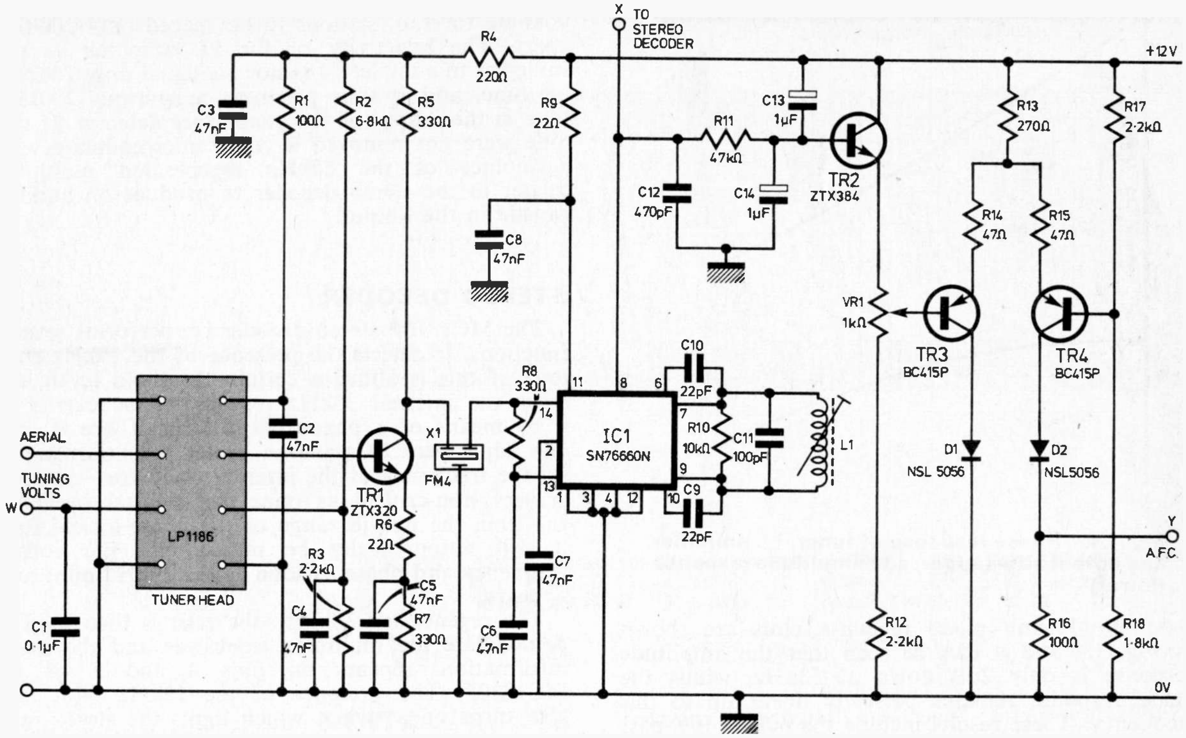


Fig. 1.1. R.F. and discriminator circuits

LIMITER/DISCRIMINATOR

The output from the ceramic filter drives the SN76660N limiter/discriminator i.c., which provides six stages of amplification and limiting followed by a quadrature detector (Fig. 1.1).

The component values in the quadrature detector have been chosen to give a distortion level of less than 0·5 per cent (typically 0·3 per cent) at 100 per cent modulation level. The distortion is of low order—mainly second and third harmonics—and is imperceptible to most listeners. It is possible to obtain lower distortion than this by the use of two coupled resonant circuits in the quadrature detector but this unfortunately introduces alignment problems that would be beyond the resources of most amateur constructors.

For stereo reception it is equally important for the detector to have a flat amplitude response and a linear phase response for modulation frequencies up to 53kHz, as failure in these requirements will lead to poor stereo separation. A linear phase/frequency response means, in effect, that the time delay through the whole tuner is constant regardless of the modulation frequency. Thus a complex waveform will come out of the system with all the harmonic components in exactly the same phase relationship to each other as when they went in. This keeps the pilot tone in the correct phase with the multiplex sidebands and gives good separation.

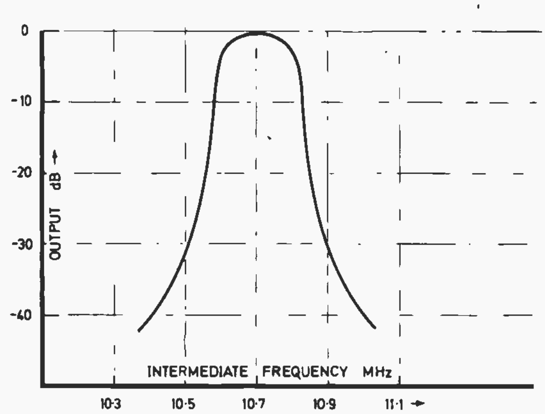


Fig. 1.2. Selectivity curve

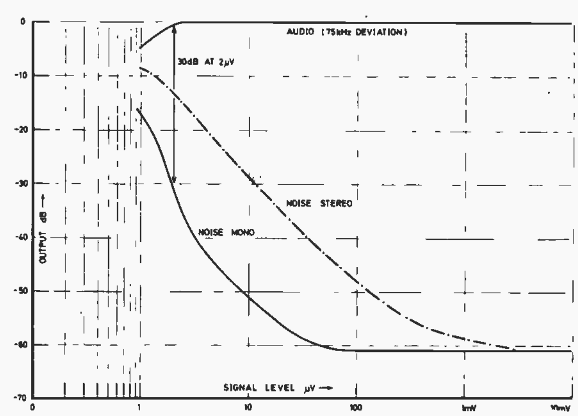


Fig. 1.3. Signal/noise graph for tuner

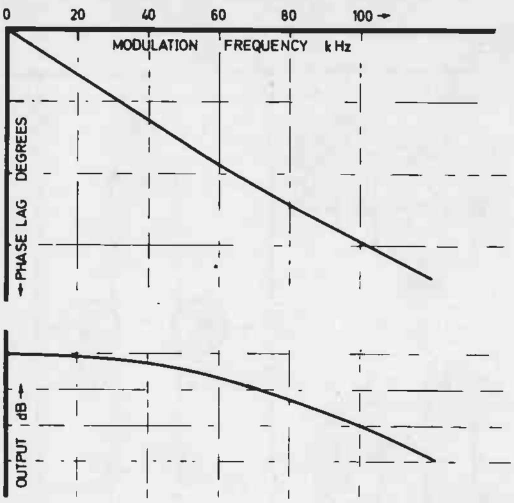


Fig. 1.4. Phase response of tuner, i.f. amplifier and output filter (upper) and amplitude response (lower)

Amplitude and phase response plots are shown in Fig. 1.4 and it can be seen that the amplitude response is only 2dB down at 53kHz, whilst the phase response remains perfectly linear up to this frequency. These results include the 60kHz low-pass filter included in the stereo decoder to remove "birdies".

BIRDIE FILTER

TR5 is an emitter follower and provides a low impedance drive for the MC1310P stereo decoder (Fig. 1.5). At the same time it acts as an active filter with capacitors C12, C15, and C16 giving a 3-pole low pass response. The response curve is −3dB at about 60kHz and approximately −37dB at 200kHz.

This filter is desirable because in some areas it is possible for f.m. stations to be spaced only 200kHz apart. The selectivity of the i.f. amplifier is not sufficient to completely remove a signal only 200kHz off tune, and it thus produces a spurious 200kHz tone in the output of the quadrature detector. If this tone were not removed it could intermodulate with harmonics of the 38kHz regenerated multiplex carrier in the stereo decoder to produce an audible whistle in the output.

STEREO DECODER

The MC1310P stereo decoder i.c. performs several functions. It detects the presence of the 19kHz pilot tone, if this is above a certain threshold level, and locks the internal 38kHz regenerated subcarrier to it by means of a phase-locked loop. There is only one adjustment to make—a preset potentiometer to set the frequency of the internal oscillator—and this is very non-critical as once the internal oscillator is within the pull-in range of the phase-locked loop it will automatically be pulled into the correct frequency and phase as soon as the 19kHz pilot tone appears.

The regenerated 38kHz subcarrier is then used to demodulate the multiplex sidebands and the audio information appears on pins 4 and 5 of the MC1310P. The presence of the 19kHz pilot tone also turns on a switch which lights the stereo indicator lamp.

The distortion generated by the MC1310P is very low, typically 0·1 per cent at the signal level used in this tuner.

The output from the stereo decoder contains a certain amount of 19kHz pilot tone and 38kHz subcarrier. These spurious signals are attenuated by the 50μs de-emphasis network on the output of the decoder, comprising components R25, C23, and R26, C24. Further attenuation is provided by a simple 16kHz low pass filter comprising R30, C27, and R31, C28.

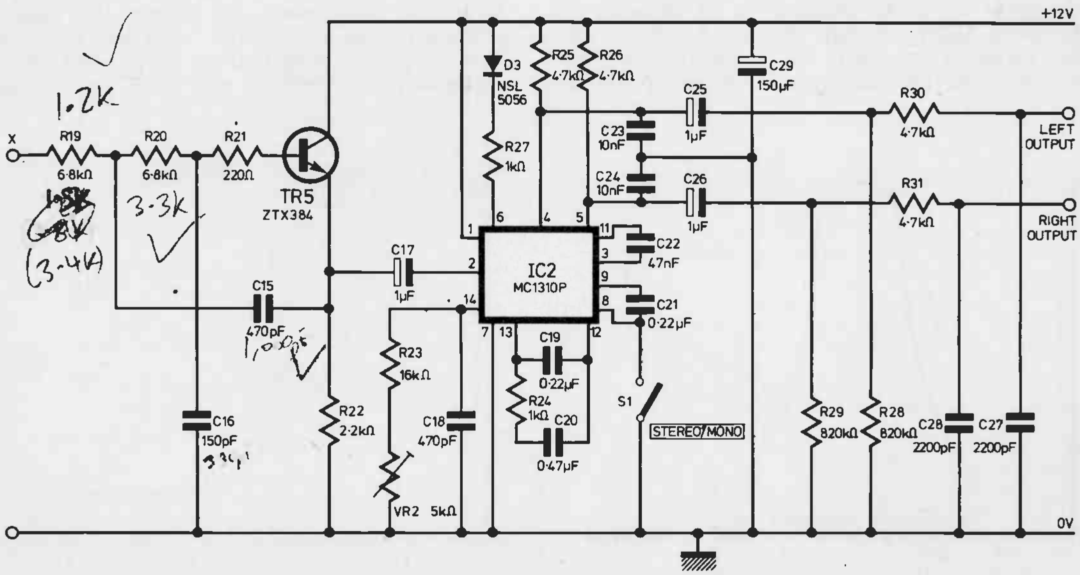


Fig. 1.5. Stereo decoder

COMPONENTS . . .

Resistors

R1	100 Ω
R2	6·8k Ω
R3	2·2k Ω
R4	220 Ω
R5	330 Ω
R6	22 Ω
R7–R8	330 Ω (2 off)
R9	22 Ω
R10	10k Ω
R11	47k Ω
R12	2·2k Ω
R13	270 Ω
R14–R15	47 Ω (2 off)
R16	100 Ω
R17	2·2k Ω
R18	1·8k Ω
R19	6·8k Ω
R20	6·8k Ω
R21	220 Ω
R22	2·2k Ω
R23	16k Ω
R24	1k Ω
R25–R26	4·7k Ω(2 off)
R27	1k Ω
R28–R29	820k Ω (2 off)
R30–R31	4·7k Ω (2 off)
R32	220 Ω
R33	1k Ω
R34	5·6k Ω
R35	6·8k Ω
R36	150 Ω
R37	68 Ω
R38	47k Ω
R39	220 Ω
R40	47 Ω
R41	4·7k Ω
R42	470 Ω
R43	4·7k Ω
R44	22 Ω

All 0·5W 5% carbon film

Capacitors

C1	0·1μF Mullard C280 polyester
C2	47nF 12V disc ceramic
C3	47nF 12V disc ceramic
C4	47nF 12V disc ceramic
C5	47nF 12V disc ceramic
C6	47nF 12V disc ceramic
C7	47nF 12V disc ceramic
C8	47nF 12V disc ceramic
C9	22pF polystyrene
C10	22pF polystyrene
C11	100pF polystyrene
C12	470pF polystyrene
C13	1μF 35V tantalum bead
C14	1μF 35V tantalum bead
C15	470pF polystyrene
C16	150pF polystyrene
C17	1μF 35V tantalum bead
C18	470pF polystyrene
C19	0·22μF Mullard C280 polyester
C20	0·47μF Mullard C280 polyester
C21	0·22μF Mullard C280 polyester
C22	0·047μF Mullard C280 polyester
C23	0·01μF Mullard C280 polyester
C24	0·01μF Mullard C280 polyester
C25	1μF 35V tantalum bead
C26	1μF 35V tantalum bead
C27	2,200pF polystyrene or polyester
C28	2,200pF polystyrene or polyester
C29	150μF 16V electrolytic
C30	10μF 35V tantalum bead
C31	0·01μF Mullard C280 polyester
C32	1,000μF 25V electrolytic
C33	0·01μF 750V disc ceramic

Potentiometers

VR1	1k Ω preset
VR2	5k Ω or 4·7k Ω preset

Switches

S1	S.p.d.t. miniature toggle or slide
S2	S.p.d.t. miniature toggle or slide
S3	Rotary mains

Semiconductors

TR1	ZTX320 Ferranti
TR2	ZTX384 Ferranti
TR3	BC415P Ferranti
TR4	BC415P Ferranti
TR5	ZTX384 Ferranti
TR6	ZTX384 Ferranti
TR7	ZTXA20 Ferranti
TR8	ZTXA20 Ferranti
TR9	ZTX108 Ferranti
TR10	ZTX550 Ferranti
TR11	ZTXA20 Ferranti
D1	NSL5056 National } All l.e.d.s
D2	NSL5056 National } All l.e.d.s
D3	NSL5056 National } All l.e.d.s
D4	BZV19 C6V2 Ferranti
D5	BZV19 C11 Ferranti
D6	ZS170 Ferranti
D7	ZS170 Ferranti
IC1	SN76660N Texas, or TBA120A (ITT)
IC2	MC1310P Motorola

Tuner Head

Mullard LP1186

Inductor

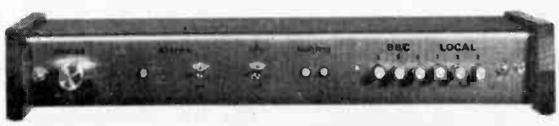
L1–24 turns of 30 s.w.g. enamelled wire close-wound on a Neosid 6mm coil former type 722/1, with core type 4× ·5× 10/900SL screening can type 7100 and base plate type 5027/4PLD.

The whole coil former assembly is available from Neosid under type No. A6.

Miscellaneous

1 Printed circuit board (Davian Electronics)
1 Case type GB1 (H.M. Electronics)
1 Vernitron ceramic filter type FM4 (Home Radio)
1 Push button tuner unit
1 15–0–15 volt mains transformer (R.S. Components type 207–217)
1 20mm fuseholder and 1A fuse
1 DIN 5 pin 180° socket
1 Belling Lee insulated co-ax aerial socket
1 Control knob (Eagle type K30/3)

Screws, spacers, grommet, connecting wire, solder



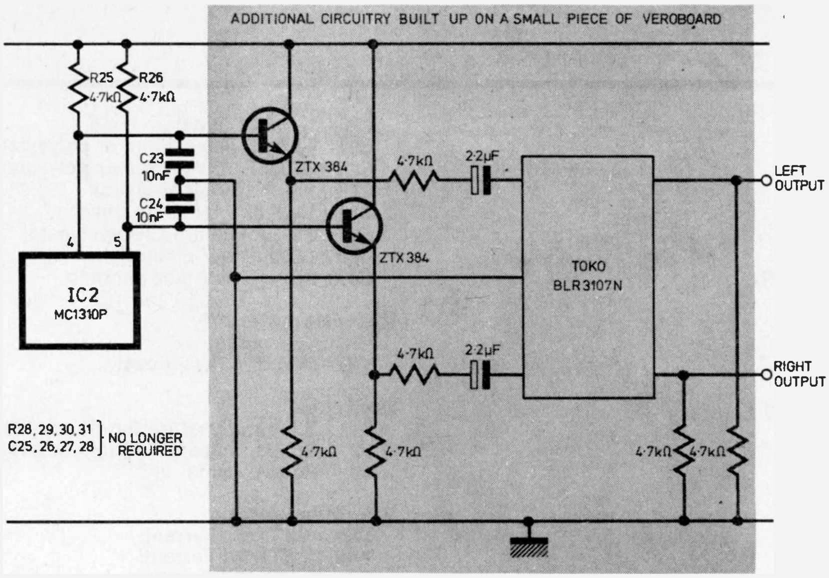


Fig. 1.6. Modifications for use of Toko notch filter

Together these filters give a 19kHz level of −35dB and a 38kHz level of −50dB. This will be quite sufficient for most purposes, but it is possible that additional filtering may be necessary for some tape recorders which do not have their own multiplex filter. If this is the case we recommend the use of a notch filter such as the Toko BLR3107N.

This needs some circuit modifications to provide the 4·7kilohm matching impedances required at input and output and it will probably be best to build up the extra circuitry required on a small piece of Veroboard.

A circuit diagram is shown in Fig. 1.6 and it should be noted that components C25, C26, C27, C28, R28, R29, R30, and R31 should be removed as they are no longer necessary.

The Toko filter provides a very sharp cut-off at 15kHz and reduces the 19kHz and 38kHz components to negligible proportions; but it should be noted that the output level is reduced from 200mV to 100mV and there may be some 15kHz ringing on the output waveform due to the very sharp cut-off.

TUNING INDICATOR AND A.F.C. AMPLIFIER

R11 together with C13 and C14 forms a low-pass filter which removes all the audio information from the output of the SN76660N leaving a d.c. voltage which varies with tuning. The emitter follower TR2 provides a low impedance drive for the a.f.c. amplifier and tuning indicator.

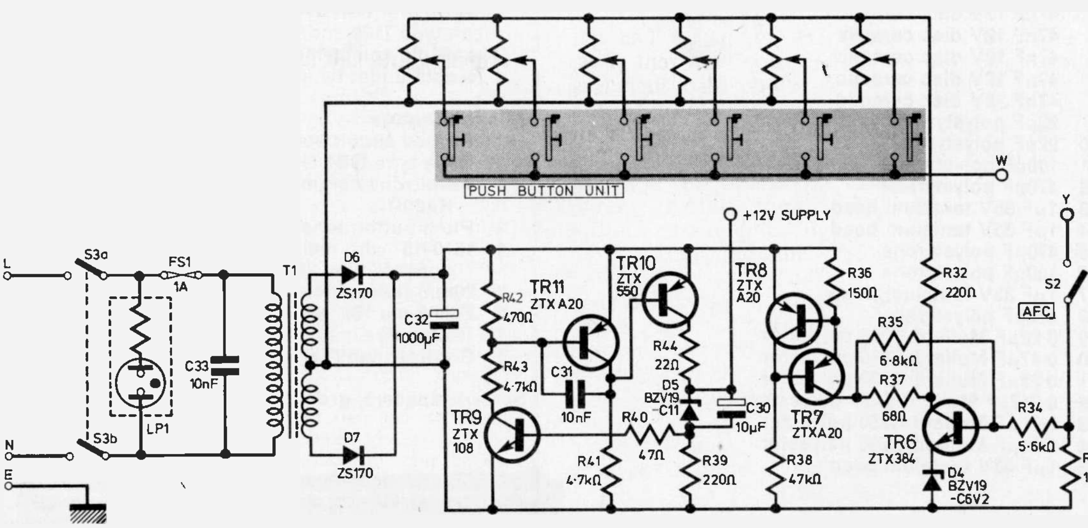
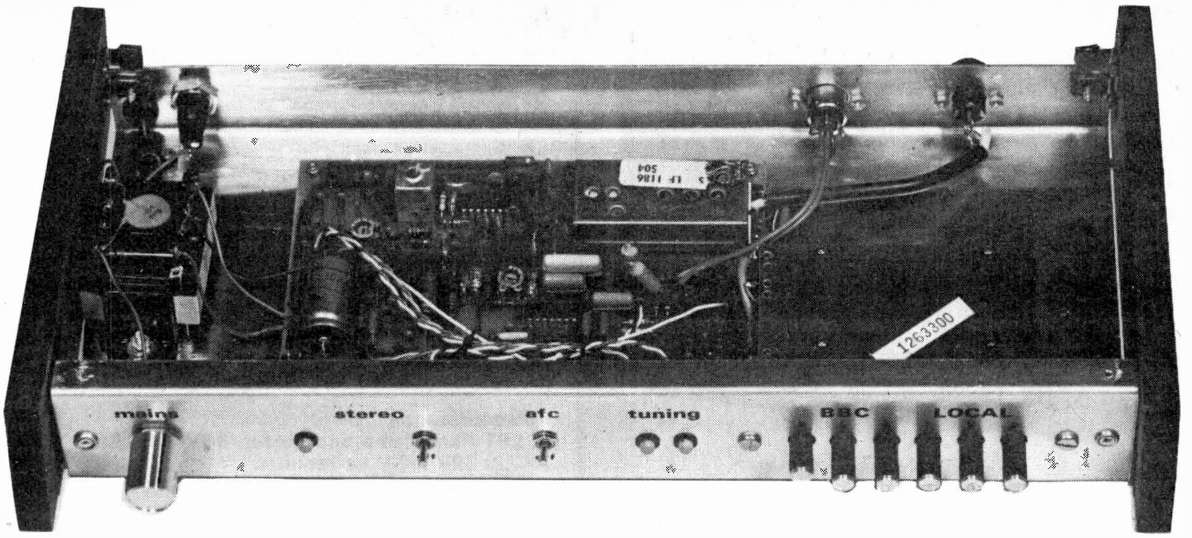


Fig. 1.7. Power supply and pushbutton unit



The design of an a.f.c. system presents certain problems in that for good stability a strong a.f.c. action is desirable—but this in turn introduces a tendency for the tuner to lock on to the wrong station when it is first switched on.

