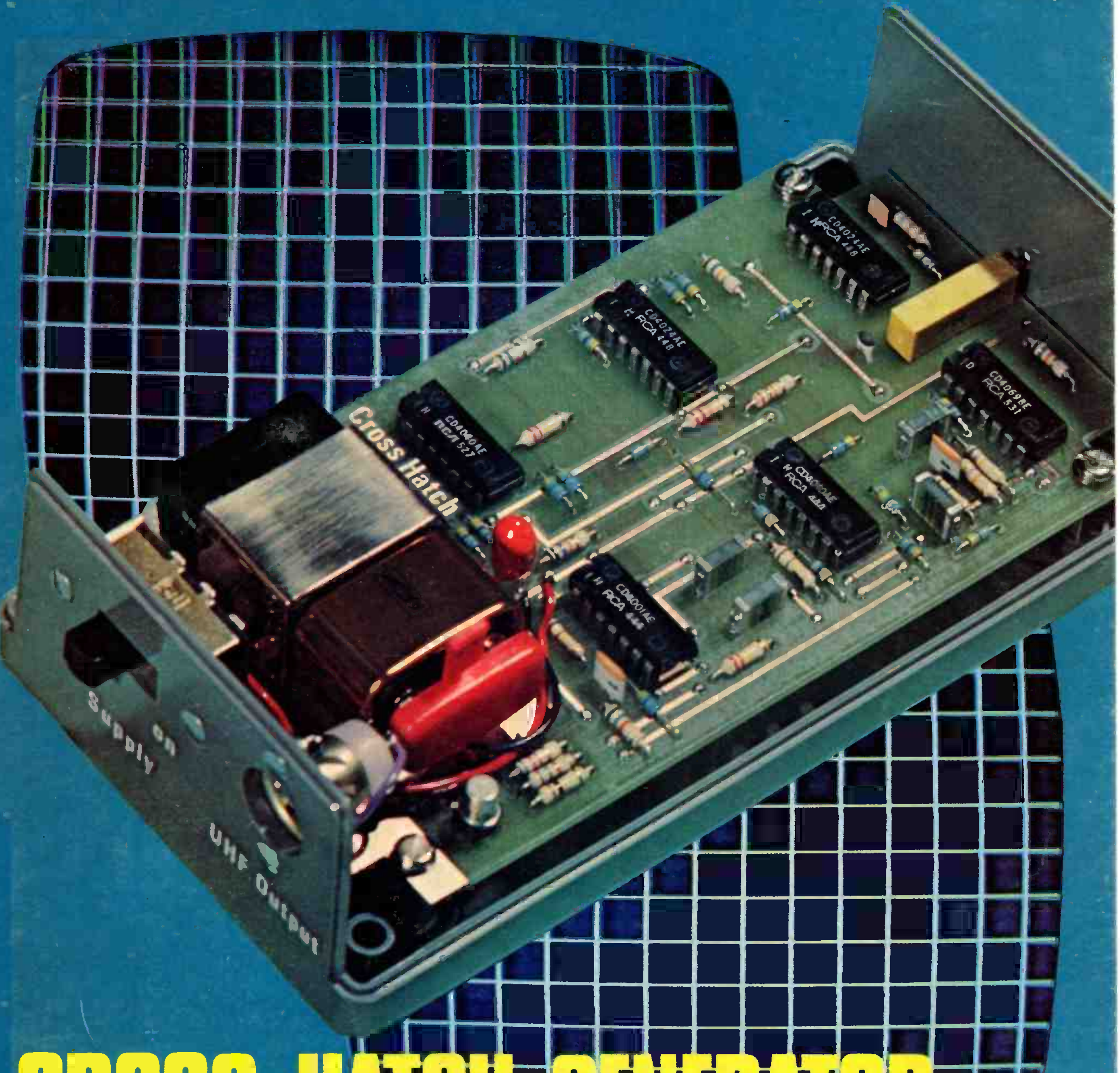
PRACTICAL

ELECTRONICS

SEPTEMBER 1976

35p



CROSS-HATCH GENERATOR

ALSO INSIDE...