This problem has been overcome in the Orion Tuner by the use of an a.f.c. amplifier which provides strong a.f.c. action over a limited range of about $\pm$100kHz, but which saturates beyond this range. Thus if the tuning is within 100kHz of the station the a.f.c. will come into action and pull the tuning in to the correct frequency, but if the error is more than 100kHz there will be no effect.

The amplifier also has ideal characteristics for use as a fine tuning indicator and the tuning is indicated by two l.e.d.s in series with the collectors of TR3 and TR4. The tuning is adjusted so that both lamps glow with equal brightness.

TUNING VOLTAGE REGULATOR

The Mullard LP1186 tuner head and the push-button tuner unit require a supply voltage of 13·5 volts at about 1mA. This is provided by transistor TR6 and Zener diode D4 (Fig. 1.7). The circuit operates as follows. As the supply current rises, the voltage across the Zener diode also increases because of its finite slope resistance. However, the increase in current through the transistor causes an increase in the voltage drop across resistor R37. This reduces the output voltage, and for a limited range of supply current the reduction in output voltage caused by R37 can be made to compensate for the increase in Zener voltage, by suitably choosing the value of R37.

Good thermal stability is also achieved because the positive temperature coefficient of the Zener diode is approximately matched by the negative temperature coefficient of the transistor base-emitter junction. This keeps the output voltage stable with variations in ambient temperature.

To further increase stability and ensure low ripple the regulator circuit is fed from a constant current source comprising TR7 and TR8.

A.f.c. action is provided by connecting the output of the a.f.c. amplifier to the top of R33. Thus any deviation in the output voltage of the a.f.c. amplifier from its nominal value of 1 volt causes a corresponding variation in the tuning voltage to compensate for the tuning error.

POWER SUPPLY

The power supply for the tuner is 11·7 volts at about 60mA, which is provided by TR9, TR10, and TR11. The circuit used has the advantage of providing very low ripple (approximately 50μV). This is desirable because the output of the stereo decoder appears in series with the h.t. rail and so any ripple on this rail would appear in the audio output.

Next Month: Constructional details and test procedures

NEWS BRIEFS

Transatlantic Microprocessor Link

One of Britain's largest i.c. manufacturers, G.E.C. Semiconductors Ltd., has decided to market the American Intel microprocessors, rather than develop yet another design of their own. G.E.C. believe that it makes sense to devote its own research and development capacity to strong support activity for the proven range of Intel products, and in this connection have just announced details of what is claimed to be a world leadership in MPU software development, the RCC80 Coral 66 Compiler. This compiler, available ex stock for £1,500, is designed for use with the Intel 8080A microprocessor, it runs on an MDS800 development system, and is designed to reduce the cost of producing reliable microprocessor software.

Coral 66 is the British Government Standard high level language for real time and process control applications, and is widely used in defence and research establishments and in nationalised and other large industries. G.C.E. Semiconductors Ltd. chose Coral 66 because of its universal acceptablity as an independently defined real-time language, and its particular relevance to microprocessor development in many of its current fields of application.

HAZARD WARNING FLASHER

By C. J. COKER

WITH so many cars on the roads these days, a breakdown can lead to a very hazardous situation. It was with this thought in mind that the unit to be described was constructed. It can be used on both 6V and 12V electrical systems with either positive or negative earth, and is connected to the car electrics with only four wires. The flashing rate, as required by law, is approximately one per second.

CIRCUIT DESCRIPTION

The hazard flasher uses the now common NE555 timer i.c. connected in the astable mode to give a continuous pulse output. The circuit diagram and connection details are given in Fig. 1.

COMPONENTS . . .

Resistors
R1, R2 47kΩ

Capacitor
C1 10μF tantalum 35V

Semiconductors
IC1 NE555 timer
D1 1GP10 or similar germanium diode

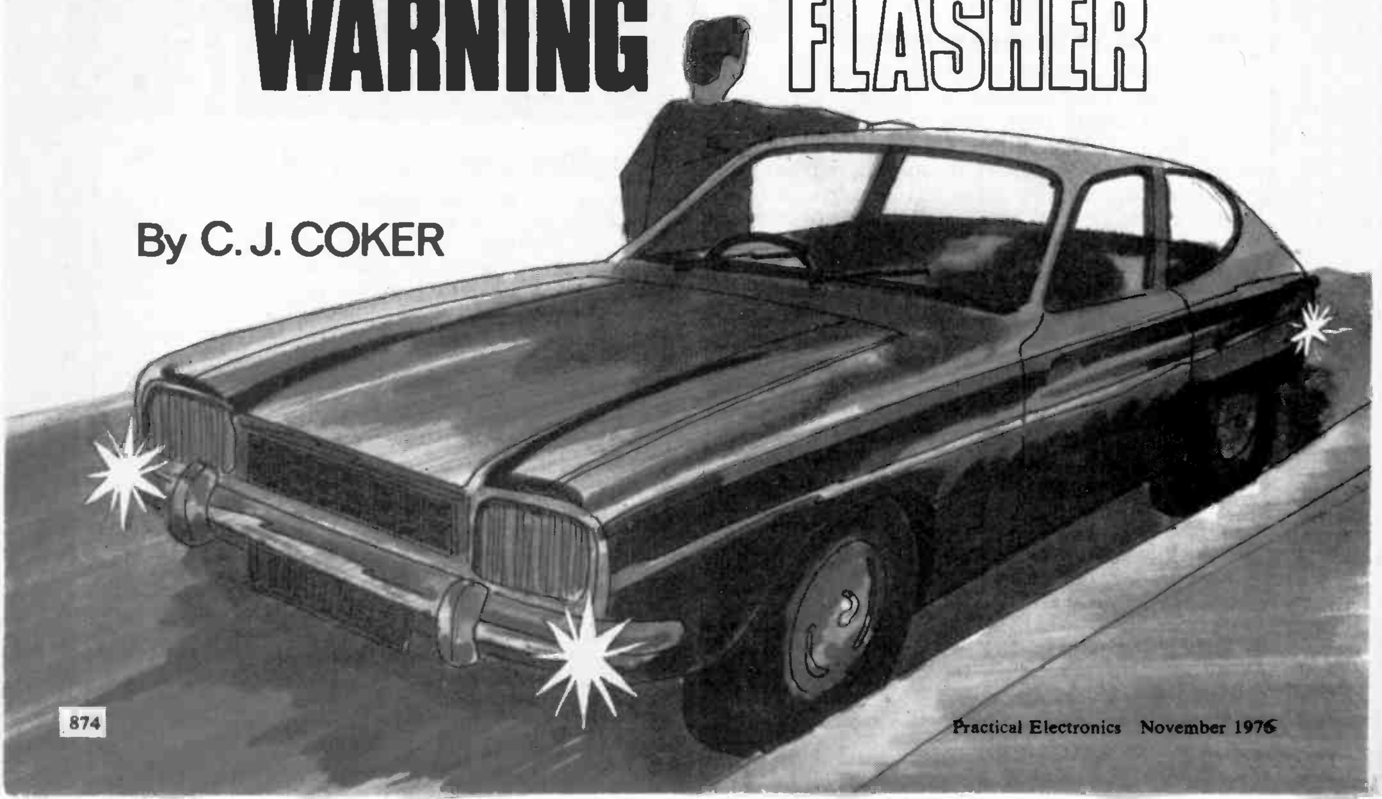
Relay
RLA 3 pole changeover with 5A contacts, 6V or 12V coil as required, see text (Pigmy mains relay-Electrovalue)

Miscellaneous
LP1 Panel lamp and holder, 6·5V 0·3A or 12V 2·2W as required
S1 S.p.s.t. switch (car accessory type)
Printed circuit board
8-pin DIL i.c. socket (optional)
4-way connector block; 10A cable for external connections; Case, 100 × 65 × 50mm approximately; 2 "Scotchlok" connectors

Capacitor C1 charges through R1 and R2 from a potential of one-third of the supply voltage up to a potential of two-thirds of the supply voltage, and then discharges again to one third of the supply voltage when the internal comparator in the NE555 causes the potential at pin 7 to go low.

The charging time is approximately 0·7(R1 + R2)C and the discharging time 0·7R2.C. The frequency of operation is approximately

$$\frac{1 \cdot 44}{(R1 + 2R2)C}$$



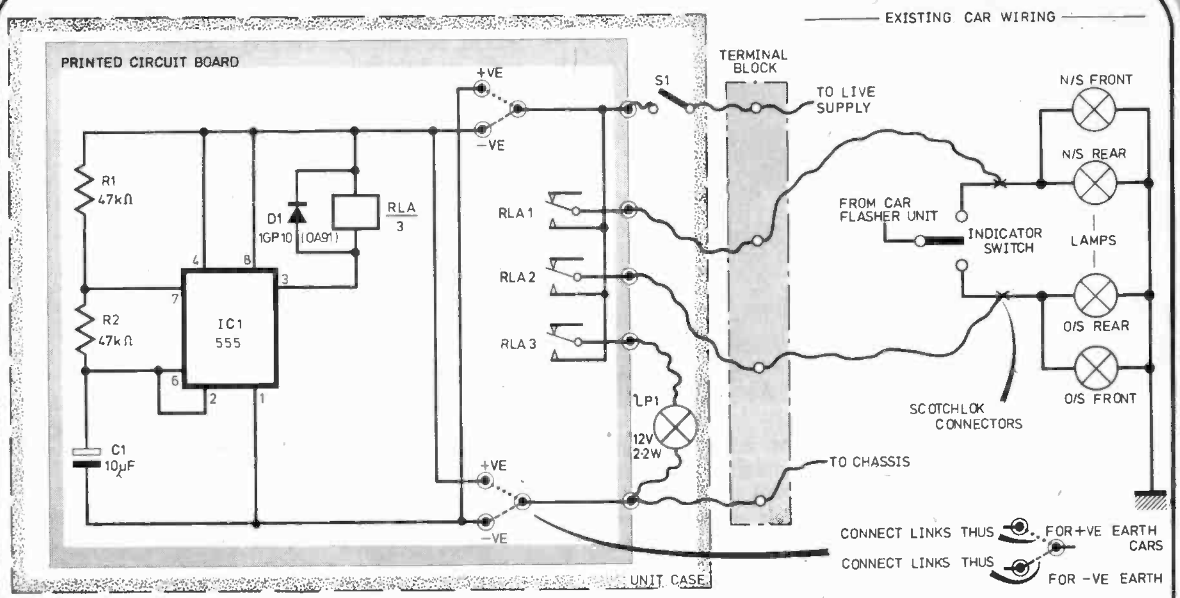
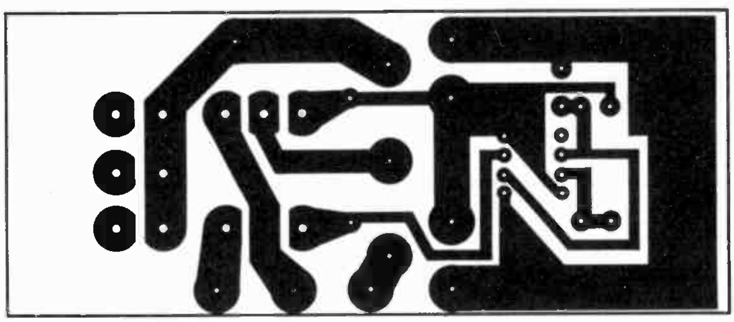


Fig. 1. Circuit diagram and connection details



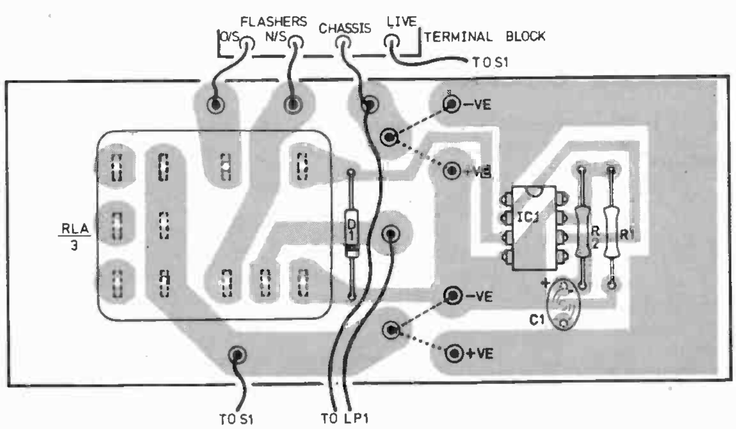
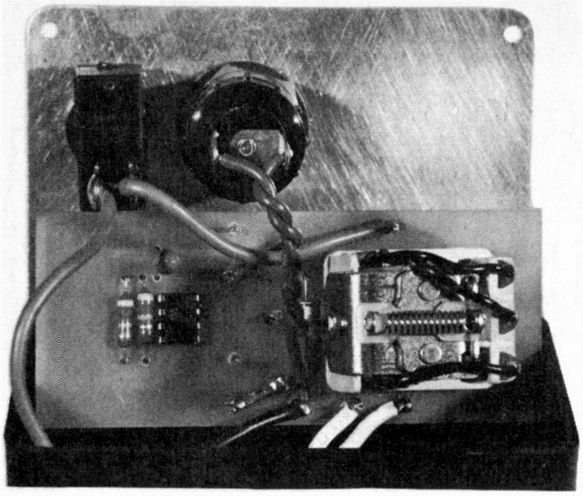


Fig. 2. Printed circuit board pattern and component layout



The output at pin 3 is a square wave which is high whilst C1 is charging and low when discharging. The diode D1 serves to suppress voltage spikes, generated when the relay is de-energised, which might otherwise damage the i.c. The lamp LP1 indicates that the unit is functioning correctly.

CONSTRUCTION

The circuit is constructed on a small printed circuit board. Fig. 2 shows the component layout and track pattern. Care should be taken when soldering the 555, as damage can easily be done. An i.c. socket can be used if desired. The relay can be any miniature type with 5A contacts, provided it does not take more than about 150mA from the supply. It can be mounted on or off the board, depending on its shape and size.

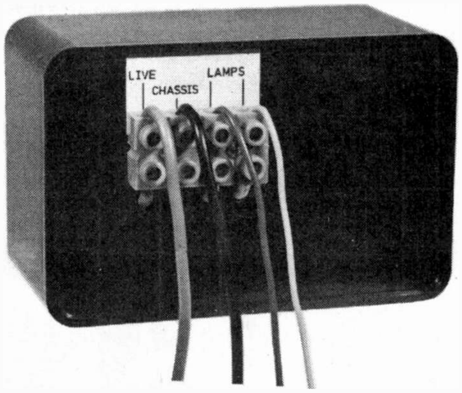
The unit can be housed in any suitable small metal or plastics box, and mounted underneath the dashboard. The on/off switch and warning lamp should, of course, be fitted on the front panel of the box.

INSTALLATION

The live supply connection is taken from the fuse box of the car, or if it has no fuse box, via a line fuseholder with a 10A fuse in circuit. The supply must be on when the ignition is turned off. The earth connection should be taken to a convenient car chassis point.

The existing wires going to the indicator lights can be located at the back of the turn indicator switch, and the two output wires tapped in using "Scotchlok" connectors, available at motor accessory shops.

The two links on the printed circuit board must be wired accordingly for a positive or negative earth supply, as shown in Fig. 2. ★



Readout— A SELECTION FROM OUR POSTBAG

Readers requiring a reply to any letter must include a stamped addressed envelope. We regret that we cannot answer any technical queries on the telephone.

Karnaugh Map

Sir,—May we draw your attention to page 652 PRACTICAL ELECTRONICS, August 1976, "Karnaugh Map Display" where Mr Cartlidge mentions how the idea of constructing a "real time" Karnaugh map display occurred to him.

We wish to claim the design as our manufactured product which has been available and sold for a number of years to a great many establishments, colleges, universities, etc. Enclosed herewith you will find an illustration, together with a booklet written by Professor Reeves of Keele University and available from us free upon payment of 15p for postage and packing.

It would be very much appreciated if you feel you could make these facts known in a future publication to your readers.

We wish your journal long success.

J. Fairhurst,
Managing Director,
Fairhurst Instruments Ltd.,
Wilmslow, Cheshire.

Our Contributor replies

Until I saw the above letter I had not heard of Fairhurst Instruments Ltd., but I must admit that their product is very similar in principle to the unit described in my article. However, how many ways can one display a four-function variable on sixteen l.e.d.s!

It was after a class in which mappings were done on paper and, during which, as an exercise a mapping unit was being built on Farnell Logikit, its display being on an oscilloscope, I thought to myself that it would be nice to have some self-contained Karnaugh Mapping Units displaying their outputs on light-emitting diodes. From that thought or "idea", myself and my lecturer friend designed the circuitry and I built the units and submitted the design for publication.

I am sorry that the phrase in the second paragraph of my article has, perhaps, been misinterpreted, and I can only say that had I known about Fairhurst's product I may have saved myself a great deal of hard work.

C. Cartlidge,
Stafford.

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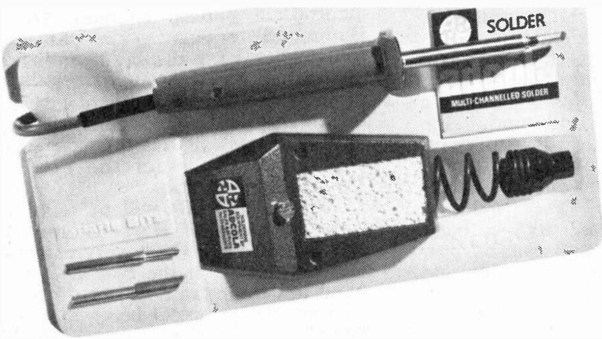

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A new soldering instrument is the star feature of this Adcola Products soldering kit. It has been developed to conform generally to British Standard BS 3456, 2:14 and to world-wide safety precautions. Known as the Invader "S" 646—the "S" stands for "safety"—it is flash tested at 2,000 V (far in excess of most safety standards) and the accent is on complete user safety without sacrificing efficiency or ease of use. The iron is thermally controlled to provide a constant level of the correct heat for soldering at 400 degrees C. Each model weighs less than 2 oz, and two metres of cable, fitted with a cable protector, are provided. The standard soldering tip provided is $\frac{3}{16}$ in. (4·7 mm) diameter but two alternative bits of $\frac{1}{8}$ in. (3·2 mm) and $\frac{1}{4}$ in. (6·3 mm) diameter are included to provide complete versatility in use. These bits are easily inserted in the hexagonal shim at the end of the tool as required.

An Invader stand is also contained in the kit to provide the user with a mobile and safe receptacle for the hot soldering instrument. The stand features an integral sponge for cleaning excess solder from the soldering bits and two holders to contain the spare bits. A wide angle spring holder is mounted on the base of the stand at an angle of about 45 degrees and the soldering tool is simply inserted into the holder when not in use.

To complete the kit a packet dispenser of Adcola solder wire—which contains its own flux—and a guide to soldering are also included.

The kit is presented in an eye-catching pack consisting of a lemon coloured plastic tray which incorporates recessed areas to locate each part. This base is covered by a crystal clear plastic lid to display the components in an effective manner.

Remittances must be by postal order or cheque (name and address on back of cheque please), crossed, and made payable to Adcola Products Ltd.

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From: Adcola Products Ltd. (P.E. Offer)
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Cut Round Dotted Line

THIS year's Musical Instrument Trade Fair (August 15–19) was spread about last year's venues, namely the Bloomsbury Centre, Russel Hotel, etc., with the exception that pianos and organs shared the Connaught Rooms.

SYNTHESISERS

Boosey and Hawkes featured a sound booth with the impressive ARP family of synthesisers; the single oscillator Axxe and multi-voiced Odyssey and 2600 and of course Little Brother which provides a lot to expand the versatility of these instruments making possible string orchestra and other instrumental ensemble effects.

Notable newcomers was the ARP Sequencer and the Omni. In principle a sequencer can be thought of as a versatile function generator. Unlike the normal function generator that provides a time-varying voltage that cycles about this can prove a complete sequence of output voltages—which are immediately programmable—for control of a synthesiser.

The ARP Sequencer in demonstration proved an extremely creative tool, providing arpeggios, "walking eight" accompaniments and melody lines. Programming is done through sixteen switches. Pitch levels can be rapidly set up and a musical pattern set which can be easily varied. Accent patterns, harmonies and rhythms can also be arranged. In conjunction with the synthesiser this is a powerful composing aid.

The ARP Omni in contrast is an outstanding keyboard for live performance. Completely polyphonic it allows one to call up string choruses in the right hand with all those gorgeous harmonic products of phasing which one associates with string ensembles, and in the left hand, brass synthesis. Since you can mix the stereo image at will and contour the sounds this is a very potent entertainment outrider to an organist.

MICRO-MOOG

Latest of Moog products is the Micro-Moog T.M. This is a single oscillator synthesiser but artfully augmented with a continuous mix of a square waveform either one or two octaves lower which overall provides a doubling effect. Square, sawtooth, variable rectangular and a mixture of variable and rectangular waveforms are available. A feature is that both the oscillator and filter control circuits are thermostated and heated which apparently makes for total pitch stability.

This is a live performance instrument which will allow you to compete with a guitarist as it includes a pitch bend ribbon and modulation wheel for those specially expressive sounds.

Brodr Jorgensen offered in its synthesiser range the modular System 100. Starting with a basic synthesiser other units can be purchased, as circumstances allow, to culminate in a studio sound synthesiser. The additions include an expander, sequencer and mixer.

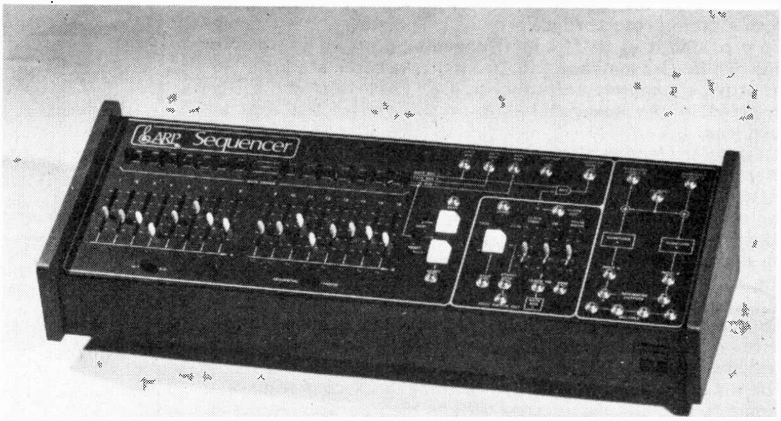
ORGANS

This year the general emphasis for organs was towards full specification models in the middle price range. There were quite a few new models but very few new features. Some sales blurb even tried to capitalise out of the single primary tone oscillator found in their instruments. This Lowrey patent has been around now for seven years.

Once again the fun machines were very much in evidence with Baldwin perhaps stealing the edge with their "FunMachine". This has two in-line keyboards—the left of one octave the right of three. A one fingered rhythmic accompaniment is played on the left from a choice of seventeen. Likewise a one fingered solo line can be picked out on the right. Once again one of those awful acronyms ASR (Automatic Solo Registration) is available to choose the correct voices (?) to go with the rhythms for those tots who are confused in selecting a registration. Major and minor chords are automatically available in the left hand with rhythm on touch or continuously available.

It's well known that repeated rhythm patterns become very wearisome and many manufacturers now incorporate pattern changes. Some Hammond organs cycle through four with a lamp display to indicate the sequencing. However, there are devices that help to mitigate such as the magic strums, arpeggios and "walking-bass" figures that are such an exciting feature of the Lowrey "Magic Genie" series.

Most organ buffs will be familiar with the name of Harry Stoneham and Jerry Allen. These very capable musicians were at the Norlin Music stand to demonstrate various Lowrey instruments, principal being the new Symphonic Citation Theatre Spinet organ. This includes a Bass Symphoniser that simulates the attack and timbre of brass instruments and an Orchestral Symphoniser which provides authentic piano and guitar yet I have still to hear anything to beat the jazz violin sounds conjured up by Bill Skidmore playing an



The ARP Sequencer

Orbit III keyboard on an 805 model Wurlitzer—real vintage Grappelli. At £3,300 this versatile instrument represents good value as its character can be readily swung from liturgical through theatrical to jazz.

M.C.H. Manufacturer's Centres Ltd., a British subsidiary of the Dutch parent company displayed the Eminent 2000 Grand Theatre organ with a specification that would fill this page and costing £4,500. At nearly half this price you can get the Eminent 310 with ARP Pro-Soloist synthesiser (preset voices).

AMPLIFIERS

Many musicians favour a valve amplifier with its "heavy" harmonically rich sound produced through the large proportion of third harmonic distortion as it approaches its rated output. Comparatively, a transistor amplifier is distortion free and provides a guitarist with a musically "thin" sound which appears sterile.

H.H. Electronics have seemingly solved this in their V-S range of instrument amplifiers, here they've invested solid state with a footswitch controllable "valve sound". The secret is a harmonic generator which creates an overtone character identical to a pentode valve output stage.

Obviously this is a useful innovation as the footswitch can immediately remotely control the amplifier for a muddy guitar solo followed by clear solid state amplification, say for a keyboard.

Among new items displayed by Omec was a voice box which will be recognised by many as used by Stevie Wonder. The box connects between instrumental amplifier and speakers; when a switch is pressed the instrument output suitably attenuated and diverted to the box transducer, usually a horn driver, then via a tube to the performer's mouth which he shapes to the instrument sound (very effective when the instrument is a synthesiser). The new sound is then passed to the microphone and P.A. system.

The Omec Digital Amplifier is certainly different with futuristic push buttons and not a knob in sight.

This is a 130W solid state unit which is designed to take a lot of the headaches away from the performer as it is possible to recall any one of four preset combinations of tonal equalisation (i.e., bass, middle or treble with volume control) complete with reverb, sustain or fuzz by pushing control buttons. Here pots and switches have been substituted by digital methods. Adjustments can be made to the selected channel while playing, any alteration being automatically transferred to the memory for that channel when a new one is selected.

The unique plus about the amp is that particular sounds can be precisely repeated at every performance by simply punching buttons.

OTHER UNITS

I suppose it had to come; the "rotating sound" or Leslie effect has gone solid state so Roland (Brodr Jorgensen) announces with their Revo (120W) and Revo 120 (70W). These are three channel units which make clever use of electronic phasing techniques and numbers of speakers, to beguile the ear with amplitude and frequency modulations normally associated with the genuine article. Both units include reverb, bass balance and an effective "rotor" speed selection. Since the price nearly equates with the Leslie and Sharma organ-speakers I don't expect the status-quo to be very much disturbed.

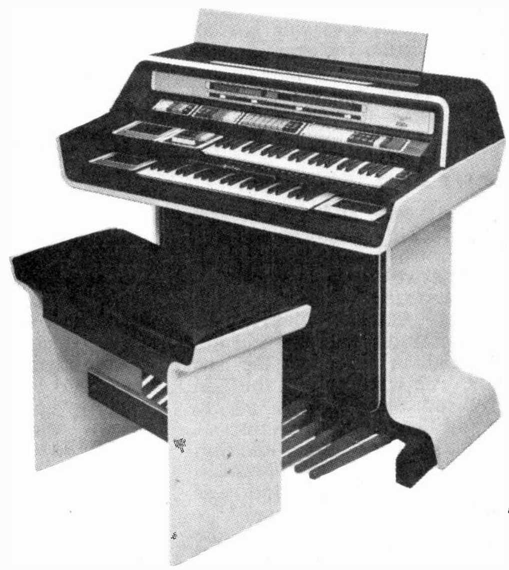
Another area which has genuflected the knee to electronics (this time "bucket-brigade" techniques) is tape-echo. Carlsbro presented an excellently engineered electronic echo—the Mantis—which is claimed to create a wide range of clean echo, reverb and phasing effects.

For the record Brodr Jorgensen have also come out with such a machine with "digital chorus" whilst I have no information on this it seems obvious that either unit could duplicate as rotary speakers but without the sophistication of the Revo units.

From Hornby Skewes comes a whole range of effects units—briefly —the Jen Motorphaser, a rotating sound footswitch which has chorus and tremolo speeds with simulated motor acceleration and deceleration; and the Systech range of pedals. These included a Harmonic Energiser with gain boosts, of up to 100 times for harmonics. An Envelope Computer for harmonic shaping and rate changing and a Flanger which effectively augments keyboards, vocals, drums, cymbals and all P.A. effects.

A demand for a modular sound effect system that could be mains powered and enable the player to have several units interconnected, all switchable with preset controls has resulted in the Black Box models by Eurotec. Fuzz, phase, sustain, octidivide and a v.c.f. are available and these effects can be varied with the pedal that completes the system.

Eminent 2000



Thomas 2001

BY FRANK W. HYDE

THE RETURN TO THE MOON

The next lunar mission, planned by NASA, will be accomplished with a pair of satellites orbiting the Moon. The present plan sets a date in 1980. NASA have already announced the outline plan and the experimenters.

The principal satellite will remain on station for about a year. This station will be in a polar orbit and will therefore make the first global survey of a body in the solar system other than the Earth. It is expected that the whole of the surface of the Moon will be observed. Continuous survey will be made of the gravitational variations, changes of magnetic field and the heat flow in the Moon.

It will also be possible to extend the experiments to determine the chemical and mineral composition of the surface. Since there has been very extensive examination of the lunar rocks, brought back by the *Apollo* missions, some anomalies have caused concern. For example, only two pieces of rock were identified conclusively as being part of the original crust of the Moon. The time scales were so at variance with those of the Earth that it seemed possible that the Moon was derived from a different source.

However, because of the *Apollo* manned observations together with the observatories left by each mission, to continue operations on the Moon itself, a number of the doubts have been resolved. It is established that the crust on the far side of the Moon is much thicker and more mountainous than the side facing the Earth. The Moon then shows today what the Earth, Venus and Mars once were.

It was thought that all debris would have been swept up within 700 million years of the original formation. Clearly this was not so. The Mare Imbrium for example was probably caused by a body the size of Cyprus. These are some of the problems that this new lunar mission may solve.

DROUGHT AND THE SUN

In recent years and particularly since the *Skylab* missions the Sun has been shown to be anything but a stable and well behaved body. It has been suggested by John A. Eddy of the High Altitude Observatory, Boulder, Colorado, that the Sun has been anomalous twice in the last 900 years. The condition of the Sun is partly indicated by the aurora activity and the number of sunspots. A very notable period when the Sun went "anomalous" was between 1645 and 1715. This period was called the "Maunder Minimum".

The records from all over the world for this period show that the Sun behaved in a most strange way. There were very few sunspots in some years in this "Maunder Minimum" and in others none at all. Aurorae were almost non-existent and it is interesting to remember that this was a period when Edmund Halley the great astronomer watched the skies almost nightly. Yet he was nearly 60 before he observed aurorae in London. During the "Maunder Minimum" the corona was faint with little structure compared with that expected now.

During such times the galactic cosmic ray particles penetrate the solar system to a much greater degree. The particles follow the magnetic field lines and enter the atmosphere destroying ozone. They also produce carbon 14 which is later absorbed by rocks, plants and trees.

Another consequence during that period was the change of climatic conditions. Europe had its coldest period for centuries. Tree rings in the USA showed erratic patterns indicative of drought.

There are signs that an anomalous state is occurring now. At the moment a drought period is beginning.

The Soviet Union is also finding agreement on these points. They have recently reported that the Arctic areas are getting colder. The north pole has already entered upon a new phase of harsh conditions. In Leningrad a survey of the North Sea covering the last 50 years has shown that the warming up period began to lessen in the 1940s and is getting progressively less. This means that the warming period which enabled the development of transport beyond the Arctic circle is reducing again. The ice is thickening and the icefields are extending southwards. Also the areas in Russia's Arctic coastline have suffered a shortening of the summer period by a month. Soviet observers believe that these conditions will continue till the year 2000.

It is clear from space observations that the Sun is a much more complicated body than was supposed. In the present, researches into the harnessing of solar energy space techniques are likely to have great demand. From the knowledge gained in solar space observation will come the leads to a better understanding, not only of the Sun itself, but also its more intimate effect on the Earth. Thus it appears that there is an interdependence between the Sun and the Earth and that the Earth, Moon and Sun must be considered together.

SALYUT 5

Some of the specialised experiments carried out by the cosmonauts were directed to surveying the terrestrial atmosphere in infra-red rays.

Previous work done with *Salyut 4* led to the conclusion that the basic source of infra-red emission from the upper layers of the atmosphere, was nitrogen oxide. A greatly improved infra-red telescope on *Salyut 5* has enabled this work to be extended.

This telescope has a system of mirrors which enables the focusing of the emission in a way that can be recorded on tape. The operation of this technique involved keeping the spacecraft and telescope directed to the disk of the setting Sun.

Another experiment is with the growth of crystals in the absence of gravity. One of the crystals produced in the crystalliser was put into a sealed container and brought back to Earth. The cosmonauts also repeated earlier experiments in soldering in weightless conditions. A cycle of studies was made to determine the changes in taste sensations under spaceflight conditions. During the period of working on the guidance of *Salyut 5*, some 17 hours continuous navigating was undertaken using an optical sight and manual control. Although the period spent aboard *Salyut 5* was shortened there is every reason to believe that the whole mission was a complete success.

SATELLITE DISCOVERY

An unusual side issue from satellite remote sensing activities comes from sensing experiments by the Indian Space Research group for the development of indigenous capabilities. Success in the location of minerals has already shown promise. A bonus came from the agricultural and forestry areas. It was shown that many areas where forests are supposed to exist have no trees at all. In the reports to the authorities false information had been recorded. So a literal eye from the sky brings truth.

RETURN OF POST MAIL ORDER SERVICE

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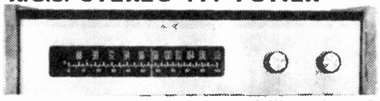

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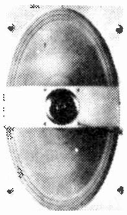

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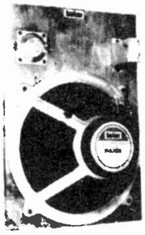

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ALL TRANSISTOR AMPLIFIER CHASSIS
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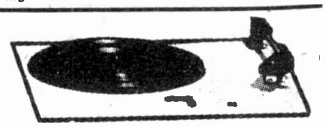

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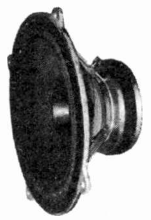

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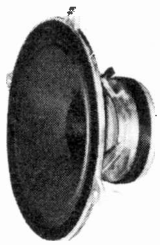

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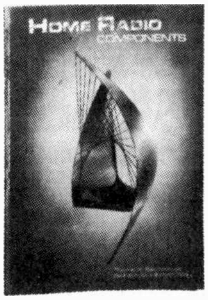

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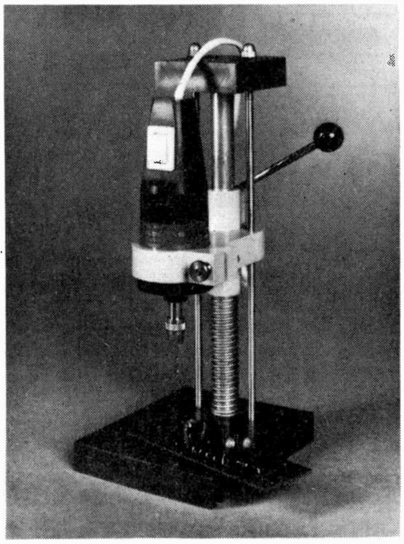

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SEMICONDUCTOR UPDATE... By R.W. COLES

SC/MP
MC904

SCAMP

"Scamp" is the way you say SC/MP, and SC/MP stands for Simple, Cost-effective, Micro-Processor, and really, I couldn't have put it better myself, because this really *is* the most simple and cost effective microprocessor to come along, and probably the first which will break into the amateur market in a significant way.

As we have all heard by now, microprocessors are "binary computers on a chip" which can be used to replace almost any array of hard-wired logic gates and flip-flops if an appropriate programme is written and stored in a ROM (Read Only Memory). These devices really are powerful, and can be used to build sophisticated control systems and a host of others. "Micro-madness" is currently gripping the professional electronic industry and microprocessors from various manufacturers are being used for just about every job which used to be done with a board full of TTL or CMOS logic.

You may be wondering why, if they are so wonderful, we haven't seen more of them in the amateur magazines, and the answer is that they have been, up to now, rather complicated things to use, requiring substantial peripheral components during the programme development phase of a project. The new National **SC/MP** is an attempt to minimise this initial complexity, and to make using a microprocessor a possibility for everyone, even amateurs.

The SC/MP instruction set is easy to learn and consists of only 46 instructions which are, nevertheless, very powerful and able to cope with a variety of memory and input/output situations. A separate clock generator circuit is not necessary, all you need is a single capacitor or perhaps a crystal, and you are in business. SC/MP also uses the tried and trusted P.M.O.S. technology and has a versatile 8-bit word length, both features which make for easy application.

To bring home the simplicity of the new chip, National sell an "Introkit" which consists of an SC/MP chip, a PROM containing a programme called Kitbug, a few peripheral chips and a small printed circuit board, which can be quickly hooked up and then used to develop programmes with the aid of just a power supply and a teletype.

The teletype is, of course, a king-sized snag if you don't happen to have one kicking around in the workshop, but don't despair! National have also produced a companion to Introkit called "Telekit" which uses a cheap calculator keyboard and display as a teletype replacement!

The SC/MP and the kits are available from National distributors.

ALL BRITISH

Not long ago the analogue of logic circuitry to make a 3½ digit, digital voltmeter, would have occupied a couple of shoe boxes and would have cost the earth. Thanks to MOS l.s.i. technology and the ingenuity of the all British semiconductor firm, Integrated Photomatrix Ltd., you can now buy the whole shooting match in a 28-pin DIP package for just a few pounds.

The I.P.L. **MC904** is a complete 3½ digit, dual ramp, autopolarity, analogue to digital converter with basic voltage ranges of ±200mV or ±2V, depending on the value of a single external resistor. The chip contains the integration and comparison amplifiers as well as all the control and counting logic, and even has "range up" and "range down" outputs so that an autoranging meter can be designed with the minimum of external components.

A wide variety of display devices can be interfaced with the MC904, including the simple and inexpensive 7-segment l.e.d. types, a combination which will be cheap enough and small enough to compete directly with moving coil meters of the traditional variety. Possible applications are varied and include comprehensive digital multimeters using the new chip as the measuring system, and requiring only the addition of suitable range switching circuits to convert a.c. and d.c. amps and volts, or resistance, into an equivalent d.c. voltage to drive the MC904 and display.

Power requirements are modest at plus and minus 14V and this new chip is likely to find its way into many amateur projects in the near future.

The MC904 is available from: Integrated Photomatrix Ltd., The Grove Trading Estate, Dorchester, Dorset.

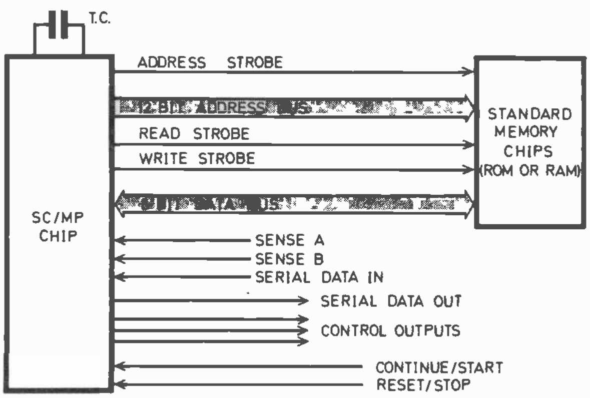


Fig. 1. A basic SC/MP system using the minimum of components and suitable for TV games and simple automatic control systems

INDUSTRY NOTEBOOK

By Nexus

INCENTIVE

When Sir Jules Thorn retired at the end of August he could look back on a lifetime of achievement. He may have been small in stature but he was big in vision—literally so considering his companies' interests in TV.

He was such a well known figure in British electrical and electronics business circles and he has been around so long that it is hard to imagine him as a diminutive immigrant arriving from Vienna during the depths of the depression in the mid-20s. The company he founded went public in 1936 with a profit of £42,000. His last address to shareholders announced a profit of £74 million from sales at home and overseas of £957 million.

He started in business in the UK by importing electric light bulbs, trading them cheaply against a "ring" of suppliers then controlling prices and markets. He subsequently started manufacturing and broadened his interests to include radio and, later, TV and a whole range of household appliances. Today, Thorn companies hold 40 per cent of the lamp market, about the same in TV manufacturing, and in TV rentals Thorn is dominant.

Sir Jules always kept a tight rein on his companies through his own personal shareholdings and those of his family. His shareholding at the time of his retirement was valued at £1·5 million and as a first-named trustee in family and charitable trusts holding almost £15 million of shares he had and retains a huge personal stake in the success of Thorn Electrical Industries.

Sir Arnold Weinstock's personal shareholding in GEC is currently worth about £4 million. I am inclined to agree with one analyst who recently observed that he would far sooner invest in companies with bosses heavily involved financially, such as Thorn and GEC, than in those where the bosses' interest is confined to basic salary and fringe benefits. It is a fact of life that people tend to be more prudent when risking their own money than other people's. Not to mention the in-built incentive to succeed.

And with a new wave of public interest in early retirement it is interesting to note that Sir Jules Thorn celebrated his 77th birthday this year and was, I suspect, still thoroughly enjoying his work to the end. We wish him well in his new and less demanding role as Thorn's president.

THREAT

People like Sir Jules Thorn and Sir Arnold Weinstock are by nature self-reliant and this is reflected in the companies they lead which are nothing if not thrusting, vigorous and as keen on penetrating overseas markets as anyone. In fact, it is nothing less than their duty to do so on behalf of their employees, shareholders and Great Britain Ltd.

However, we still find Thorn and GEC, together with Philips, petitioning the Departments of Trade and Industry, not with the begging bowl, thank heaven, but its near relation which is a plea to curb imports of electronic consumer products from Japanese manufacturers in Japan, or from low-cost labour areas in the Far East where many Japanese-controlled factories are situated.

The managing director of Mullard, the U.K. component manufacturing arm of Philips, Jack Akerman, has already sounded off on the threat to British component manufacturers before the new initiative of the big three in consumer electronics which, it should be noted, was on behalf of the whole industry.

The case for import restriction is based firmly on allegations of unfair competition. That the pricing of Japanese products in the U.K. market place is neither reflecting inflation in manufacturing costs nor the devaluation of the pound sterling against the Japanese yen. In fact that Japanese prices remain stable whereas they ought to have advanced considerably. It is implied that prices are being deliberately manipulated to damage the British industry.

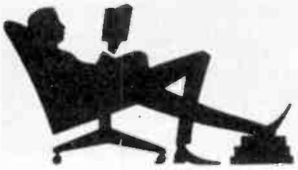
Following Jack Akerman's earlier statement, a thoughtful leading article "Tapping the Glass" was published in the September issue of PE so I won't cover the same ground again except to observe that I am in agreement with our Editor when he writes that "the average person will not take kindly to any restriction on his access to cheaper goods".

I would only add that the British company BSR dominates the Japanese market for record players because BSR is clever at making them and the Japanese aren't. That GEC colour TV is selling rather well in Europe. Good sets in their own right but built with relatively cheap British labour compared with labour costs in Germany or France. That Philips, while complaining of low-cost imports from Taiwan, has a semiconductor assembly plant there because it is cheap and convenient. That GEC employs black and coloured labour in South Africa and pays well above the official Household Subsistence Level, but this is still substantially lower than that enjoyed by Europeans.