GAS/SMOKE DETECTOR • CAR LIGHT-UP ALARM

PRACTICAL ELECTRONICS

VOLUME 12 No. 9 SEPTEMBER 1976

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CROSS-HATCH GENERATOR *by A. A. Birch*
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Full constructional details for a multi-channel on/off system based on tone coding 716

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Our October issue will be published on Friday, September 10, 1976
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Sparkrite mk2

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12V 300mA £1. 12V 500mA £1. 12V 750mA £1. 40V 2A tapped 10V or 30V £2·50. 20V 3A £2. 40V 3A £2·50. 30V 5A + 34V 2A ct. £3·75. 20–0–20V 1A £2. 30V 1½A £1·75.
AUTO TRANSFORMERS. 115V to 230V or 230V to 115V 150W £5; 250W £6; 400W £7; 500W £8.
CHARGER TRANSFORMERS. Input 200/250V for 6 or 12V 1½A £2·75; 4A £4·60.
FULL WAVE BRIDGE CHARGER RECTIFIERS: 6 or 12V outputs 1½A 40p; 2A 55p; 4A 85p.

R.C.S. STABILISED POWER PACK KIT

All parts including printed circuit and instructions to build this unit. Voltages available: 6V, 7·5V, 9V, 12V. Up to 100mA output.
Please state voltage required. **£2·95** Post 45p.

R.C.S. STEREO FM TUNER

This completely cased mains powered Hi-Fi Tuner with brushed aluminium facia is British made using the latest circuitry. Bargain. **£27·50** Post 45p
Stereo Tuner/Amplifier Chassis. Brand new £38·50.

BARGAIN 3W AMPLIFIER. 4 Transistor Push-Pull Ready built with volume, treble and bass controls. 18 volt battery operated. **£3·95**

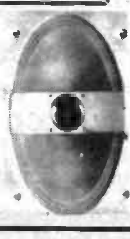
WAFER THIN HEATING ELEMENTS

Size 10½ × 8½ × $\frac{1}{16}$in. Operating voltage 200/250V a.c. 250W approx. Suitable for Heating Pads, Food Warmers, Convector Heaters, etc. Must be clamped between two sheets of metal or asbestos.

ONLY **40p** EACH (FOUR FOR £1·50)

ALL POST PAID—Discounts for quantity.

E.M.I. 13½ × 8in SPEAKER SALE!



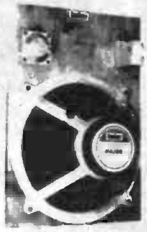
With tweeter. And crossover. 10W. State 3 or 8 ohm. As illustrated. **£5·25** Post 45p

15W model £7·95
8 or 15 ohms. Post 50p

20W model £8·95
8 or 15 ohms. Post 50p

BAKER MAJOR 12 £10·35

Post 50p



30–14,500 c/s. 12in double cone, woofer and tweeter cone together with a BAKER ceramic magnet assembly having a flux density of 14,000 gauss and a total flux of 145,000 Maxwells. Bass resonance 40 c/s. Rated 25W. NOTE: 3 or 8 or 15 ohms must be stated.

Module kit, 30–17,000 c/s with tweeter, crossover, baffle and instructions. As illustrated. **£13**

Please state 3 or 8 or 15 ohms. Post 80p

"BIG SOUND" BAKER SPEAKERS

Robustly constructed to stand up to long periods of electronic power. As used by leading groups and discos. Useful response 30–13,000 c/s. Bass Resonance 55 c/s.

GROUP "25" 12in 30W 3, 8 or 15 ohms. **£8·95** Post 40p

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GROUP 50/12in 60W 8 or 15 ohms with aluminium presence dome. **£14·50** Post 80p

GROUP "50" 15in 75W 8 or 15 ohms. **£19·50** Post 80p

Disco, Group + PA Cabinets in stock. Send for Leaflet.

BAKER 150 WATT ALL PURPOSE TRANSISTOR MIXER AMPLIFIER

Ideal for Groups, Disco, P.A. and Musical Instruments. 4 inputs speech and music. 4 way mixing. Output 8/15 ohm. a.c. Mains. Separate treble and bass controls. **£68** Carr. £1·00
50 watt model £49.