The name of the game is competition as Sir Jules Thorn demonstrated when he started out in business with cut-price imported lamps and the buying public responded. Was this unfair? The established suppliers certainly thought so. Whether the present Japanese onslaught on the U.K. consumer market is unfair trading in the sense of landing goods at less than production cost may or may not be true—without hard evidence we can only guess. Perhaps it's just that the Japanese are cleverer at making and marketing electronic consumer products than the British, just as they are so clearly better at building and marketing motorcycles.

The big multinational corporations decide what they are going to make, and where to make it, for a complex variety of reasons of which labour cost is only one. Sony is already manufacturing in the U.K., National Panasonic is to start soon and Hitachi is said to be thinking about it. On level terms with established British manufacturers how will they fare? If they can make better sets more cheaply for the U.K. and European market, then we shall all be rejoicing on the further buoyancy of British electronics and British-built exports, just as we do now for other great British-based exporters like Hewlett-Packard (US owned), ITT (US owned), and not forgetting Philips (Dutch owned).

It is easy to forget the fact that we in electronics are all in a world-trading environment and that it is natural for various products to be manufactured in different locations for world markets. All the big companies play the multinational game and none more keenly than the British.



BOOK REVIEWS

ELECTRONICS FOR WORKS ELECTRICIANS
By Noel M. Morris
Published by McGraw Hill
268 pages, 230×150mm. Price £6·00

THIS is one of those all too rare books pitched at a level between the elementary introduction and the advanced mathematical treatment. Although, as its title implies, it is intended to help electricians in industry to cope with the growth of electronic controls, etc., it is written in such a way as to form a useful introduction to electronics in general.

More than half the book is devoted to basic theory and a description of components and their properties, including semiconductors and opto-electronic devices. The remainder deals with amplifiers and basic logic circuits, feedback amplifiers and oscillators, operational amplifiers, stabilised power supplies and power electronics, and finally test equipment.

G.C.A.

QUESTIONS AND ANSWERS ON RADIO AND TELEVISION (4th Edition)
By H. W. Hellyer and I. R. Sinclair
Published by Newnes Technical Books
120 pages, 165×110mm. Price £1·25

A USEFUL little book for the enquiring beginner in radio or television. The treatment is essentially basic and non-mathematical.

G.C.A.

TWO TRANSISTOR ELECTRONIC PROJECTS
By F. G. Rayer
Published by Babani Press
90 pages, 180×108mm. Price 85p

A SELECTION of simple circuits using two transistors, ranging from the astable multivibrator in various applications, through audio amplifiers, games and controls of various types to radio receivers.

G.C.A.

POINTS ARISING

CROSS-HATCH GENERATOR *(September 1976)*
In Fig. 3b, page 712, the pad for pin 1 of IC2 appears to be joined to the adjacent pad connected to R5, D5, etc. This is, of course, incorrect. Constructors should ensure that the two pads are isolated from each other on their p.c.b.

DIGITAL FREQUENCY METER *(May/June 1976)*
In Fig. 6, page 379, the leads from S1a to pins 17 and 19 on the main board should be transposed. The wiring shown in Fig. 12, page 503, is correct.

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INDEX for 1976

PRACTICAL
ELECTRONICS
DECEMBER ISSUE ON SALE NOVEMBER 12

FOUR CHANNELS—THREE MODES

THIS article describes the circuit and construction of a discotheque lighting and strobe unit. The system is completely self-contained and all controls are simple to understand and operate.

Designed using TTL integrated circuits, the unit may be constructed for about one fifth the cost of a comparable commercial unit.

In addition to the main strobe unit, details are given for construction of the lamp display units compatible with the system.

DESIGN FEATURES

There are four channel outputs, each channel being connected to two 100W lamps. The layout of the lamps is in two portable banks of four.

Each channel has an override switch to permanently enable or inhibit selected channels.

A variable speed control for the strobe effect is incorporated.

The design allows synchronised strobing (to the beat of the music) to be added, and the number of lamps per channel to be increased.

Three modes of operation of the unit are provided:

1. **Sequential**—each channel strobes in turn, only one channel at a time being enabled.
2. **Random**—the channels flash in a purely random sequence.
3. **Full Strobe**—all channels flash simultaneously.

Provision is made for the operator (disc jockey) to monitor the selected mode of operation by means of small l.e.d. slave lamps on the top of the unit.

BLOCK DIAGRAM

The full block diagram is shown in Fig. 1.

The main timing source is an oscillator whose frequency is variable between about 2Hz and 20Hz, the control being mounted on top of the unit for the operator to use.

The output of the oscillator feeds a four-bit register where, in conjunction with the MODE switch and appropriate gates, the three modes of operation described above can be selected. The resultant four-channel selected output is routed along the four "highway" lines to an intermediate gating stage. It is to these highway lines that the slave monitor l.e.d.s are connected (the lamps being mounted on top of the unit). Also, at this point, the override facility for each channel is incorporated.

The ultimate switching of the mains on each channel is achieved with triacs. For these devices to operate correctly a triggering source must be provided and this is achieved by using another oscillator which is at a fixed frequency of about 800Hz.

The oscillator is followed by a monostable circuit so that very narrow pulses are formed and these pulses are gated with each highway such that if any highway is at its high state then these trigger pulses are allowed through to operate the appropriate triac drive circuit.

Two power supplies are necessary: a 5V rail for the TTL circuits and a −6V rail for the triac drive circuits.

The complete circuit diagram is shown in Fig. 2.

The main timing source uses a 7413 Schmitt trigger IC1a which is connected as an oscillator, variable in speed between 2Hz and 20Hz.

To use the 7413 as a square wave oscillator, a feedback resistor (R1 and VR1 in series) is connected from the output back to the commoned input pins and a capacitor (C1) connected between input and earth.

The oscillator output is fed to the register as a common clock pulse. The register consists of two 7474 dual D-type latches (IC2 and IC3) to give the required four stages.

For simplicity the three modes of operation will be described individually.

SEQUENTIAL MODE

In the SEQUENTIAL (S) mode, only the first two stages of the register are used. The output of the second stage ($\overline{B}$) is fed back to the input of the first stage forming what is known as a Johnson Counter. This has four states which are decoded by the four three-input gates IC4a to c and IC5a. In fact only two of the three inputs to each gate are actually used for decoding, the third input being used as an inhibit.

When SEQUENTIAL mode is selected by setting S1 to "S," an enabling input is put on gates IC4a to c and IC5a by S1c such that the individual outputs are routed to the main channel highways via gates IC8a to IC8d. Also, at this time, gates IC5b and IC6a to c are inhibited by S1c giving an earth to their inputs so the outputs of these four gates are all at a constant logic 1.

RANDOM MODE

For the RANDOM (R) mode, all four stages of the register are used. The configuration is known as a pseudo-random generator and the random sequence is established by feeding the last two stages of the register through an equivalence circuit formed from gates IC7a to IC7c.

The equivalence circuit will feed a logic 1 back to the input if the outputs from the last two stages are the same and a logic 0 if they are different.

No decoding is necessary for this mode so the outputs of the four stages of the register are taken to the appropriate gate from IC5b to IC6. When RANDOM (or FULL STROBE) mode is selected S1c provides an enabling input to gates IC5b to IC6c and inhibits gates IC4a to IC5a such that the outputs can be routed via gates IC8a to IC8d to the main channel highways.

FULL STROBE MODE

In the FULL STROBE (F) mode, the output of the oscillator is fed to gates IC5b to IC6c directly via S1a. However, to ensure that there is no interaction from the register, each stage is either reset or set by means of S1d such that the register outputs to gates IC5b to IC6c are all held at a high level.

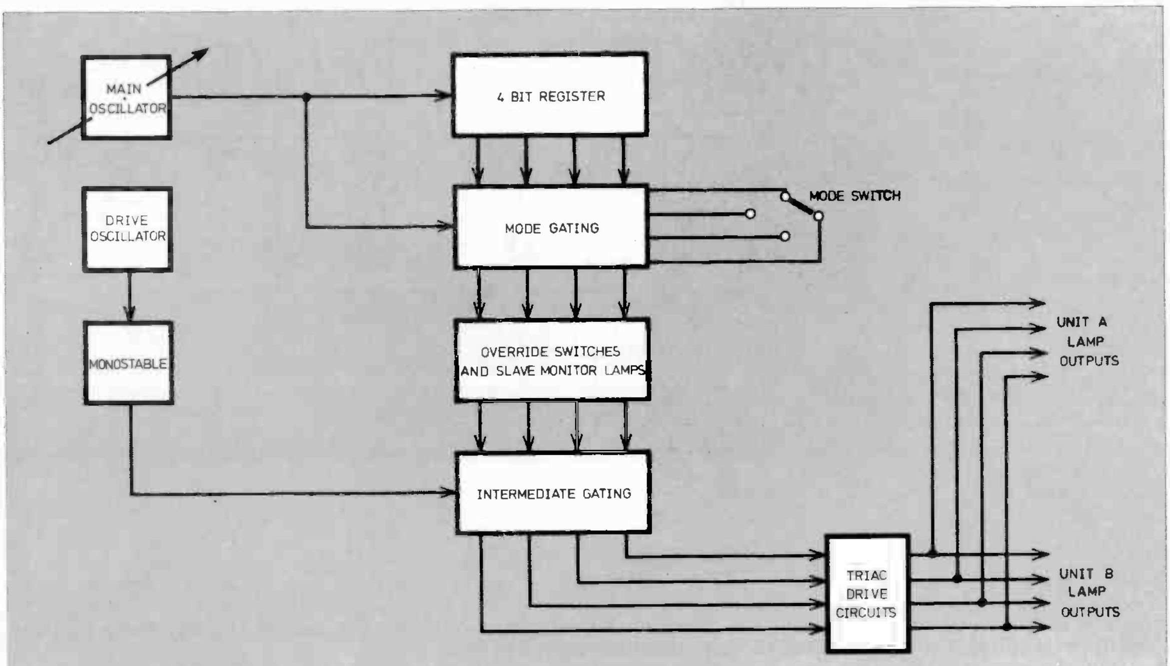


Fig. 1. Block diagram of the Discostrobe system

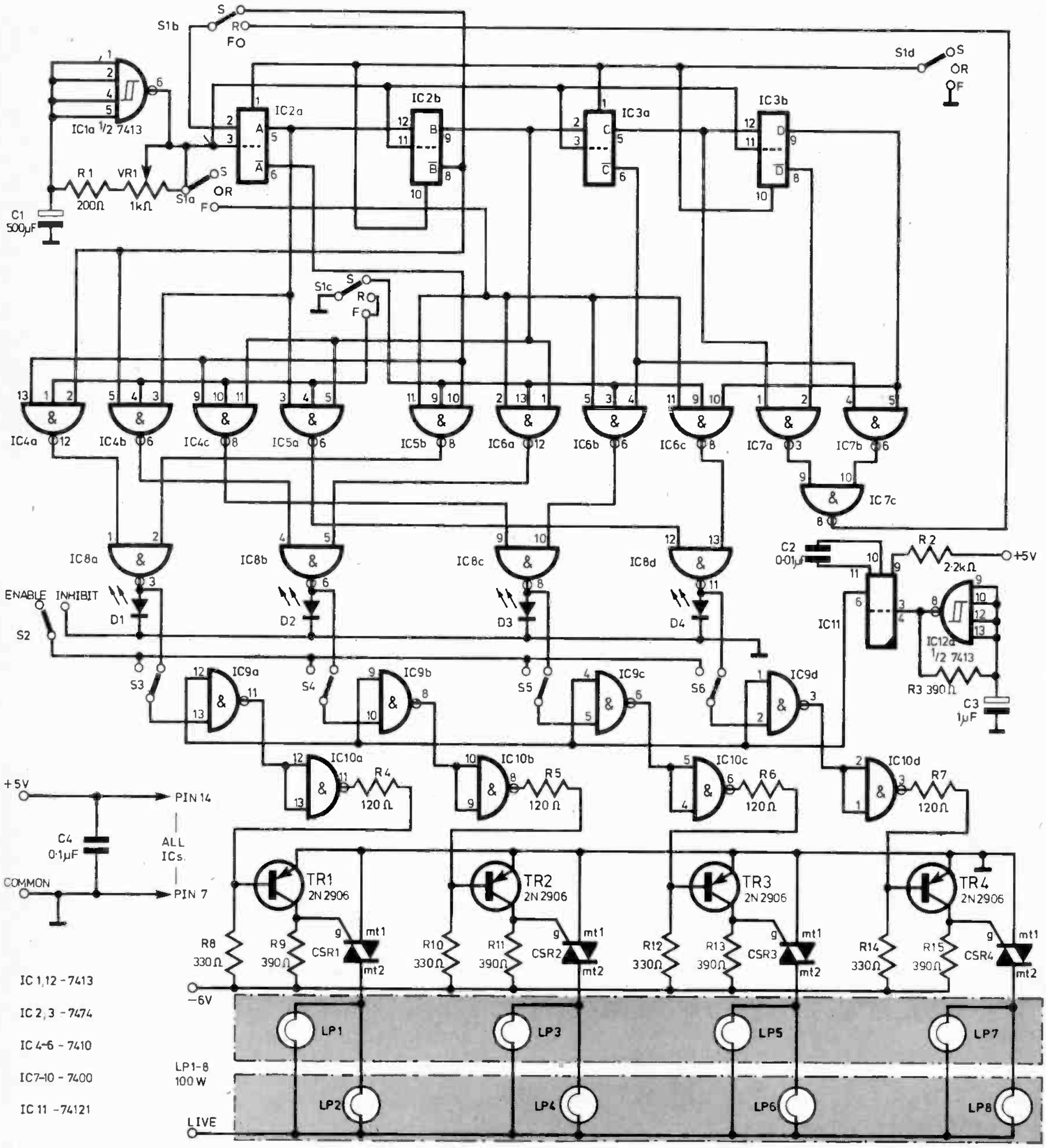


Fig. 2. Complete circuit diagram of the Discostrobe system excluding the power supply. Note that the common terminal is not connected to earth but to the neutral line

OVERRIDE

The main channel highways are the outputs of gates IC8a to IC8d and these drive the l.e.d. indicators D1 to D4 located on top of the unit. These give the operator an indication of the sequence in use.

The highways are also routed via the channel override switches S3 to S6. The INHIBIT/ENABLE switch S2 determines the function of the override switches.

With S2 in the INHIBIT position, switching on any of the override switches will permanently inhibit that channel. With S2 in the ENABLE position, the override switches will cause the selected channels to be permanently on.

TRIAC TRIGGERING

The pulses for triggering the triacs are produced by an oscillator with a frequency of 800Hz coupled to a monostable which gives pulses about 20μs duration.

The oscillator is formed from half of the dual Schmitt trigger IC12. The monostable, IC11, is a 74121 i.c. which is triggered by the negative-going transitions of the output of IC12a.

The output of the monostable is fed to all four gates IC9a to IC9d. Should any of these gates have an enabling high level from its associated highway (or should the highway be open circuit) then the trigger pulses will pass through to the triac drive circuit via the appropriate inverter gate (IC10a to IC10d) to re-establish them as positive pulses.

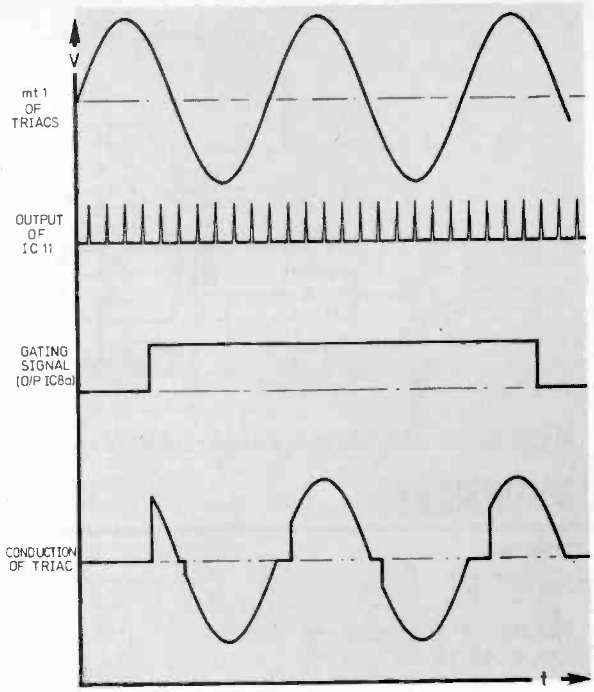


Fig. 3. Waveforms at various parts of the circuit of Fig. 2

Table 1: Resistor Values for Triacs

Type	Current (A)	Voltage	Values of R9, 11, 13, 15 (Ω)
NAS 0164X	1·6	400	470 to 560
NAS 0304X	3·0	400	390 to 470
NAS 0354X	3·5	400	330 to 390
NAS 0654X	6·5	400	220 to 330
NAS 0854X	8·5	400	180 to 220
NAS 1004X	10·0	400	100 to 180

The triac is a bi-directional switch and belongs to the thyristor family of devices, i.e. devices which are four-layer *pnpn* type with a gate connection.

The triac will conduct current in either direction i.e. from mt1 to mt2 or vice versa. It is triggered into conduction by either a positive or negative signal on the gate. Once the triac is triggered it will stay on, regardless of the gate voltage, until the main current drops below a threshold value. Therefore, if used for passing an a.c. voltage, the device will switch off every half cycle as the voltage passes through zero.

Bearing these points in mind, the device must be triggered every half cycle during the period that conduction is to take place: removing the trigger will allow the triac to automatically turn off.

Rather than build a complicated circuit to detect the start of each half cycle of mains voltage for triggering the triac, the Discostrobe uses the method of triggering at a much higher frequency than the mains supply such that the triac conducts shortly after the start of each half cycle.

The operation of the triac drive circuit is such that when a positive-going pulse is present at the base of the transistor the transistor cuts off and current is allowed to flow from the −6V rail into the gate of the triac. When the trigger pulse is removed, the transistor conducts providing effectively zero volts at the gate of the triac which causes the device to cut off when the a.c. mains once again passes through zero volts.

The waveforms at various parts of the circuit are shown in Fig. 3. Note that the common point of all the supply lines and the common terminals of the triacs must be returned to the neutral line of the mains supply.

If a higher output power rating is required the triac types and the values of resistors R9, R11, R13 and R15 will have to be changed. A list of the various triacs available along with suggested values of resistors is given in Table 1.

POWER SUPPLIES

Although TTL logic usually requires a highly stable power rail, in this application all that was necessary was the simple smoothed supply as shown in Fig. 4. This circuit is quite adequate provided that the number of TTL circuits is not going to be increased too dramatically.

In constructing the power supply, the common rail of the two supplies should be connected to the **neutral** of the mains supply and **not earth.**

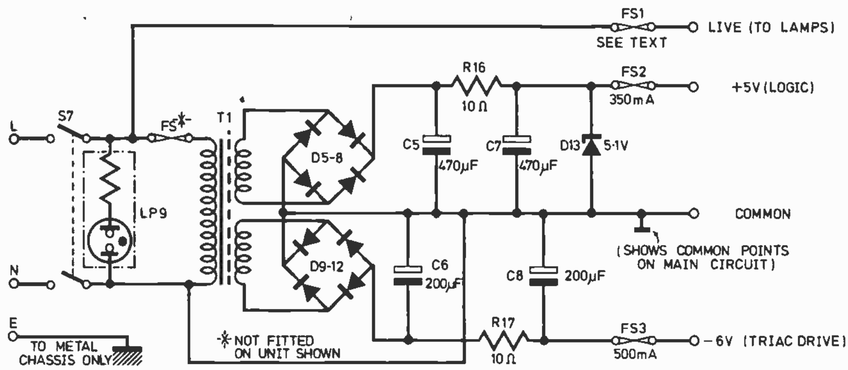


Fig. 4. Circuit diagram of the power supply to give the 5V and −6V lines required by the Discostrobe system

COMPONENTS . . .

Resistors

R1 200Ω
R2 2·2kΩ
R3 390Ω
R4–R7 120Ω (4 off)
R8, 10, 12, 14 330Ω (4 off)
R9, 11, 13, 15 390Ω 1W (4 off)
R16, R17 10Ω 5W (2 off)
All ±10% ¼W except where stated

Potentiometer

VR1 1kΩ linear

Capacitors

C1 470μF 12V elect.
C2 0·01μF
C3 1μF 12V
C4 0·1μF
C5, C7 470μF 10V elect (2 off)
C6, C8 200μF 10V elect (2 off)

Transistors and diodes

TR1–4 2N2906 (4 off)
D1–4 TIL209 or similar l.e.d. (4 off)
D5–8 50V 1A bridge rectifier
D9–12 50V 1A bridge rectifier
D13 5·1V 400mW Zener diode

Integrated Circuits

IC1 7413
IC2, 3 7474 (2 off)
IC4–6 7410 (3 off)
IC7–10 7400 (4 off)
IC11 74121
IC12 7413

Triacs

CSR1–4 NA S0354X 400V 3·5A triac (4 off) (Available from The Radio Shop, 16 Cherry Lane, Bristol BS1 3NG) (For more than 2×100W per channel see Table 1)

Miscellaneous

S1 4 pole 3 way rotary switch
S2–6 S.p.d.t. toggle switch (5 off)
S7 D.p.d.t. mains switch
T1 Mains primary, 0–6V, 0–6V ½A secondaries
FS1 5A fuse and holder
FS2 350mA fuse and holder
FS3 500mA fuse and holder
LP1–8 100W, bayonet type mains spot lamps (various colours) (8 off)
LP9 Mains neon indicator
0·1in matrix Veroboard, case to suit, edge connectors (if used)
5-way mains sockets and plugs (2 off) (if required use Bulgin P551 and P552)

CONSTRUCTION

The logic is divided between two main boards as shown in Figs. 5 and 6. In the prototype the two boards were 0·1in matrix stripboard which plugged into an edge connector so that the boards were easily removable from the unit. However, this expense is not essential.

Board A (Fig. 5) is mounted in the bottom of the case and carries the main oscillator (IC1), the register (IC2 and 3), and mode selection gates (IC4 to IC8). Two 200μF capacitors in parallel have been used for C1 but these can be replaced by a single 470μF.

Capacitor C4 serves to decouple the supply lines.

Board B is shown in Fig. 6. This board is fed with 6V a.c., the bridge rectifier and smoothing components sharing this board with the logic i.c.s. Also mounted on this board are the triac drivers (TR1 to TR4 and associated components). The triac oscillator IC12, monostable IC11 and gates IC9 and IC10 complete this board.

Because of the complexity of the wiring it is not possible to give point to point wiring diagrams for these two boards. However, layout of the components is in no way critical and by laying out the i.c.s and using the circuit diagram as a wiring guide, no difficulties should occur.

The four triacs are bolted on to the side of the case as shown in Fig. 7. Their leads are inserted into a piece of stripboard which carries wires from the triac drivers (Board B). This small piece of board also carries the smoothing components for the −6V supply.

The lid of the case has been turned back in Fig. 8 to show the components it carries. Also seen in this photo are the two output sockets which carry the signals to the two banks of lights. The type used in the prototype were Plessey types but a suitable alternative is the Bulgin P551 and P552 plug and socket.

Note carefully that the earth input from the mains is used only to earth the metal chassis; the neutral wire is connected to the common terminal of the power supply.

The layout of the controls on the top panel is shown in the photographs.

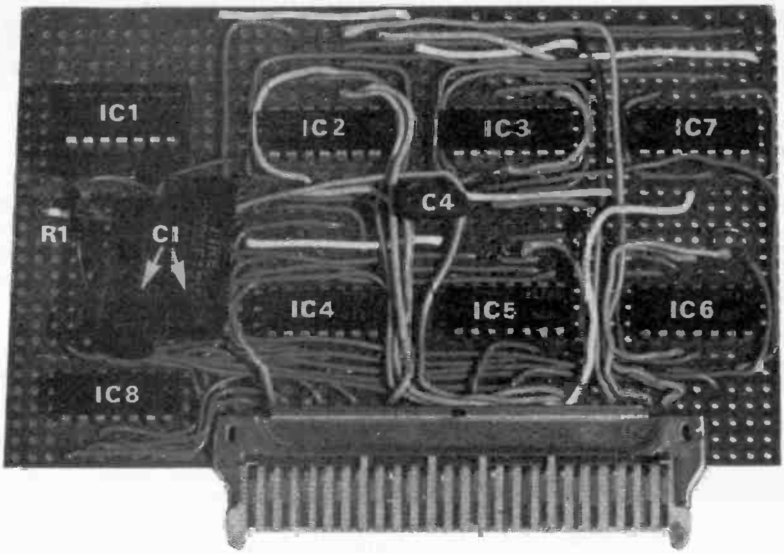


Fig. 5. Board A carries the main oscillator, register and mode selection gates. Though two capacitors in parallel have been used for C1, a single 470μF type should be used

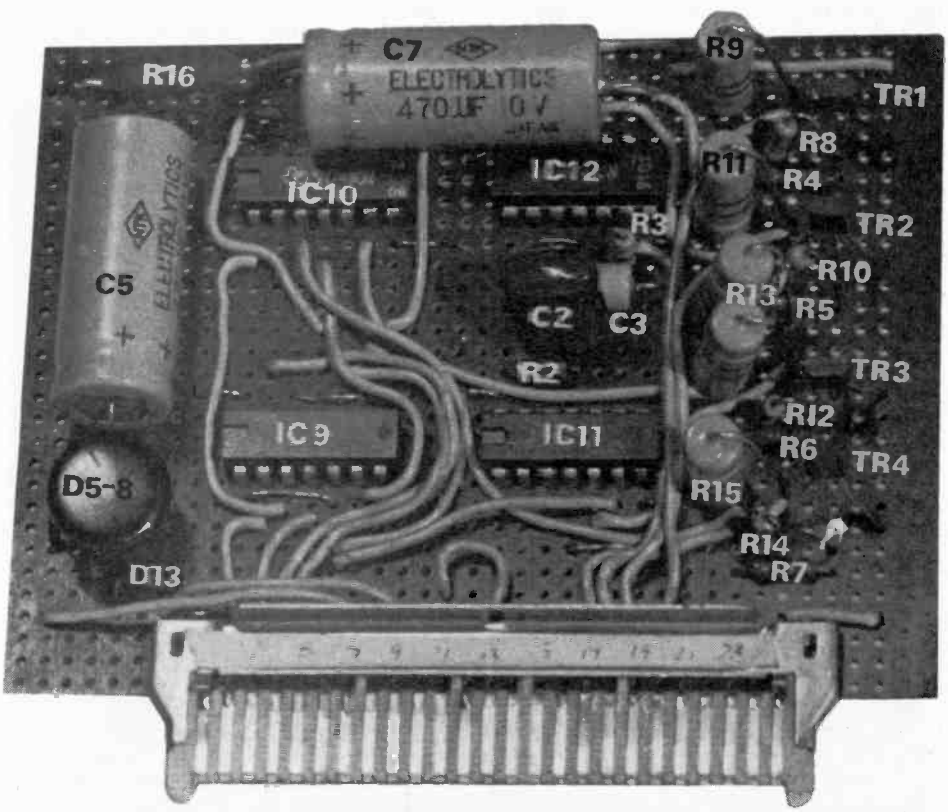


Fig. 6. Board B carries the 5V power supply components, triac drivers, and output gating circuits

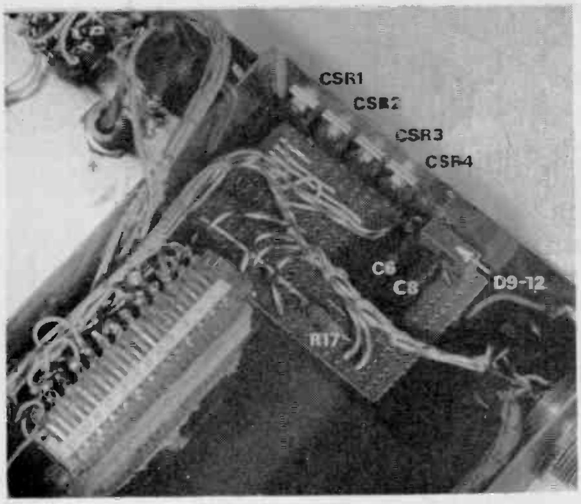


Fig. 7. The triacs CSR1 to 4 are bolted to the side of the case as shown with their leads in the piece of stripboard. Also on the stripboard are the −6V power supply components

CONSTRUCTION OF THE LAMP DISPLAYS

The construction of the light display boxes is shown in Fig. 9.

The unit is made from five-ply hardboard to make it sturdy. The units used with the Discostrobe were finished in matt black paint and the effect was very pleasing.

More of these units may be constructed but ensure that the rating of the triacs is not exceeded when there are a number of lamps per channel.

Ideally, four different colour lamps should be used: these should be mains spotlight types with bayonet fittings to match the connectors.

TESTING

No adjustments are necessary when the unit is complete. Before connecting the lamp display to the unit, the logic circuitry may easily be checked by observing the four l.e.d.s on the front panel. If the three modes operate correctly on monitoring these lamps then the light display boxes may be connected.

If the logic circuitry does not operate correctly and no suitable test equipment is available, then a useful tool for fault finding is a simple logic probe which is easily constructed and will be useful in other logic applications.

Details of a suitable probe are shown in Fig. 10.

To use the probe, connect the flying lead to the common rail (in this case the neutral of the mains supply). The probe can then be moved around the integrated circuit pins. A logic 1 is indicated by the l.e.d. lighting.

INCORRECT TRIGGERING

It is possible that when the lamp displays are connected a channel may not trigger correctly. This will be indicated by the lamp(s) on that channel becoming half-lit or pulsating with, possibly, false logic switching.

The effect is due to small variations in the characteristics between triacs and can be overcome by reducing the values of resistors R9, 11, 13 or 15. The fault is that insufficient gate current is getting to the triac with the component values specified.

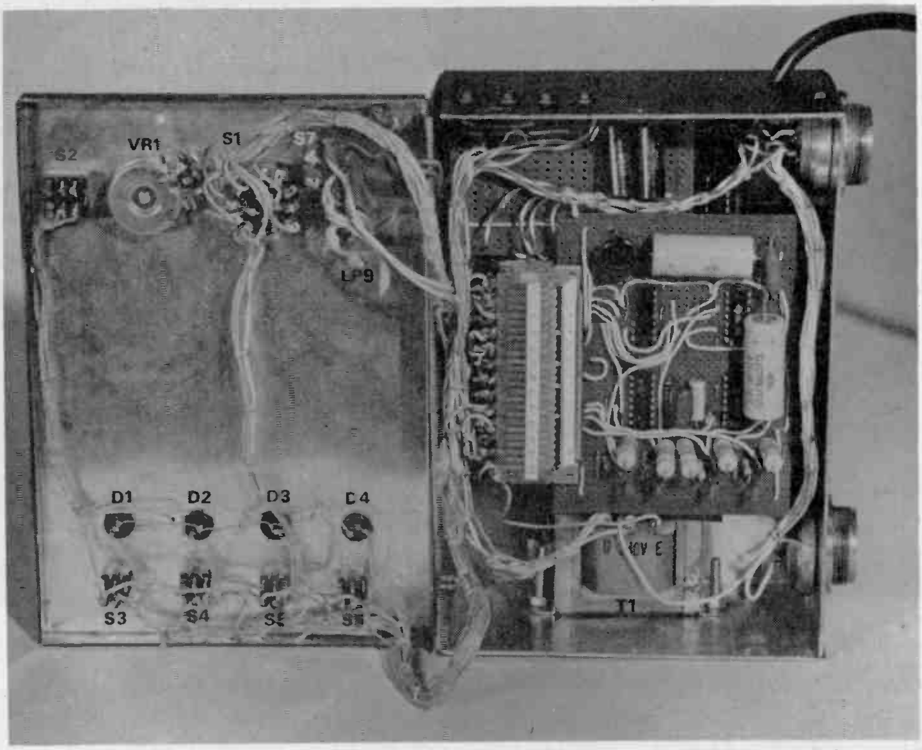
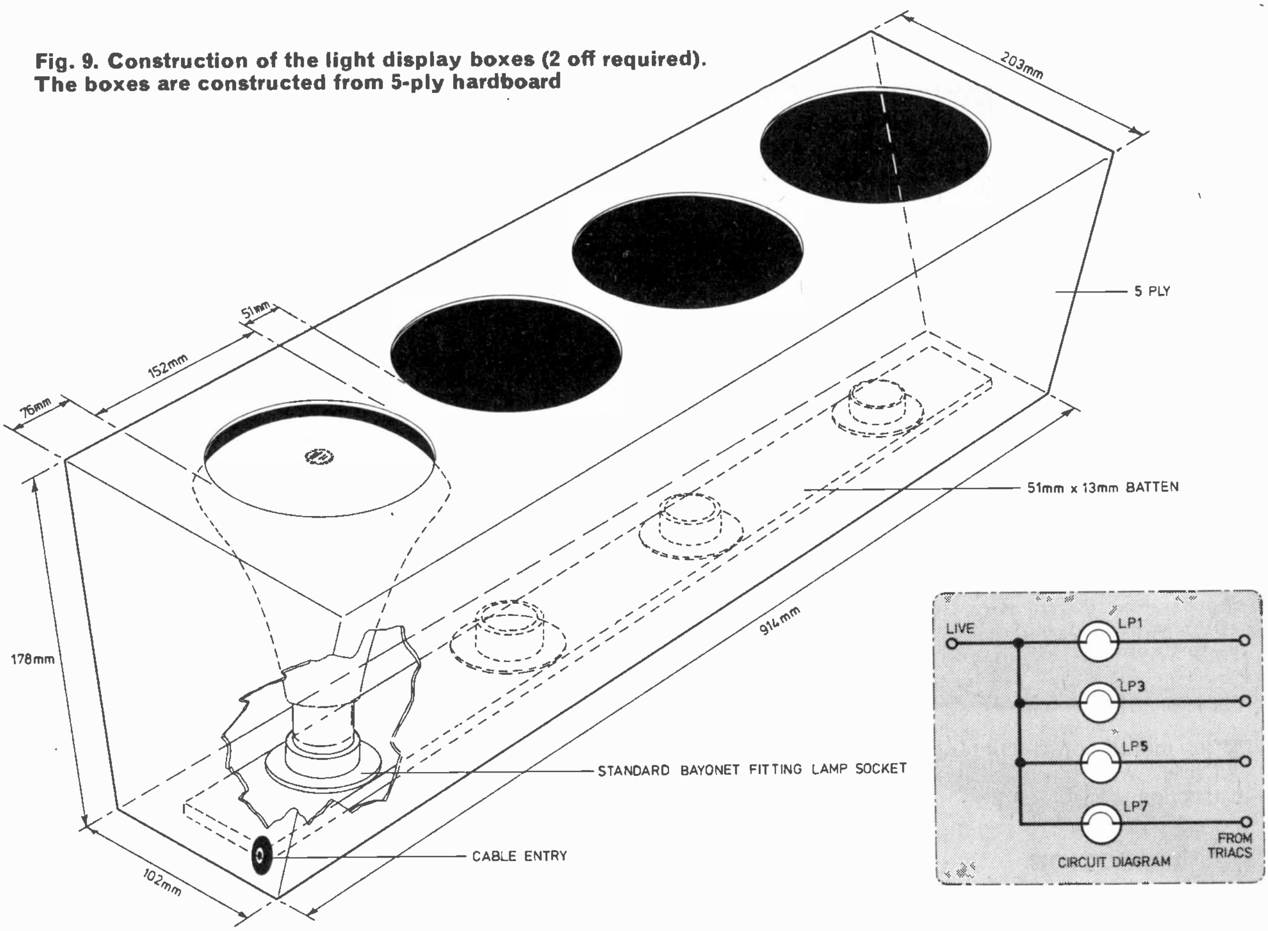


Fig. 8. The switches, potentiometer and l.e.d.s are mounted on the lid of the case as shown

Fig. 9. Construction of the light display boxes (2 off required). The boxes are constructed from 5-ply hardboard



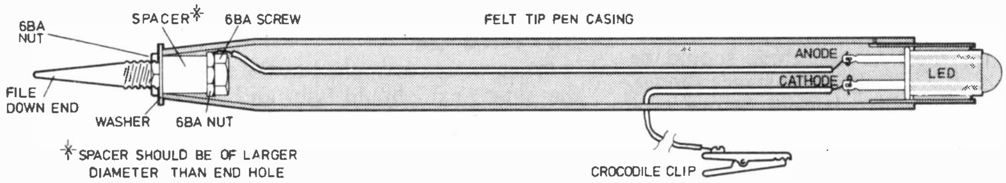


Fig. 10 A simple logic probe useful for fault finding

The fault is possible since the gate current with these values is very near to the minimum limit in an attempt to keep the drain on the −6V line as low as possible.

Provided the rating of the transformer T1 is over ½A the values R9, 11, 13 or 15 can be reduced to about 100 ohms quite satisfactorily.

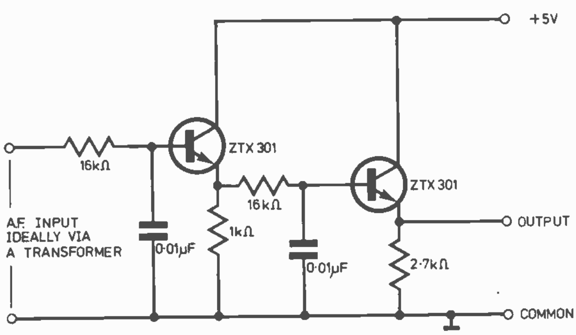


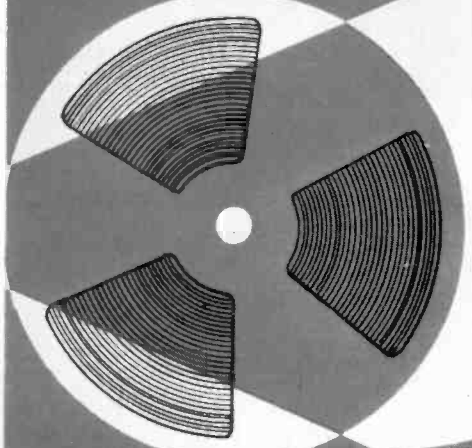
Fig. 11. This circuit may be used to replace the main oscillator in the Discostrobe system. It gives a 12dB per octave roll off above 1kHz

EXPANSION

Provision has been made in the circuit design for expansion in a number of areas.

The strobe effect may be synchronised to the beat of the disco music rather than the internal oscillator by connecting a suitable circuit to the input to IC2a (pin 3). Either the internal oscillator (IC1, C1, R1 and VR1) may be eliminated or a switch may be used to give the two alternatives. A circuit to detect the beat of the music need not be complicated, a suggested configuration being shown in Fig. 11.

The number of lamps per channel may be increased as explained earlier. Always allow an adequate margin between expected current and triac current rating. For example, if six 100W lamps are to be driven the current per channel is about 3A so use a triac with a 4A capability. ★



CINE/TAPE SYNCHRONISER

PART 2

By N.V. DAVIES

. . . featuring a CMOS 12-bit magnitude comparator

This month construction of the Cine/Tape Synchroniser will be detailed together with setting-up instructions.

CONSTRUCTION

The Sync Indicator is constructed on a d.i.l. Breadboard. Due to the complexity of the interconnecting wiring between the i.c.s, this is shown in two stages in Fig. 4.

Sockets are used for the i.c.s and these should be fitted first, followed by the wiring in the stages shown. Each stage should be carefully checked before proceeding to the next, paying particular attention to the possibility of shorts between the copper conductors or socket pins.

As many different colours of connecting wire as possible should be used to make checking easier.

On completion of the wiring the i.c.s can be inserted, the normal precautions for handling CMOS i.c.s being taken.

No details of mechanical construction or housing are given as the requirements depend on whether a battery or mains power supply is incorporated, so this is left to the individual constructor.

Plugs and sockets will be required for connections to the tape recorder and these should match the constructor's existing equipment.

Suitable cases are available from many advertisers in this magazine.

If space is available, the unit can, of course, be built into the projector (as was the prototype, see Fig. 5), or into the tape recorder. The circuit layout is not critical and can be split over a number of smaller boards to fit the space available.

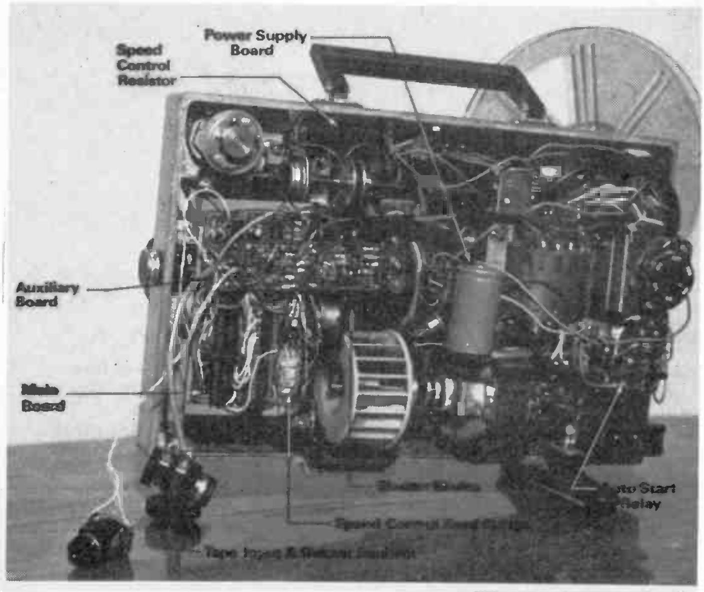
If the unit is built into the projector, the photodiode D1 may be placed inside the projector case using the opposite side of the shutter, and if insufficient light is available from the projector lamp in this position, a separate small panel-type lamp can be used. An l.e.d. could be used, but in this case a more sensitive photodetector such as the 2N5777 would be necessary. In the prototype the photodiode mounting was as shown in Fig. 6.

The l.e.d. indicators are shown mounted on the circuit board for convenience. They can, of course, be mounted in any convenient position and connected to the board by suitable leads.

SETTING UP

When power is applied to the Sync Indicator board, the SYNC l.e.d. should light and the remaining l.e.d.s remain unlit. If this is not the case, a fault must exist and the power supply must be switched off (and disconnected from the mains if a mains power supply is being used) and the fault located and rectified.