NEW 'DISCO 100 WATT' £52

ALL TRANSISTOR AMPLIFIER CHASSIS
2 inputs. 4 outputs separate volume treble and bass controls. Ideal disco or slave amplifier chassis. Carr. £1
WOOD CABINET AVAILABLE £9.

PW SOUND TO LIGHT DISPLAY

Complete kit of parts with R.C.S. printed circuit. Three 1,000W channels. As featured in December Practical Wireless. **£12·50** CABINET extra £3.

GOODMANS CONE TWEETER

18,000 c/s. 25W 8 ohm. Price **£3·25**

R.C.S. 100 WATT VALVE AMPLIFIER CHASSIS

Professional model. Four inputs. Treble, Bass, Master Volume Controls. Ideal disco, P.A. or groups. S.A.E. for details. 5 speaker outputs. 3 or 8 or 15 ohm. 100V line to order. **£85**
Suitable carrying case £16·50. plus £2·50 carr.

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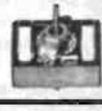
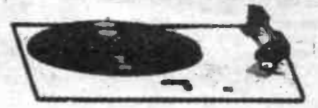


NEW BSR HI-FI AUTOCHANGER

Plays 12in, 10in or 7in records Auto or Manual. A high quality unit backed by BSR reliability with 12 months' guarantee. A.c. 200/250V. Size 13½ × 11¼in. Above motor board 3¼in. Below motor board 2¼in. With STEREO/MONO CARTRIDGE. **£10·95**
Single Player version £15·50. All Post 75p
GARRARD AUTOCHANGER Model 6300 £14·95.

PORTABLE PLAYER CABINET £4·50

Post 50p.
Modern design. Size 16in × 15in × 7in rexine covered. Large front grille. Hinged lid. Chrome fittings. Motor board cut for Garrard or BSR deck.



R.C.S. DISCO DECK SINGLE RECORD PLAYER

Fitted with auto stop, stereo/compat. cartridge. Baseplate. Size 11in × 8½in. Turntable. Size 7in diameter. A.c. mains. 220/250V.
3 speeds plays all size records. **£6·25** Post 45p
Two for £12. Post 75p.

HEAVY METAL PLINTHS

With P.V.C. Cover. Cut out for most B.S.R. or Garrard decks. Silver grey finish. **£5·95**
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Ideal for record decks, tape decks, etc. Post 75p.

BAKER HI-FI SPEAKERS

HIGH QUALITY—BRITISH MADE

SUPERB

12in 25 watts

A high quality loudspeaker, its remarkable low cone resonance ensures clear reproduction of the deepest bass. Fitted with a special copper drive and concentric tweeter cone resulting in full range reproduction with remarkable efficiency in the upper register.
Bass Resonance 25 c/s
Flux Density 16,500 gauss
Useful response 20–17,000 c/s
8 or 15 ohms models.

£16·30 Post 80p.

AUDITORIUM

12in 35 watts

A full range reproducer for high power. Electric Guitars, public address, multi-speaker systems, electric organs. Ideal for Hi-Fi and Discotheques.
Bass Resonance 35 c/s
Flux Density 15,000 gauss
Useful response 25–16,000 c/s
8 or 15 ohms models.

£15·50 Post 80p.

15in model 45 watts £19·50. Post 90p.

BLANK ALUMINIUM CHASSIS, 18 s.w.g. 2½in sides, 6in × 4in, 70p; 8in × 6in, 90p; 10in × 7in, £1·15; 14in × 9in, £1·50; 16in × 6in, £1·45; 12in × 3in, 87p; 16in × 10in, £1·70.

ALUMINIUM PANELS, 18 s.w.g. 6in × 4in, 15p; 8in × 6in, 25p; 10in × 7in, 30p; 12in × 5in, 30p; 12in × 8in, 40p; 16in × 6in, 45p; 14in × 9in, 50p; 12in × 12in, 55p; 16in × 10in, 75p.
ALUMINIUM ANGLE BRACKET, 6in × ¾in × ¾in, 20p.