Fig. 5. Side view of the prototype modified projector. Here the fully automatic synchronisation facility has been built in



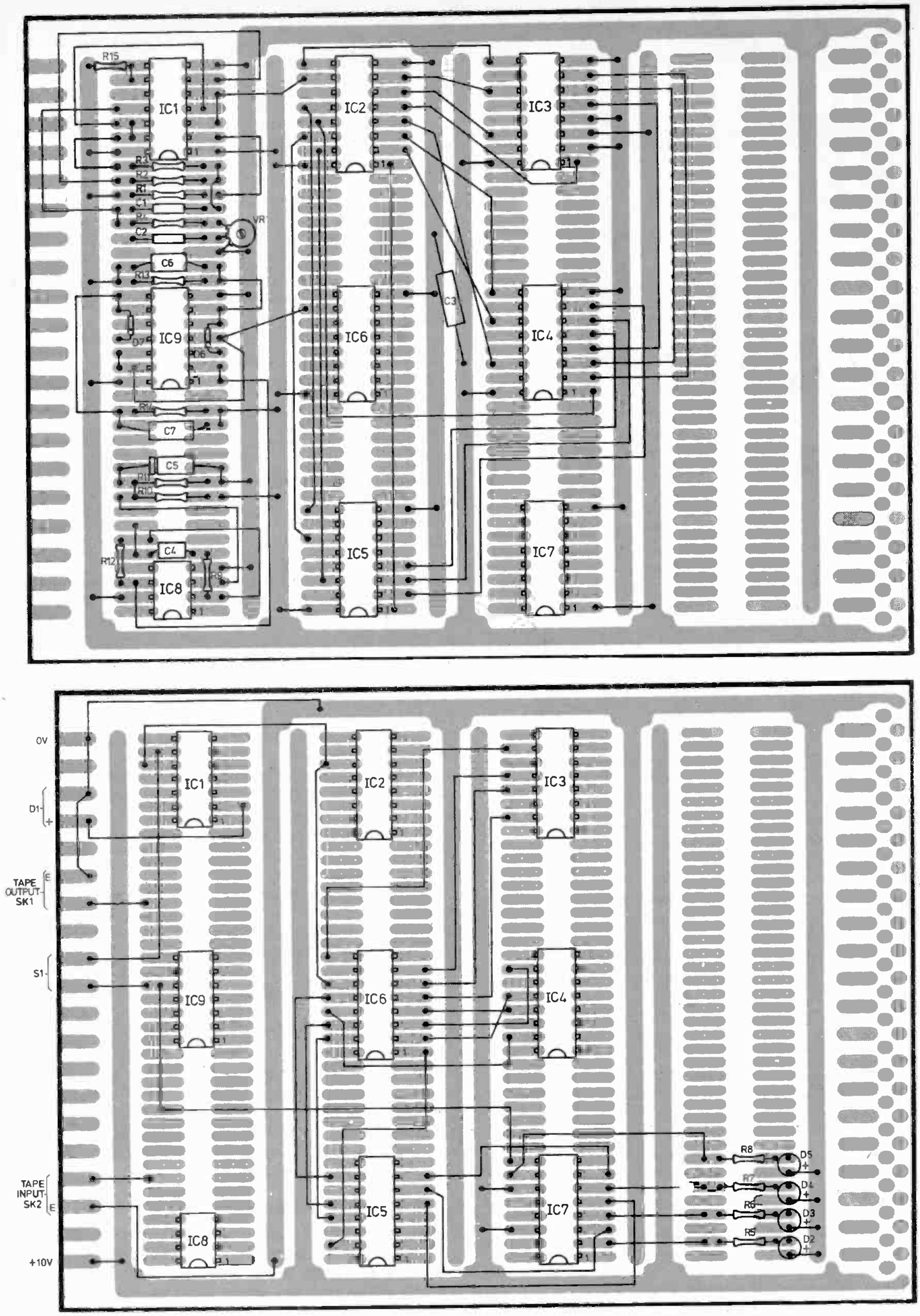


Fig. 4. Layout of components and interwiring on the DIP Breadboard. To simplify matters the wiring is shown in two stages

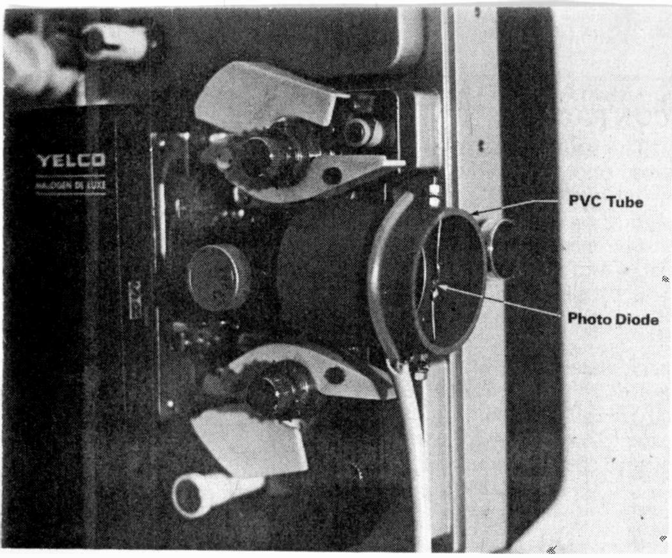


Fig. 6. The photodiode is mounted in a p.v.c. tube which fits over the lens mounting

Assuming that all is well, which it should be if reasonable care is taken during construction and reliable components used, the photodetector assembly should be placed over the projector lens and the projector started. It is not necessary to have any film in the projector during this test run.

The projector speed control may be at its normal setting provided this allows a small speed variation either up or down to allow sync errors to be corrected. The eye is extremely tolerant of small variations in projection speed so even if the speed has to be set slightly above or below its normal setting to allow this tolerance for synchronising, this will not be noticeable.

The output from the synchroniser should now be connected to the tape recorder high-level input and, with the recording level control set at a suitable level, VR1 should be adjusted for full modulation of the tape as indicated on the recording level indicator.

A recording of the sync pulses of at least five minutes duration should now be made. On completion of the recording, the tape should be rewound back to the start and the projector stopped.

The line or external amplifier output of the tape recorder should now be connected to the Sync Indicator input and the tape played back..

The SYNC l.e.d. should go out as soon as the pulses are received from the tape and the START and SLOW le.d.s light.

The projector should now be started and its speed control set to a slightly higher speed than that used for the recording. After a few seconds, the projector counter will catch up with the tape counter, the SLOW l.e.d. will go out, the SYNC l.e.d. flash briefly, and the FAST l.e.d. light.

The projector should now be slowed down until the opposite process occurs and this should be repeated making smaller adjustments to the speed control on each occasion until the SYNC l.e.d. stays alight at full brilliance and the FAST and SLOW l.e.d.s either go out completely or one or the other just glows dimly.

This process sounds complicated but it takes longer to describe than it does to carry out, and after a little practice it will be performed almost automatically each time the projector is started.

IN USE

The first indication that tape and film are beginning to drift out of sync will be the dimming of the SYNC l.e.d., and brightening of either the FAST or SLOW l.e.d. depending on the direction of the sync error.

If no correction is made and the sync error continues to increase the SYNC l.e.d will go out and either the FAST or SLOW l.e.d. come up to full brightness. At this stage the sync error is only one third of a frame and this would have to increase to four frames or more (depending upon the type of sound) before it became noticeable. Even if this amount of error or even more was allowed to occur, it would only be necessary to adjust the projector speed as indicated by the l.e.d. which is alight and the Sync Indicator will show when sync has been restored.

RECORDING A SOUND TRACK

When recording an actual sound track the film should be loaded on the projector and stopped when the first frame is in the gate.

The Sync Indicator is set up for recording the sync pulses on one track of the tape, while the other track is used for the film sound track. The tape recorder is started, followed by the projector.

It is not necessary to record the whole of the film sound track in one go as, provided the tape recorder can be switched to record on the track used for the film sound while replaying the sync pulse track, once the complete pulse track has been recorded, the tape and film can be rewound and the sound track re-recorded as necessary to obtain the desired result, using the Sync Indicator to keep the film and tape in sync.

The process can be repeated as many times as is necessary. If S1 is opened once the projector has started at the beginning of the film, it will be possible to stop the projector and tape recorder at any point during the film without the loss of tape pulses resetting the counters and sync being lost. This enables the recorder to be stopped to switch from record to playback or vice versa to alter and re-record part of the sound track. The tape recorder and projector must, of course, be stopped or restarted within a few seconds of each other.

Each time the film and tape are rewound it is necessary to load the film so that the first frame is in the gate before starting the tape recorder, and the projector must not be started until the START l.e.d. lights. This rule must be observed on each subsequent showing of the film and sound track.

AUTOMATIC PROJECTOR START

Automatic projector start controlled by the tape pulses is easy to arrange as the power supplies to the projector can be switched by a relay operated by a transistor connected to the START l.e.d. driver. The relay used must be suitable for switching mains voltage and the full load current of the projector, a suitable circuit being shown in Fig. 7.

MONO TAPE RECORDERS

Two methods of using the Sync Indicator with mono tape recorders are possible. An additional pulse replay head operating on the lower track can be fitted. No additional record or erase head is necessary as the sync pulses may be recorded first using the existing heads and the tape then reversed to record the sound track, using the sync pulses to keep the film and tape in sync.

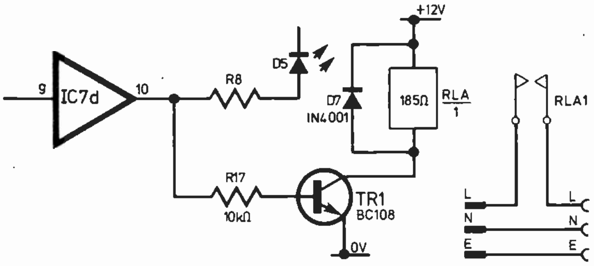


Fig. 7. To produce automatic start and stop the start driver IC7d is used to drive a relay via the transistor TR1. The relay controls the supply to the projector and should have contacts rated at 240V 5A a.c.

CAMERAS WITH SOUND SYNC CONTACTS

The sound sync contacts in cameras fitted with such close once per frame and a small battery powered unit using one CD4011 can be built to produce a burst of square waves each time the contacts close.

The circuit is similar to that used in the Sync Indicator and is shown in Fig. 10.

Because the pulse bursts will be at frame frequency, it will be necessary to fit a divide-by-three counter in the Sync Indicator circuit as was done for use with the perforated tape but, as in this case it may also be required to produce sync pulses for recording, the original circuit of IC1 must be retained and a further CD4011 used. The alterations necessary to the Sync Indicator circuit are shown in Fig. 11.

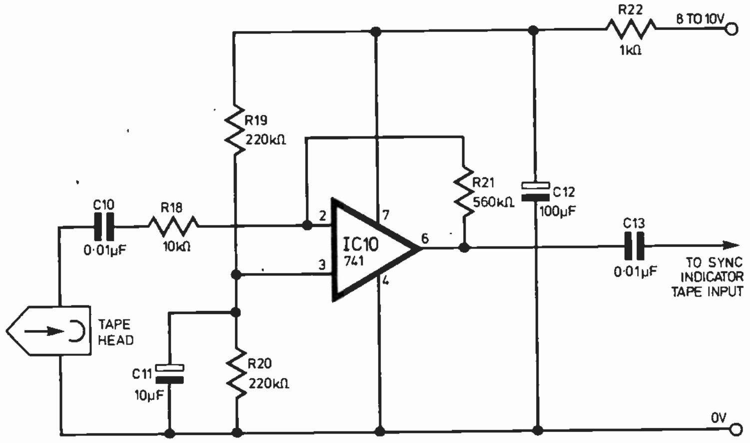


Fig. 8. When using mono tape recorders fitted with an extra head, this preamplifier circuit is necessary

If the recorder is fitted with $\frac{1}{4}$ track heads, the unused half of the existing head can be used.

A replay preamplifier for the pulse head will be required and a suitable circuit is shown in Fig. 8. As pulses only are to be amplified, no replay equalisation is required.

The second alternative is to use perforated tape which is available from various advertisers in photographic magazines and can be obtained with either 16 or 18 perforations per $3\frac{3}{4}$ or $7\frac{1}{2}$ inches. The correct type for the projection and tape speed to be used should be obtained.

The passage of the perforations is sensed by a photo-detector and l.e.d. placed on either side of the tape in line with the perforations and mounted in a suitable housing to exclude light.

Because the pulses produced from the perforations will be at frame rather than shutter frequency, it will be necessary to fit a divide-by-three counter between the output of IC1a and the input to the projector pulse counter.

The circuit used is a CD4018 presettable divide-by-n counter connected to divide by three by connecting the $\overline{Q1}$ and $\overline{Q2}$ outputs back to the data input via a NAND gate and inverter.

As the circuit to produce the bursts of square waves for recording is no longer required, the spare gates in IC1 can be used. The alterations necessary to the Sync Indicator are shown in Fig. 9.

FULLY AUTOMATIC SYNCHRONISATION

Whilst not wishing to discourage anyone from attempting fully automatic synchronisation, it must be understood that mains voltages are being dealt with and

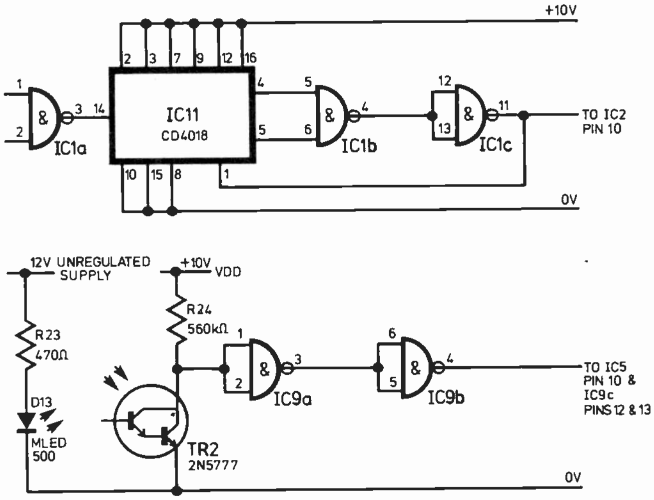


Fig. 9. Modifications to enable the synchroniser to be used with a mono tape recorder using perforated tape

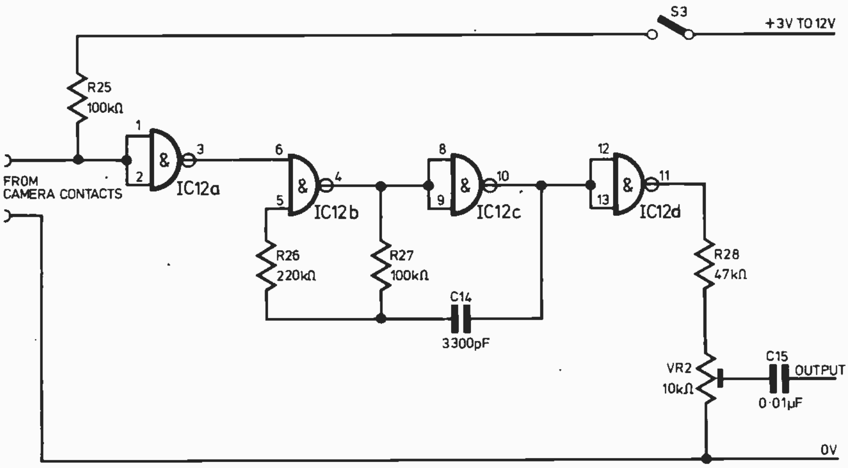


Fig. 10. A pulse generator circuit suitable for use with cameras fitted with sound sync contacts

all the necessary precautions must be observed: the projector must be disconnected from the mains before carrying out any work on the internal circuitry.

The actual modification to the projector will, in most cases, only involve fitting a mains socket which is connected in the projector motor circuit to enable this to be brought out to the synchroniser.

It will be essential to determine the type of motor fitted and, if necessary, the manufacturer's data should be consulted.

Because of the wide variety of projectors in use and the different types of motor fitted, only general guidance and suggested circuits which may be adapted for use with a particular type of motor can be given.

A.C. COMMUTATOR MOTORS AND RHEOSTAT SPEED CONTROL

Projectors fitted with a.c. commutator motors and rheostat variable speed control were, until recently, the most common. The projector speed is continuously variable from under 16 f.p.s. up to 24 f.p.s. by means of a variable resistor in series with the motor.

Automatic speed control and synchronisation can be achieved by connecting additional resistors in series with the speed control rheostat and arranging for these resistors to be shorted out in sequence by relays controlled by the SYNC and SLOW l.e.d. driver outputs.

This was the method adopted by the author for his Yelco P111Q projector and the circuit used is shown in Fig. 12.

The miniature reed relays RLB and RLC have 12V, 1,040 ohm coils but will operate from as little as six volts so could be driven directly by the two spare buffers in the CD4050 package IC7.

The author was rather dubious about using this arrangement as no information was available on the performance of CMOS buffers into an inductive load. The prototype synchroniser has, however, been in extensive use for a number of months and no problems have occurred. Separate driver transistors could be used and would be required in any case if heavier duty relays had to be used to carry the projector motor load.

The circuit shown for the auto-start relay would be suitable but high speed relays would be necessary as they have to operate at over 50Hz on occasions.

The value of the speed control resistors has to be determined experimentally—about ten per cent of the value of the speed control rheostat would be a good starting point. The resistors must be wirewound types rated to carry the full motor current.

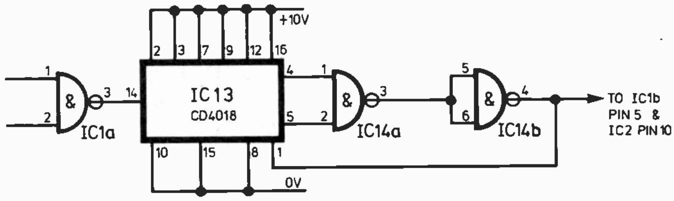


Fig. 11. Modifications to Sync Indicator circuit to operate at frame frequency for use with sync pulses recorded from camera sound sync contacts. IC14c and d are unused and their inputs should be connected to 10V line

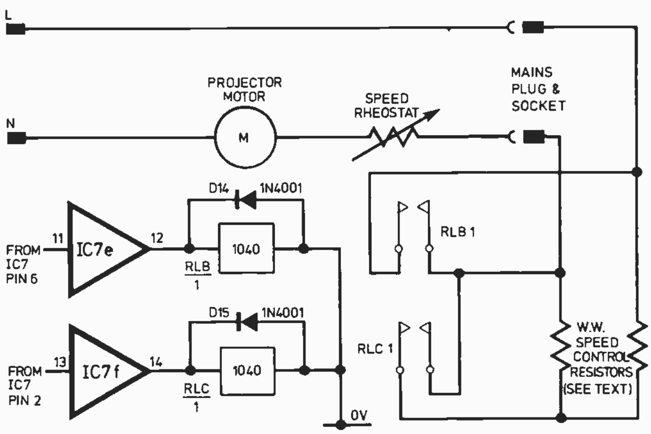


Fig. 12. Auto synchroniser circuit for use with projectors having rheostat speed control. The relays are reed types with 250V 0·5A contacts

If the resistors are too low in value insufficient speed variation will be obtained for reliable synchronisation and if they are too high in value the projector motor will tend to hunt instead of running at a steady speed.

SOLID STATE SPEED CONTROL

An alternative all solid state method of speed control is shown in Fig. 13. This uses an opto-isolator made by cementing an l.e.d. to an ORP12 photoresistor using epoxy glue and giving the whole assembly a liberal coating of black paint to exclude external light.

The opto-isolator is used to isolate the Sync Indicator from the mains part of the circuit which uses a power transistor connected across a bridge rectifier as a variable speed control resistor.

The power transistor will have to dissipate a number of watts so must be fitted with an adequate heatsink from which it must be isolated as the transistor casing will be at mains voltage.

The three preset resistors must be adjusted to obtain correct speed control, starting at a minimum value to avoid excessive dissipation in the power transistor.

The fixed series resistors prevent excessive current being drawn from the drivers.

As no thermal stabilisation is incorporated, the projector will tend to speed up as the temperature of the power transistor rises but once a stable temperature is reached the circuit will operate satisfactorily.

ELECTRONICALLY GOVERNED D.C. MOTORS

In projectors with electronically governed d.c. motors, it may be possible to identify a preset resistor which is used during manufacture to set up the projector speed, or resistors which are switched into circuit by the projector speed control.

If this is so, the circuit of Fig. 12 using suitable value resistors or the circuit of Fig. 13 with the rectifier removed may be connected in series or possibly in parallel with one of these resistors in order to control the projector speed by the synchroniser.

The modification is to disconnect the cascading outputs of the first CD4063 (IC3) from the cascading inputs of the second CD4063 (IC4), and connect the cascading inputs of IC4 as follows: Pin 3 to +10V, Pins 2 and 4 to 0V. Constructors who have used sockets for the i.c.s. can remove IC3 as it no longer serves any purpose in the circuit. As a result of this modification, the first four stages of the CD4040 counters act simply as dividers and the comparator and sync indicator will now operate at one sixteenth of shutter frequency.

With the modified circuit, when a sync error occurs the SYNC l.e.d. and (depending upon the direction of error) either the FAST or SLOW l.e.d. will begin to flash on and off due to the phase difference at the comparator inputs. At small sync errors the phase difference will be small and the SYNC l.e.d. will be on for longer than it is off, while the appropriate error l.e.d. will be off for longer than it is on. If the sync error increases, the phase difference will increase and this will be indicated by an increase in the off period of the SYNC l.e.d. and the on period of the error l.e.d. until the sync error reaches $5\frac{1}{3}$ frames. At this point the phase difference will be 360° and the SYNC l.e.d. will extinguish and the error l.e.d. remain on.

This modification gives a good indication of the magnitude as well as the direction of sync error over the range of plus or minus $5\frac{1}{3}$ frames, which should be sufficient for all practical purposes. The modification is not however recommended if it is intended to use the circuit for automatic speed control.

A.C. INDUCTION MOTORS

An increasing number of manufacturers are using a.c. induction motors with speed selection by a stepped drive pulley as used on tape recorders.

This type of projector presents the most serious problem and without resorting to drastic measures such as changing the motor, very little can be done. The only possible approach appears to be to supply the motor or indeed the entire projector from a transistor inverter, the frequency of which can be controlled by the synchroniser.

This solution, although complicated, is extremely attractive as it would enable modern projectors such as the Eumig 610D to be synchronised and no modifications to the projector would be necessary, as the projector would simply be plugged into the inverter instead of the mains. ★

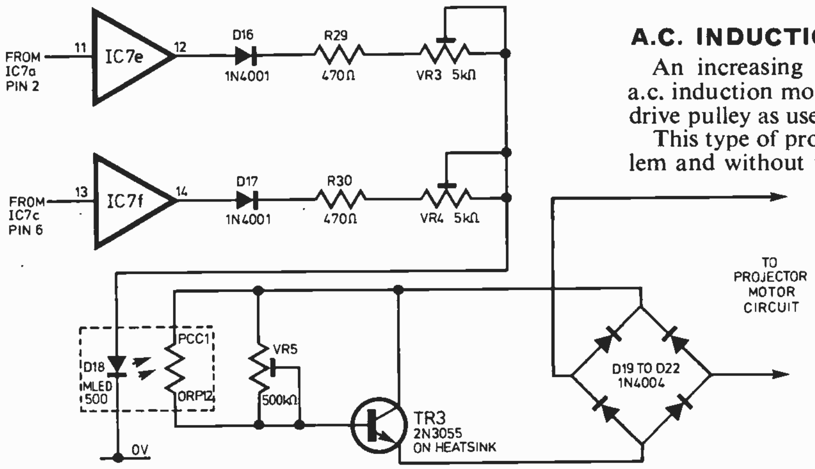


Fig. 13. All solid state auto synchroniser. D18 and PCC1 form an opto-isolator to isolate the synchroniser circuit from the mains. TR3 must be fitted with a heatsink from which it is insulated as its case will be at mains potential

If a circuit diagram of the projector speed control can be obtained or traced from the wiring this will of course make it much easier to identify a suitable point to connect the synchroniser.