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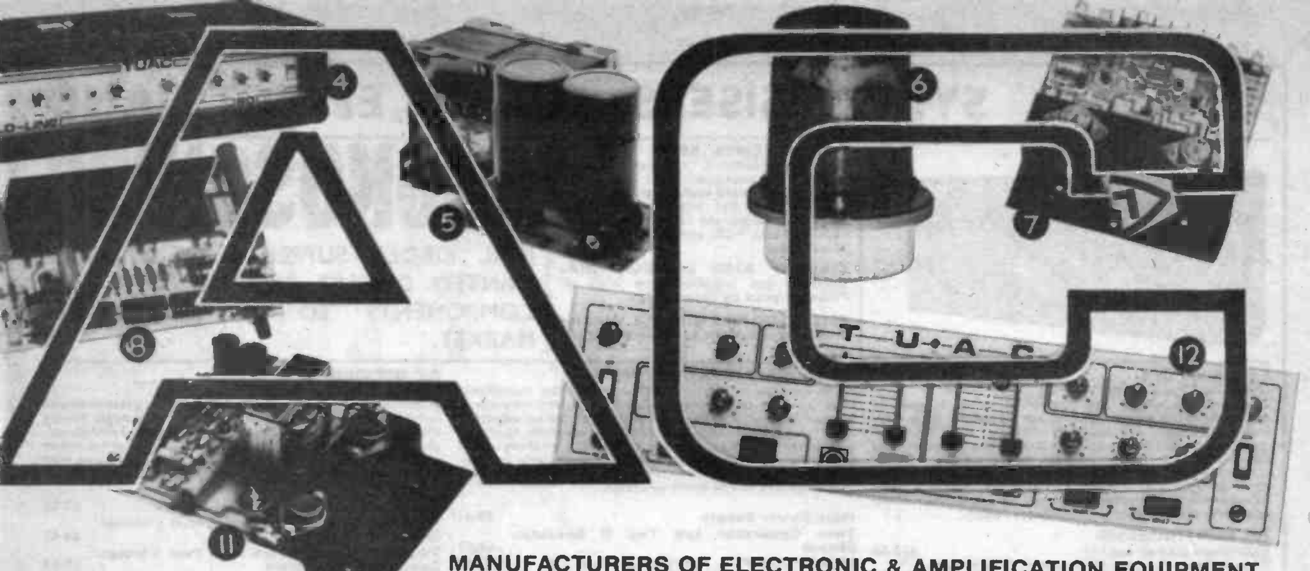

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PS 60 ±38 volts for TL60	£14·50
PS 30 ±25 volts for TL30	£9·75
PSU 2 for supplying disc mixer	£6·50

4 CHANNEL SOUND TO LIGHT SEQUENCE CHASER—4LSMI 8

- RCA 8A Triacs
- 1000W per channel
- Fully suppressed and fused
- Switched master control for sound operation from ¼W to 125W
- Speed control for fixed rate sequence from 8 per minute to 50 per second
- Full logic integrated circuitry with optical isolation for amplifier protection
- Full wave control
- 13 easy connections

Patents applied for **£18·75**

Model 501 500W per channel as above without sound triggering £12·25

10 3 CHANNEL LIGHT MODULATOR—S1LMB

- RCA 8A Triacs
- 1000W per channel
- Each channel fully suppressed and fused
- Master control to operate from 1W to 100W
- Full wave control
- 12 easy connections

£18·00

(Single Channel Version 1500 Watts £9·50)

ADD SEQUENCE CHASING AND DIMMING EFFECTS TO YOUR TUAC 3 CHANNEL LIGHT MODULATOR

- Speed Control 3 per min. to 10 per sec.
- Full logic integrated circuitry
- Dimmer control to each channel
- 9 easy connections

3 Sequence Dimmer Module—3SDMI **£13·00**

See you on STAND 39

We will be demonstrating our full range daily

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12 STEREO DISCO MIXER

With touch sensitive switching and auto fade

INPUTS: Four identical stereo inputs available with any equalisation. Two magnetic and two flat supplied as standard. High quality slider control on each channel. Volume, treble and bass controls for each pair of sliders. Sensitivity mag., 3mV (R.I.A.A. comp.). Flat 50mV at 1kHz. Bass controls ±18dB at 60Hz. Treble controls ±18dB at 15kHz. **OUTPUT:** Up to 3 volts (+12dB) available. Attenuated output for TUAC Power Modules. Rotary master and balance controls. Band width 15Hz-25kHz ±1dB.

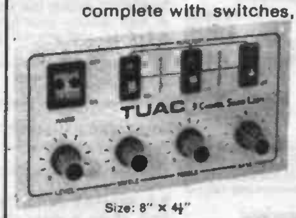
P.F.L.: Output 250mV into 8 ohms. Rotary volume control. Monitoring facility for all 4 channels. Selection via touch sensitive illuminated switches. Switched visual cue indicator.

Miscellaneous Facilities: Two illuminated deck on/off switches. Mains illuminated on/off switch. Auto fade illuminated on/off switch. Mains powered with integral screen and back cover. Complete with full instructions.

Size: 25in long × 6in high × 3in deep **£115**

FRONT PANELS FOR LIGHTING EFFECT MODULES

complete with switches, neons and knobs as illustrated



For S1LMB **£6·50**

Size: 8" × 4¼"

Size: 6¼" × 4¼"

For 4LSM1 **£5·50**

For S1LMB combined with 3SDM1 **£7·50**

Size: 9" × 4¼"

FUZZ LIGHTS

RED GREEN BLUE AMBER

240 volt a.c. Long Life Candle Bulb, Revolving Reflector, adds a new dimension to disco lighting effects.

6 **£19·50**

Suppliers to H.M. Govt. Depts. Manufactured and assembled in Gt. Britain fully tested and guaranteed.

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Make cheques/P.O.s payable to TUAC LTD. (PE9) or quote Access/Barclaycard No. and post to TUAC LTD. (PE9), 119 Charlmont Road, London, SW17 9AB. We accept phone orders from Access/Barclaycard Holders. Phone: 01-672 3137/9080.

Send large stamped addressed envelope with all enquiries for fully illustrated 12 page catalogue

OTHER PROJECTS

PHOTOGRAPHS in this advertisement show two of our units containing some of the P.E. projects built from our kits and PCBs. The cases were built by ourselves and are not for sale, though a small selection of other cases is available.

LIST—Send Stamped Addressed Envelope with all U.K. requests for free list giving fuller details of PCBs, kits, and other components.

OVERSEAS enquiries for list: Europe—send 20p; Other Countries—send 40p.

KEYBOARDS AND CONTACTS

Kimber-Allen Keyboards as required for many published circuits, including the **P.E. Joanna, P.E. Minisonic,** and **P.E. Synthesiser.** The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C. The keys are plastic, spring-loaded and mounted on a robust aluminium frame.

3 Octave (37 notes) **£20·50.** 4 Oct (49 notes) **£23·50.** 5 Oct (61 notes) **£27.**

Contact Assemblies for use with above keyboards: Single-pole change-over (type SP) as for P.E. Joanna and P.E. Minisonic. Two-pole normally open-make-break (type DP) as for P.E. Synthesiser. Special contact assembly (type 4PS) having 4 poles, 3 of which are normally-open make-break contacts and the fourth is a change-over contact—this special assembly enables THE SAME KEYBOARD to be used with the P.E. Synthesiser, P.E. Minisonic and the P.E. Joanna simultaneously thus avoiding the cost of more than one keyboard.

Contact	*Each*	*3 Octave Set*	*4 Octave Set*	*5 Octave Set*
SP	20p	£7·40	£9·80	21·20
2P	24p	£8·88	£11·76	£14·64
4PS	48p	£17·76	£23·52	£29·28

PRINTED CIRCUIT BOARDS for use with the above contacts and thus eliminating most of the inter-wiring required, are available. Details in our lists.

SOUND-TO-LIGHT (P.E. Apr./Aug. 71)

The ever-popular **Aurora**—4 or 8 channels each responding to a different sound frequency and controlling its own light. Can be used with most audio systems and lamp intensities. A MUST for any Disco, and a fascinating visual display for the home.