PROJECTORS WITH COARSE SPEED CONTROLS

Constructors whose projectors have rather coarse speed controls may have difficulty in adjusting the projector speed to maintain sync within plus or minus one third of a frame for any length of time. In this case a simple modification to the sync indicator circuit will give a better indication of the magnitude of sync error over a much wider range, and also indicate within this range whether the sync error is increasing or decreasing.

NOTE

The MRD150 photo-diode, the MLED500 l.e.d.s and the 2N5777 Darlington pair are available from Fibre Optic Supplies, 2 Loudoun Road Mews, London, NW8 0DN.

A selection of readers suggested circuits. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought. Any idea published will be awarded payment according to its merits. Why not submit YOUR IDEA?

Please Note

Articles submitted for publication should conform to the usual practices of this journal, e.g. with regard to abbreviations and circuit symbols. Diagrams should be on separate sheets, not inserted in the text.

A SIMPLE ACCENTING METRONOME

THE circuit shows a means of using the 2N2646 unijunction transistors for providing audible beats, with bar accents, directly in a loudspeaker. This arrangement is far simpler and cheaper than has been described with the use of a number of integrated circuits.

Two unijunction transistors are used, with their b1 bases returned to negative supply via the loudspeaker coil. TR1 generates the tempo beat rate, adjustable by VR1, while TR3 generates the bar accent beats adjustable by VR2.

The tempo beat generator is a conventional relaxation oscillator circuit. The sudden discharges of C1 via the emitter and the loudspeaker coil produce clearly audible beats.

Switching transistor TR2 is a *pnp* type which is rendered conductive between emitter and collector only when the base goes negative. This occurs at each discharge of C1 during the tempo beats. Differentiation by C2, R2 limits these negative excursions to uniform negative "spikes". C3, therefore, receives a uniform length pulse on each tempo beat at a charging rate determined by the setting of VR2. Diode D1 ensures that the charge does not leak back between pulses. During one of the tempo beats the stepped charge on C3 will be sufficient to fire TR3. The discharge of C3 via the emitter and loudspeaker coil will then augment (or accent) the tempo beat. The setting of VR2 determines the number of beats per each accent.

It has been found that wirewound variable resistors are suitable for VR1 and VR2 which may be calibrated for tempo and beats in the bar. By tapping off the loudspeaker coil via a capacitor and feeding into an amplifier and loudspeaker some interesting drum effects may be obtained.

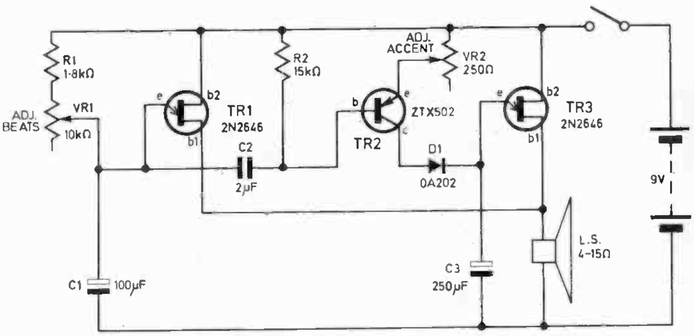


Fig. 1

F. Hayes,
Southall,
Middlesex.

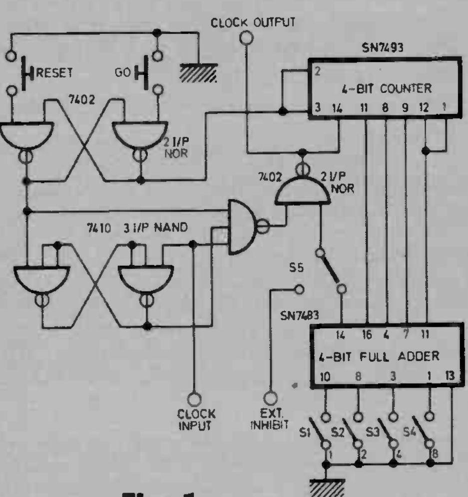


Fig. 1

PROGRAMMABLE LOGIC GENERATOR

WHEN checking static logic levels, or complete logic circuits, it is useful to have available a programmable source of clock pulses, so that the circuit can be "frozen" after a finite number of pulses have been input. Ideally, the source should provide pulse trains either of a fixed number of pulses, or which can be terminated by a logic level within the unit under test.

This circuit (Fig. 1) will give fixed length pulse trains of between 1 and 15 pulses as set by switches S1 to S4, initiated by pressing the RESET and GO switches in sequence. Alternatively the train can be terminated by a signal on the EXT INHIBIT input.

J. R. Keneally,
Weymouth,
Dorset.

SIMPLE TOUCH DIMMER

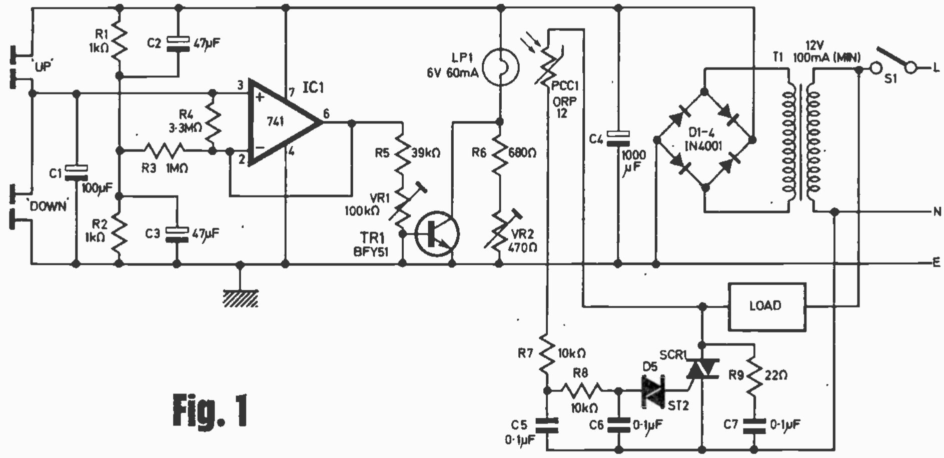


Fig. 1

THE two touch pads, which may consist of copper clad Veroboard with alternate tracks linked, are used to charge and discharge the 100μF capacitor C1 which acts as an analogue memory. The capacitor is connected to a d.c. buffer built around a 741 operational amplifier. This circuit is bootstrapped and displays an input impedance in the region of 400 megohms, giving a theoretical time constant in excess of 10 hours for the circuit. In practice, however, it was found that the capacitor had a tendency to drift towards the voltage at the junction of R1 and R2 over a period of about three hours. Since the dimmer was designed to be a novelty, this was not found to cause any real inconvenience as the same lighting level was rarely set for more than an hour at a time.

The output of the 741 is applied to TR1 which drives a small lamp—l.e.s. or m.e.s. 6V 0·06A—placed in close proximity to an ORP12 photocell, which replaces the potentiometer in a standard phase control dimmer circuit. The photocell and lamp should be taped together to exclude external light, with two layers of tissue paper between them. This helps to diffuse the light from the bulb and provide a more linear dimming effect. Great care should be taken that the two components are completely isolated from one another electrically. A heatsink clip is advisable for TR1. The low voltage electronics must be earthed. If they are not, static voltages can build up on the floating circuit and cause alarming though harmless shocks when the touch pads are touched.

Any large signal *npn* transistor is suitable for TR1. The type of triac used is not critical as the circuit will fire any rating up to 25 amps. A quadrac (triac with internal diac) can be used if D5 is omitted.

This circuit also has other applications. Since the unit is basically a voltage controlled dimmer, it could be operated from a great variety of sources. If the two touch plates and C1 are omitted, pin 3 of the i.c. can be connected to a voltage source so that an input varying between 0V and +15V can control the load over its full range of brightness.

N. Valentine,
Forfar,
Angus.

15Hz FLASHER

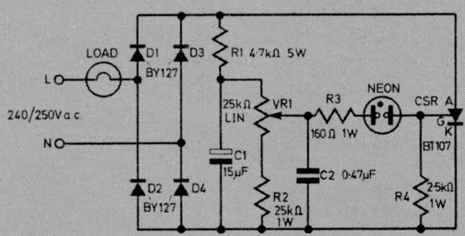


Fig. 1

THIS circuit (Fig. 1) consists of a bridge rectifier and a neon oscillator firing a thyristor. The flash rate is adjusted by means of VR1, which should have an insulated spindle since all components are at mains potential. Changing R2 will alter the range of frequency available by VR1.

The resistors used should be one watt types, except for R1 which runs quite hot and should be rated at five watts. The capacitors should be 350 volt working. The unit has been used to drive a 100 watt reflector spotlight in a disco strobe application, and has proved to be quite satisfactory.

D. White,
Paisley,
Renfrewshire.

PIP TONE GENERATOR

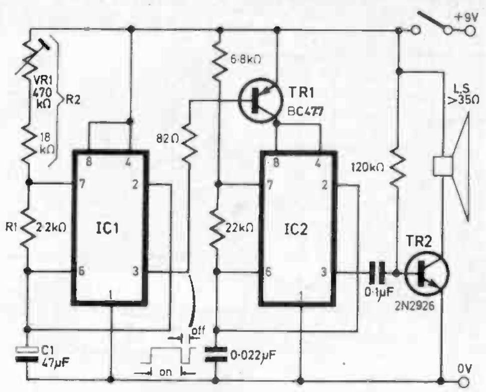


Fig. 1

THIS circuit provides a "pip" (BBC News type) at regular intervals in the range 3 to 20 seconds, the delay being adjusted by means of VR1. Two 555 integrated circuit timers are used, both in the astable mode. The first, IC1, produces a squarewave voltage at pin 3 which is adjusted to have a short zero-voltage pulse length (about one second—the length of the "pip"), and a long positive-voltage pulse length equal to the delay between pips. For the 555 operating as an astable, it is not possible to have the "on" time at pin 3 (given by 0·7 (R1+R2) C1) shorter than the "off" time, given by 0·7R1.C1.

Timer IC2 is wired as an astable operating at a frequency of about 1·2kHz, and is driven by the "off" pulse at pin 3 of IC1. This off pulse pulls down the voltage at the base of the *pnp* transistor TR1, thereby switching it on and allowing current to pass into the positive supply pin of IC2. During the delay period, controlled by VR1, the base of TR1 is at too high a voltage for it to conduct.

In order to obtain adequate output amplitude, a single transistor audio amplifier based on TR2 is used, driving a miniature loudspeaker. Capacitor C1 should be a tantalum type for reliable long period delays between successive pips. Even longer delays may be obtained by increasing VR1 to 1 megohm, and C1 may be increased to, say 100μF or more.

M. Plant,
Nottingham.

SELF-STOPPING COUNTER

A 9310 decade counter can be arranged to stop at its terminal count simply by connecting the TC (Carry) output to the CEP (Enable P) input via an inverter, see Fig. 1. It should not, however, be connected to the CET input since TC is a function of CET; such a connection causes oscillation.

N. V. Smith,
Shenfield,
Essex.

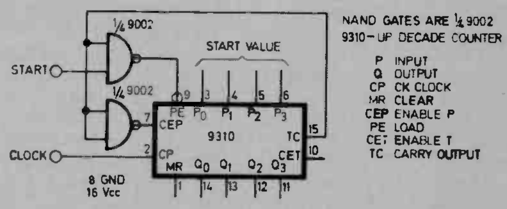


Fig. 1

COUNTER WITH BUILT-IN BOUNCE ELIMINATOR

THE first stage of a 9305 variable modulo counter can be used as a debouncing latch. It is a master/slave flip-flop, but when the clock input CP_0 is low, the master is isolated from the slave and Q_0 and $\bar{Q}_0$ can be used as latch outputs.

This circuit will accept bouncing contacts and counts modulo 5, 6, 7 or 8 depending on the S_0 and S_1 connections to the Q_1, Q_2 and Q_3 outputs. The steady state contact current is negligible (less than 2mA), a momentary current of about 50mA is drawn for less than 20ns.

N. V. Smith,
Shenfield,
Essex.

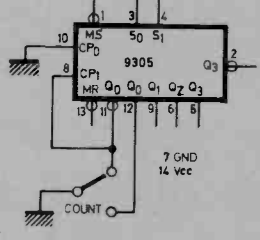
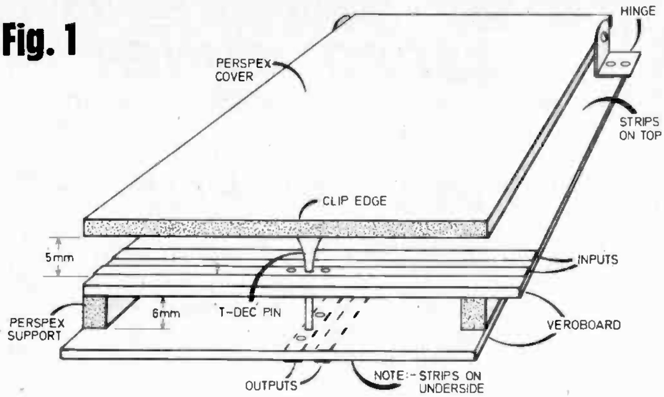


Fig. 1

PATCH PANEL

Fig. 1



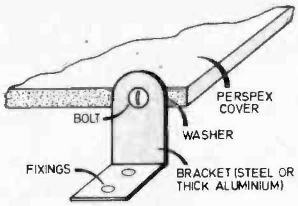
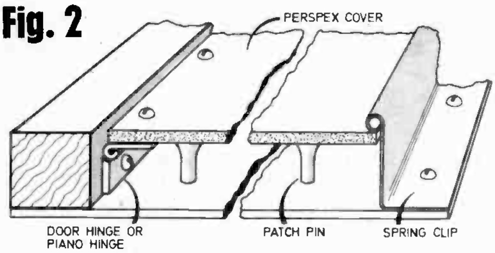


Fig. 3

Fig. 2



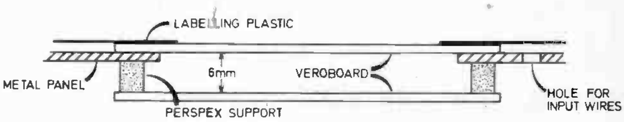


Fig. 4

THIS is an idea for a simple, cheap and reliable patch panel for use with synthesisers etc. The copper strips of a "stiff quality" 0.1 or 0.15in pitch Veroboard are coated along their length liberally with solder so as to cover all the holes but not to short adjacent strips. On to the upper surface of this board two parallel perspex supports (6mm thick) are stuck with impact adhesive. The 6mm allows for 1mm Veroboard thickness. A second board is placed with strips at right angles to the first and with an overhanging edge across the supports as shown in Fig. 1. The holes are carefully aligned using "T-Dec" pins and the top board is stuck to the supports (clamps are recommended).

The patch pins are simply "T-Dec" pins which have a shoulder to butt against the top Vero strips. To hold the strips in position a piece of Perspex is used which is hinged at one end to allow easy access to the pins. The hinge can be either a "piano-hinge" or end brackets with a bolt into either edge acting as a hinge (see Figs. 2 and 3). The other edge of the perspex is held down by a spring clip made of beryllium copper or spring steel, and bent round a rod at the top and into a suitable right angle at the bottom (Fig. 2).

The unit was originally sunk into wood but it could be fitted to a metal panel (Fig. 4).

To finish the patch panel a suitable square hole is cut into a piece of a thin p.v.c. plastic or card and labelled with Letraset along the "X" and "Y" axes. Also to aid in line recognition the space between every fifth copper strip can be inked.

R. A. Curtis,
Worthing.

PHASE COMPARATOR

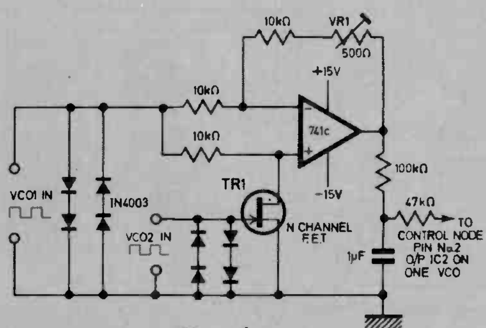


Fig. 1

THIS circuit (Fig. 1) was constructed for use with the *P.E. Sound Synthesiser* (February, 1973—February, 1974), and provides an easy method of phase-locking the v.c.o.s in the keyboard. The circuit consists of a phase comparator followed by a low-pass filter.

The potentiometer VR1 is adjusted to cancel out the effect of the r_{ds} of TR1 when it is on. Any general purpose *n*-channel f.e.t. should be suitable. The diodes on the inputs limit the amplitude of the input signals to about 1·4V peak to peak.

P. Gopakumar,
Cochin,
India.

SIGNAL INJECTOR/TRACER

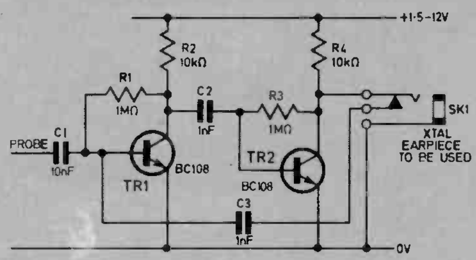


Fig. 1

THE circuit shown in Fig. 1 makes an excellent signal injector with harmonics going well above 5MHz, and also a crude but effective signal tracer.

Without the earpiece connected, the circuit acts as an astable multivibrator, feedback being provided via C3. When the earpiece is plugged in, C3 is disconnected and the unit becomes a simple two-stage audio amplifier.

The prototype unit was built into a small plastic box with four Mallory batteries, current consumption being less than 0·5mA.

P. Dow,
Sunderland.

TRAFFIC LIGHT CONTROLS

THIS simple circuit controls a set of traffic lights for a cross roads and can perhaps also be used as a party lights display.

If the sequence for a set of traffic lights is drawn out as shown in Fig. 1, three facts become apparent:

(a) Both sets of amber are always on together.
(b) One set of red or other is always on.
(c) When one red is on, the other green is on, except when the amber lights are on.

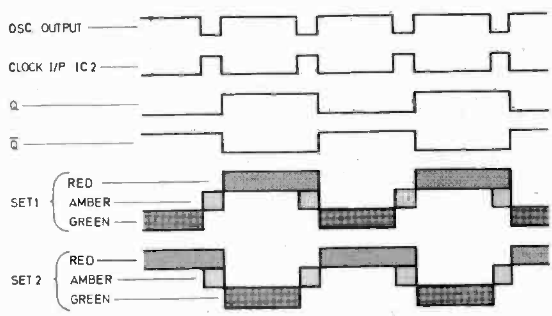
The circuit to achieve this is shown also in Fig. 1. IC1 is the ubiquitous 555 connected as an oscillator with 1 second in its low state and 5 seconds in its high state.

The output of IC1 drives the amber lights direct (max. load 200mA) turning them on when it goes low. The output of IC1 also feeds IC2, a single binary counter. The Q and $\overline{Q}$ outputs drive the two reds via the transistors TR2 and TR3.

The positive supply for the green lights is provided by IC1 (i.e. it is removed when the waveform goes low and the ambers are on). The negative return for the green is connected to the red on the other set giving the correct sequence.

Diodes D1 and D2 prevent the sneak paths that would occur between red and green when IC1 output goes low. D3 provides the 5V supply for IC2 and TR1.

E. A. Parr,
Carluke.



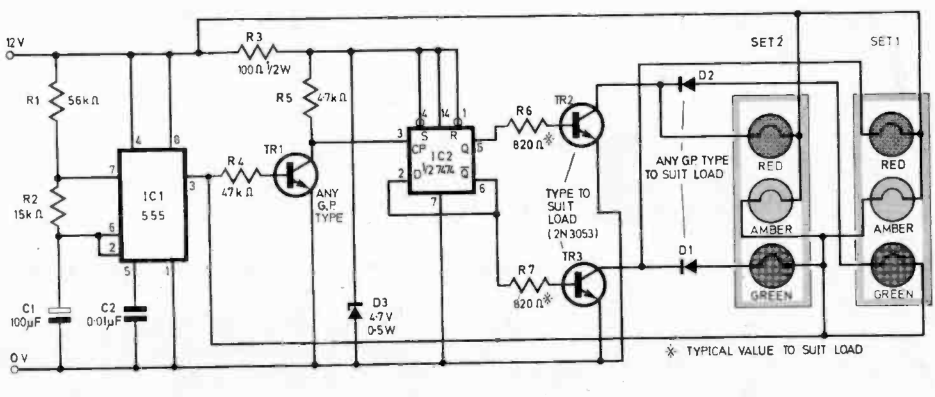


Fig. 1

20x20 Watt STEREO AMPLIFIER

Superb Viscount IV unit in teak-finished cabinet. Black fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic, magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets, DIN speaker and input sockets, plus fuse. 20+20 watts rms, 40+40 watts peak.