4 Channel Component Set (excl. thyristors)	£13·05
8 Channel Component Set (excl. thyristors)	£22·56
Power Supply Component Set	£4·96
PCB for 4 frequency channels	£3·32
PCB for power supply and 8 lamp drivers	£1·56
1A 400V thyristors (1 per chan. req.) each	75p
Panel meter (1µA) (optional)	£3·75

3-CHANNEL SOUND-TO-LIGHT (P.E. Apr. 76)

A simple but effective sound-to-light controller capable of operating 3 lamps each of approximately 700 watts. Includes power supply, thyristors, and by-pass switches.

Component Set incl. PCB	£11·36

BIOLOGICAL AMPLIFIER (P.E. Jan./Feb. 73)

Multi-function circuits that, with the use of other external equipment, can serve as lie-detector, alphaphone, cardiophone etc.

Pre-Amp Module Component Set incl. PCB	£3·71
Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lamp-driver circuits	£5·38
Audio Amplifier Module Type PC7	£6·75

TAPE NOISE LIMITER

Very effective circuit for reducing the hiss found in most tape recordings. All kits include PCBs.

Standard Tolerance Set of Components	£2·60
Superior Tolerance Set of Components	£3·22
Regulated Power Supply (will drive 2 sets)	£3·98

SINE AND SQUARE WAVE GENERATOR (P.E. July 75)

Suitable for audio, digital, or general purpose. Controllable through 4 decade ranges 10Hz to 100kHz, switched attenuation through 10 ranges from 10V to 1mV peak-to-peak.

Component Set	£8·88
PCB for above components	£1·60
Power Supply	£5·70
PCB for Power Supply	96p

NEW GUITAR EFFECTS UNIT

Practical Electronics, August, 1976

Details in list

SEMI CONDUCTOR TESTER (P.E. Oct. 73)

Essential test equipment for the enterprising home constructor. While stocks last.

Set of resistors, capacitors, semiconductors, potentiometers, makaswitches and PCB	£8·44
Panel meter (500µA)	£3·75

PHOTOPRINT PROCESS CONTROL (P.E. Jan./Feb. 72)

For colour and B & W, and indispensible dark-room unit for finding exposure, controlling enlarger timing, and stabilising mains voltage. While stocks last.

Component Set (excl. meter)	£10·72
Printed Circuit Board	£1·74
Panel Meter (1mA)	£3·75

TREMELO inc. P.C.B.	£2·85
FUZZ UNIT inc. P.C.B.	£1·80

TRANSISTORS

AC128	20p
AC176	20p
BC107	13p
BC108	13p
BC109	13p
BC147	12p
BC148	12p
BC149	12p
BC157	13p
BC158	13p
BC159	13p
BC182L	12p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC212L	15p
BC213	15p
BC478	28p
BCY71	22p
BD131	44p
BD132	54p
BFY50	22p
BFY51	22p
BFY52	24p
BSY95A	22p
MJE2955	110p
OC28	60p
OC71	14p
OC72	14p
OCB4	25p
ORP12	66p
ZTX107	12p
ZTX108	7½p
ZTX501	13p
ZTX503	15p
ZTX531	23p
2N706	13p
2N914	22p
2N1304	22p
2N2219	27p
2N2905	27p
2N2905A	28p
2N2907	22p
2N3053	18p
2N3054	66p
2N3055	48p
2N3702	12p
2N3703	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N4060	12p
2N4871	36p
2N5245	51p
2N5777	45p

INTEGRATED CIRTS.