£29.90 + p & p £2.10

HOW YOU CAN SAVE

SYSTEM 1B

For only £80, you get the 20+20 watt Viscount IV amplifier; a pair of our 12-watt-rms Duo Type IIb matched speakers; a BSR MP 60 type deck complete with magnetic cartridge, de luxe plinth and cover. **£80.00** + p & p £6.50

SYSTEM 2

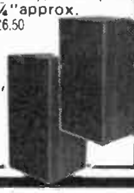
Comprising our 20+20 watt Viscount IV amplifier; a pair of our large Duo Type III matching speakers which handle 20 watts rms each; and a BSR MP 60 type deck with magnetic cartridge, de luxe plinth and cover. **£92.00** + p & p £7.60

Carriage surcharge to Scotland: System 1b £2.50, System 2 £5

SPEAKERS

Two models– Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18½"x 13½"x 7¾" approx. **£34** + p & p £6.50 PER PAIR

Duo III, 20 watts rms, 40 watts peak, 27"x 13"x 11½" **£48** + p & p £7.50 PER PAIR

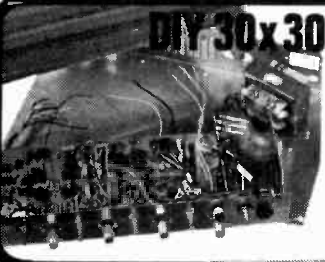


TURNTABLE

Popular BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe plinth and cover. **£24.00** + p & p £3.50

VALUE

DIY 30x30 AMPLIFIER KIT



Specially designed by RT-VC for the experience constructor, this kit comes complete in every detail. Same facilities as Viscount IV amplifier. Chassis is ready punched, drilled and formed. Cabinet is finished in teak veneer. Black fascia and easy-to-handle aluminium knobs. Output 30+30 watts rms, 60+60 peak. **£29.00** + p & p £2.10

STEREO CASSETTE DECK KIT

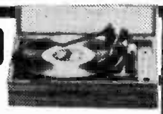
Again, this kit is specially designed for the experienced constructor – for mounting into his own cabinet. Features include solenoid-assisted AUTO-STOP, 3-digit counter, record/replay PC board, mains transformer and input and output controls. AC BIAS AND ERASE. **£32.50** + p & p £1.50

DELUXE ACCESSORY KIT

Comprises of a matched pair of dynamic mics. and two replacement slider level controls. **£3.95** + p & p. £1

P. & P. FREE WHEN PURCHASED TOGETHER WITH ITEM BELOW.

DIY STEREO SYSTEM



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TURNTABLES BY BSR

Big value from RT-VC! Two units COMPLETE WITH PLINTHS. First, the popular MP 60 type semi-professional deck. **£17.50** + p & p £2.50

Second, the lower-cost C141 automatic unit, fitted with a stereo ceramic cartridge. **£11.95** + p & p £2.55

Both units have plinths finished in superb teak veneer. Either way, you're on to a bargain from RT-VC.

STEREO AMPLIFIER KIT

Build up a 4-watts rms per channel stereo amplifier with Unisound MK2 modules. For only £9.95 you get pre-amp, power amp, and all the control panel parts. Features include IC power chips for low distortion. For the experienced constructor only. **£9.95** + p & p £1.55

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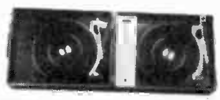
Here's the mono unit you need to start off with. Gives you a good solid 35 watts rms, 70 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume. **£27.50** + p & p £1.50



PORTABLE DISCO CONSOLE with built-in pre-amplifiers

Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single-play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simply connects into your existing slave or external amplifier. **£55.00** + p & p £6.50

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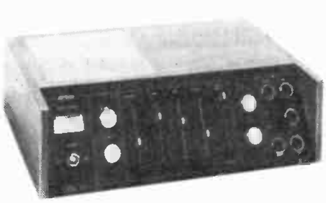
All the big features as on the 70-watt disco amplifier, but with a massive 100 watts rms, 200 watts peak output power. **£65.00** p & p £4.00



DIY SPEAKER KITS

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15-WATT KIT IN CHASSIS FORM

YOU CAN'T DO BETTER

When you are looking for a good speaker, why not build your own from this kit. It's the unit which we supply with the above enclosures. Size 13" × 8" (approx.) EMI woofer, 3¼" (approx.) tweeter, and matching crossover. Power handling capacity 15 watts rms, 30 watts peak. **£7.50** + p & p PER SET

'COMPACT' FOR TOP VALUE

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20-WATT HI-FI KIT IN CHASSIS FORM

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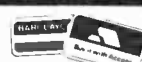

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THE NEW AND REVISED VAT LEAFLET No. VLA/8/76 ISSUED BY CUSTOMS AND EXCISE

VAT and Components

To help unravel some of the confusion still existing regarding VAT, a new and revised VAT leaflet, No. VLA/8/76, covering electrical and electronic components has been issued by H.M. Customs and Excise. This leaflet gives recent alterations of rate and changes of interpretation as they affect components.

For those Advertisers and readers who do not receive a copy we give below the full text of the VAT leaflet No. VLA/8/76. Any Traders interested in obtaining their own copy should note that the leaflet is available from their local VAT Office.

HIGHER RATE OF VAT: ELECTRICAL AND ELECTRONIC COMPONENTS

1—Introduction The following guidelines, which have been agreed with representatives of the component manufacturing industry are to be used to determine the liability to VAT of various product categories of electronic components. It should be noted that, in certain cases, these guidelines have been revised with effect from 1 July 1976; this leaflet incorporates all such changes.

2—Determination of liability The product categories of electronic components which are chargeable at the higher rate of VAT under the provisions of Schedule 7 of the Finance (No. 2) Act 1975 are listed in paragraph 4 below. Where the higher rate is not specified as applying, the standard rate is normally chargeable. However, while the list in paragraph 4 is intended to be as complete as possible, it cannot be exhaustive, particularly in view of the continuing technological developments in the industry. Any trader who is in doubt about the liability of a component not covered by the list, or who requires additional guidance, should therefore consult his local Customs and Excise VAT Office.

3—Components manufactured to a specification Special rules apply where parts and components are manufactured solely to the specification of a particular customer (or group of customers) for use in standard-rated or zero-rated goods and are not made available for use for any other purpose. In such cases the list in paragraph 4 need not be followed and such parts and components may be regarded as chargeable at the standard rate. This special treatment extends to those parts and components which both have a specification higher than the upper end of the standard components specification range and are sold at a higher price than standard components.

4—Product categories to be charged at the higher rate of VAT

(A) Cathode ray tubes for television sets or radio receiver/monitors.

(B) Tuners for radio and television sets, including tuners featuring touch button controls and/or remote control units for audio equipment and television sets, video tape recorders with a built-in tuner, and video receiver/monitors.

(C) Delay lines and networks for television sets and audio equipment.

(D) Transformers, chokes and coils for television and audio equipment, and domestic appliances.

(E) All valves for higher-rated goods.

(F) Voltage multipliers (triplers, etc.) for higher-rated goods.

(G) Modules (assemblies and sub-assemblies) for higher-rated goods.

(H) Printed circuit boards and micro circuits (including hybrid and passive) for higher-rated goods.

(J) Digital and linear integrated circuits suitable for higher-rated goods.

(K) Discrete semiconductors:

(1) Transistors, triacs and thyristors, plastic encapsulated and less than 3A rating.

(2) Power transistors for TV deflection applications.

(3) All plastic diodes and diacs of less than 1A rating, except light emitting diodes.

(4) All Zener diodes which have plastic encapsulation and a power rating of less than 3W.

(5) Rectifiers of a kind suitable for use in low voltage battery charger equipment having a current rating of less than 5A.

(L) Capacitors excluding:

(1) Any capacitor supplied against a Government department approval, e.g., R.R.E., R.A.E., S.R.D.E., A.S.W.E., G.P.O.

(2) Paper and plastic film capacitors of greater than 0·5μF and/or metal cased and/or rated above 500V d.c. and/or meeting I.E.C. Specification 68.2 or equivalent—21 days humidity rating.

(3) Sintered tantalum capacitors of greater than 300 microcoulombs and/or metal cased.

(4) Tantalum capacitors with liquid electrolyte.

(5) Aluminium electrolyte capacitors meeting I.E.C. Specification 103, Type 1–85°C or equivalent specification or operating in excess of 110V a.c.

(6) Mica (other than rivetted and bonded types) and Polystyrene capacitors.

(7) Ceramic and porcelain capacitors of multilayer construction.

(8) Vacuum and pressure gas capacitors.

(9) Variable capacitors having a precious metal deposit on rotor or stator and/or rated at or above 2,000V d.c.

(M) Resistors.

(1) Fixed resistors:

Carbon composition, up to and including 2W rating, excluding hot moulded types.

Carbon film, up to and including 2W rating.

Wirewound, excluding (i) vitreous and silicone protected types, (ii) precision types and (iii) types using heat sink methods of power dissipation.

Pluggable metal oxide.

Pluggable thick film.

(2) Variable resistors:

Wirewound convergence controls.

Focus control for colour TV.

Potentiometers and presets using carbon composition elements, excluding hot moulded track type.

(3) Other resistors:

Non-linear voltage or temperature dependent, except directly and indirectly heated bead thermistors.

Modules specifically designed for TV applications.

(N) Transducers suitable for higher-rated goods.

(O) Filters (electronic) suitable for higher-rated goods.

(P) Connectors excluding:

(1) Edge connectors;

(2) Connectors used solely with goods which are not subject to the higher rate;

(3) Connectors for a wire size area exceeding 3·3mm^2;

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430	15–24	4 c/o	95p*
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600	14–24	4 c/o	95p
700	12–24	2 c/o	85p*
700	16–24	4 c/o	95p*
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*Incl. Base. All prices incl. P. & P.

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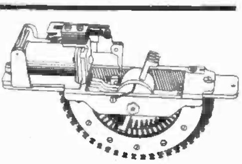

4 bank, 25 way 75 ohm. Coil, 36–48V d.c. operation. Ex. New equipment £4·25, P. & P. 75p. Total price inc. VAT £5·40.

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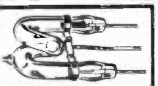

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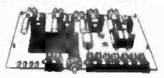

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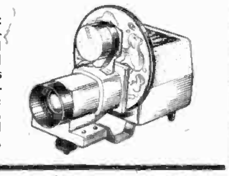

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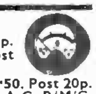

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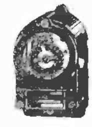

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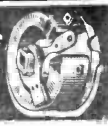

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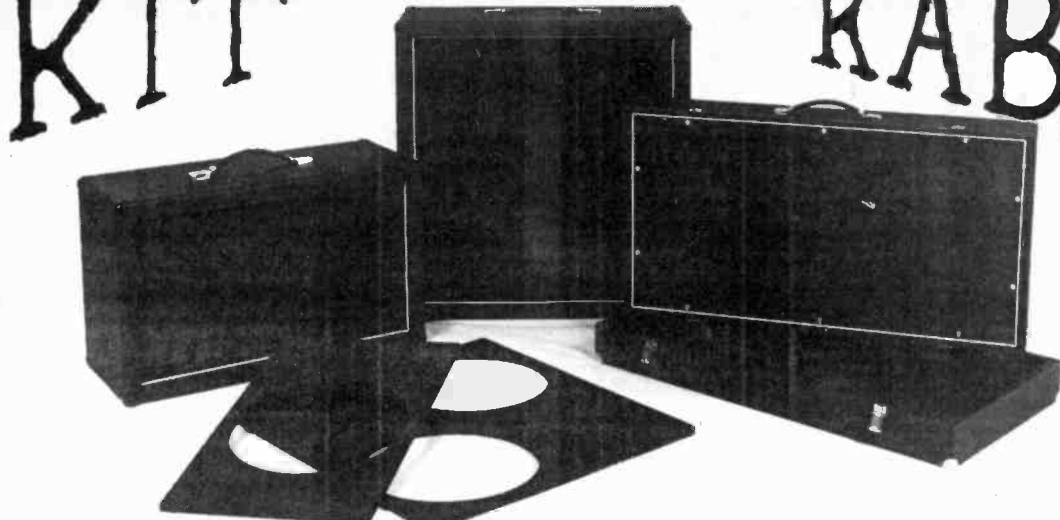

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2N918	0·34
2N929	0·25
2N930	0·26
2N1302	0·37
2N1303	0·37
2N1304	0·40
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2N2905A	0·38
2N2906	0·28
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3N200	2·80
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40408	0·50
40409	0·55
40410	0·55
40411	2·30
40594	0·75
40595	0·85
40601	0·70
40602	0·50
40603	0·60
40604	0·60
40636	1·15
40673	0·73
AC126	0·37
AC127	0·44
AC128	0·37
AC151V	0·35
AC152V	0·50
AC153	0·40
AC153K	0·42
AC154	0·45
AC178	0·40
AC176K	0·45
AC187K	0·46
AC188K	0·45
AC187	0·46
AC188	0·42
AD142	0·65
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AD150	1·28
AD161	0·75
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AF106	0·45
AF114	0·65
AF115	0·65
AF116	0·65
AF117	0·65
AF118	0·65
AF124	0·65
AF125	0·65
AF126	0·65
AF127	0·65
AF139	0·69
AF186	0·50
AF200	0·70
AF239	0·74
AF240	0·90
AF279	0·80
AF280	0·85
AL102	1·50
AL103	1·50
BC107	0·14
BC108	0·12
BC109	0·15
BC113	0·17
BC115	0·19
BC116	0·19
BC116A	0·20
BC117	0·22
BC118	0·16
BC119	0·30
BC121	0·45
BC125	0·18
BC126	0·25
BC132	0·30
BC134	0·15
BC135	0·15
BC136	0·19
BC137	0·14
BC140	0·60
BC141	0·65
BC142	0·30
BC143	0·30
BC147	0·10
BC148	0·10
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BC160	0·78
BC167	0·12
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BC177	0·19
BC178	0·18
BC179	0·21
BC182	0·11
BC182L	0·14

BC183	0·11
BC183L	0·14
BC184	0·12
BC184L	0·14
BC207	0·11
BC208	0·10
BC212	0·14
BC212L	0·17
BC214L	0·17
BC237	0·17
BC238	0·12
BC239	0·16
BC251	0·15
BC253	0·22
BC257	0·17
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BC261	0·21
BC262	0·19
BC263	0·30
BC300	0·45
BC301	0·45
BC302	0·40
BC303	0·60
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BC338	0·21
BC547	0·12
BC548	0·10
BC549	0·13
BCY30	1·03
BCY31	1·06
BCY32	1·18
BCY33	0·90
BCY34	0·98
BCY38	2·00
BCY42	0·60
BCY58	0·55
BCY59	0·32
BCY70	0·25
BCY71	0·26
BCY72	0·24
BD115	1·20
BD116	1·20
BD121	2·00
BD123	2·00
BD124	2·00
BD131	0·51
BD132	0·54
BD135	0·42
BD136	0·42
BD137	0·45
BD138	0·48
BD139	0·50
BD140	0·50
BD529	0·35
BD530	0·38
BDY20	1·13
BF115	0·36
BF117	0·70
BF121	0·55
BF123	0·55

BF152	0·25
BF153	0·25
BF154	0·25
BF159	0·35
BF160	0·30
BF161	0·60
BF166	0·40
BF167	0·33
BF173	0·33
BF177	0·38
BF178	0·45
BF179	0·48
BF180	0·45
BF181	0·45
BF182	0·45
BF183	0·45
BF184	0·35
BF185	0·30
BF194	0·12
BF195	0·11
BF196	0·13
BF197	0·14
BF198	0·15
BF200	0·31
BF225J	0·25
BF244	0·35
BF245	0·34
BF246	0·75
BF254	0·20
BF255	0·20
BF257	0·37
BF258	0·49
BF259	0·49
BFR39	0·24
BFR79	0·24
BFS21A	2·60
BFS28	1·04
BFS61	0·30
BFS98	0·27
BFX29	0·36
BFX30	0·38
BFX84	0·38
BFX85	0·41
BFX87	0·35
BFX88	0·32
BFX89	0·95
BFY50	0·30
BFY51	0·38
BFY52	0·36
BFY53	0·34
BFY90	1·27
BRY39	0·50
BSX20	0·31
BSX21	0·32
BU105	3·05
BU205	2·40
C106D	0·65
CA3020A	1·50
CA3028A	0·85
CA3035	1·35
CA3046	0·73
CA3048	2·15
CA3052	1·62
CA3080A	1·10
CA3089E	2·00
CA309AQ	4·25

CA3130	0·88
LM301A	0·47
LM308N	1·32
LM309K	1·80
LM380	0·98
LM381AN	2·07
LM702C	0·75
LM709	
TO99	0·40
8DIL	0·40
14DIL	0·40
LM710	0·45
LM723C	0·60
LM741	
TO99	0·38
8DIL	0·35
14DIL	0·40
LM747CN	0·78
LM748	
8DIL	0·44
14DIL	0·41
LM3900N	0·55
LM7805P	1·39
LM7812P	1·39
LM7815P	1·39
LM7824P	1·39
LOO5TI	1·60
MC1303	1·47
MC1310	1·96
MC1330P	0·75
MC1351P	0·87
MC1352P	0·87
MC1466L	3·95
MC1469R	2·50
MEO402	0·20
MEO404	0·15
MEO412	0·20
ME4102	0·10
ME4104	0·10
MJ480	1·05
MJ481	1·30
MJ490	1·05
MJ491	1·55
MJ2955	1·21
MJE340	0·58
MJE2955	1·25
MJE3055	0·75
MJE370	0·68
MJE371	0·81
MJE520	0·65
MJE521	0·75
MP8111	0·35
MP8112	0·40
MP8113	0·45
MPF102	0·30
MPSA05	0·20
MPSA06	0·20
MPSA12	0·35
MPSA55	0·20
MPSA56	0·20
MPSU05	0·40
MPSU06	0·40
MPSU55	0·45
MPSU56	0·45
NE555V	0·48
NE556	1·30
NE560D	4·48

NE561	4·48
NE565A	1·30
OC28	2·00
OC35	1·50
OC42	0·50
OC45	0·75
OC71	0·45
OC72	0·45
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R53	1·80
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SL610C	2·35
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SL612C	2·35
SL620C	3·50
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SL623C	5·75
SL640C	4·00
SL641C	4·00
SN76003N	2·36
SN76013N	1·50
SN76023N	1·45
SN76033N	2·50
ST2	0·20
TAA263	1·25
TAA300	2·67
TAA350	2·48
TAA550	0·60
TAA611C	2·25
TAA621	2·15
TAA661B	1·32
TBA641B	2·50
TBA651	1·80
TBA800	1·20
TBA810	1·16
TBA820	1·03
TBA920	1·79
TIL209	0·30
TIP29A	0·50
TIP29C	0·75
TIP30A	0·60
TIP30C	0·65
TIP31A	0·62
TIP31C	0·85
TIP32A	0·75
TIP32C	1·00
TIP33A	1·00
TIP33C	1·45
TIP34A	1·20
TIP34C	1·70
TIP35A	2·50
TIP36A	3·35
TIP41A	0·70
TIP41C	1·00
TIP42A	0·90
TIP42C	1·20
TIP2955	1·00
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SN7406	0·51	SN7425	0·27	SN7447	0·81	SN7475	0·40	SN7492	0·43	SN74123	0·40	SN74163	1·20	SN74193	1·13
SN7407	0·18	SN7427	0·27	SN7448	0·81	SN7476	0·36	SN7493	0·43	SN74141	0·72	SN74164	0·93	SN74196	0·81
SN7408	0·18	SN7430	0·16	SN7450	0·85	SN7480	0·45	SN7494	0·74	SN74145	0·74	SN74165	0·93	SN74197	0·81
SN7409	0·18	SN7432	0·27	SN7451	0·16	SN7481	1·10	SN7495	0·50	SN74150	1·20	SN74167	3·70	SN74198	2·04
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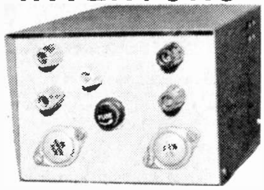

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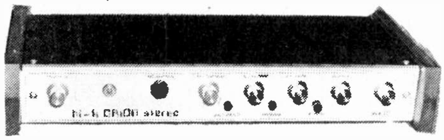

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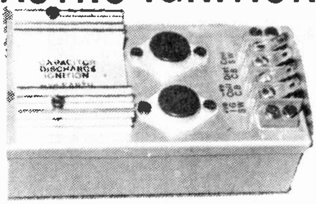

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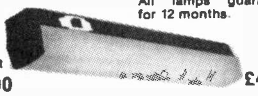

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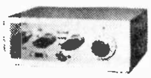

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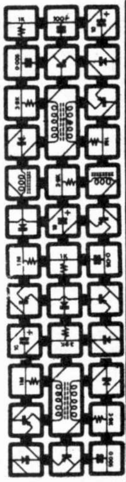

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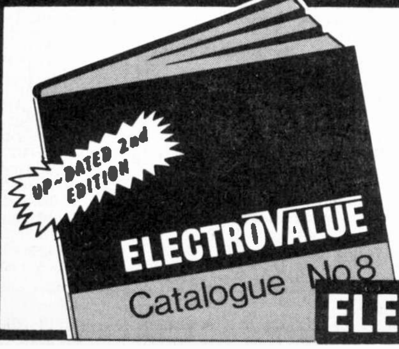

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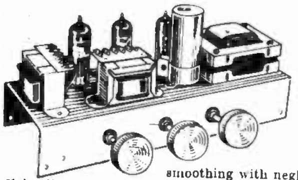

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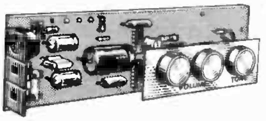

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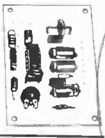

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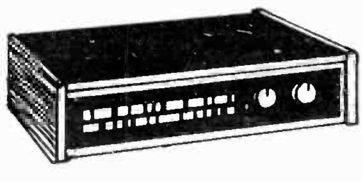

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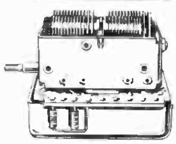

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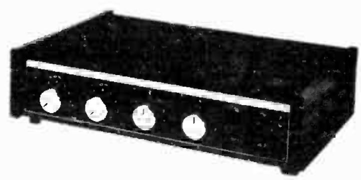

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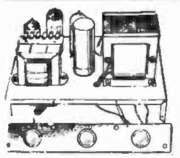

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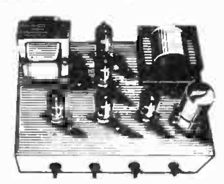

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