709	T05	40p
709	8-pin DIL	40p
723	T05	95p
741	8-pin DIL	32p
748	T05	63p
748	8-pin DIL	63p
µA7805	T0220	165p
µA7808	T0220	165p
µA7812	T0220	165p
µA7815	T0220	165p
µA7818	T0220	165p
AY-1-0212		622p
AY-1-6721/6		188p
CA3046		71p
MFC4000B		73p
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SG3402N		220p

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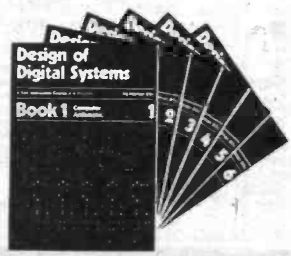

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7406	22	7472	22	74164	1-10
7407	22	7473	26	74165	1-25
7408	14	7474	26	74166	1-15
7409	14	7475	37	74173	95
7410	10	7476	23	74175	95
7411	16	7483	70	74176	95
7413	29	7485	80	74177	85
7416	22	7486	24	74180	80
7417	22	7489	1-50	74181	2-50
7420	11	7490	40	74182	80
7422	22	7491	71	74184	1-55
7423	22	7492	44	74185	1-30
7425	22	7493	39	74190	95
7426	23	7494	45	74191	95
7427	22	7495	49	74192	90
7430	12	7496	55	74193	85
7432	22	74100	79	74194	95
7437	25	74105	60	74195	72
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7444	60	74126	50		
7445	75	74141	68	74132	·50
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74L42	89	74L86	38		

LOW POWER SCHOTTKY

74LS00	£-23	74LS32	25	74LS95	1-20
74LS02	23	74LS40	30	74LS107	35
74LS04	23	74LS42	80	74LS164	1-20
74LS08	25	74LS74	40	74LS193	1-30
74LS10	23	74LS90	80	74LS197	1-20
74LS20	23	74LS93	80		

HIGH SPEED

74H00	£0-16	74H22	£0-18	74H61	£0-25
74H01	16	74H30	18	74H62	20
74H04	16	74H40	16	74H74	32
74H08	16	74H50	16	74H101	35
74H10	16	74H52	18	74H102	35
74H11	16	74H53	20	74H103	40
74H20	16	74H55	20	74H106	40
74H21	16	74H60	21	74H108	40

SCHOTTKY

74S00	23	74S08	30	74S22	23
74S02	30	74S10	23	74S32	35
74S03	23	74S20	23	74S74	23
74S04	30				

8000 (NATIONAL)

8091	£0-33	8214	£0-93	8811	£0-38
8092	33	8220	93	8812	60
8095	76	8230	1-42	8822	1-42
8121	49	8520	71	8830	1-42
8123	88	8551	91	8831	1-42
8130	1-20	8552	1-37	8836	27
8200	1-42	8554	1-37	8880	73
8210	1-92	8810	44		

8000 (SIGNETICS)

8263	3-79	8267	1-79

9000

9002	24	9309	56	9601	62
9301	72	9312	56	9602	56

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8 pin	£-11	24 pin	£-25
14 pin	-12	28 pin	-36
16 pin	-13	40 pin	-42
18 pin	-19		

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CMOS

4000A	21	4018A	89	4066A	72
4001A	21	4020A	1-22	4068A	36
4002A	21	4021A	1-13	4069A	36
4006A	1-10	4022A	90	4071A	22
4007A	22	4023A	21	4072A	29
4008A	1-46	4024A	72	4073A	32
4009A	47	4025A	21	4075A	32
4010A	44	4027A	48	4078A	32
4011A	22	4028A	81	4082A	29
4012A	21	4030A	37	4518A	1-69
4013A	37	4035A	1-04	4528A	1-31
4014A	1-22	4040A	99	4585A	1-71
4015A	1-22	4042A	1-21	4901A	31
4016A	46	4049A	48		
4017A	98	4050A	48		
74C00	24	74C74	72	74C162	2-05
74C02	35	74C76	1-07	74C163	2-05
74C04	47	74C107	94	74C164	2-21
74C08	47	74C151	1-83	74C173	1-83
74C10	41	74C154	2-21	74C195	1-90
74C20	41	74C157	1-38	80C95	94
74C42	1-36	74C160	2-05	80C97	94
74C73	98	74C161	2-05		

CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal — battery operation 40 pin	£1-99
CT5005	12 digit, 4 function plus memory, fixed decimal 28 pin	2-06
MM5725	8 digit, 4 function, floating decimal 28 pin	1-37
MM5736	6 digit, 4 function, 9V battery operation 18 pin	2-78
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation 24 pin	2-78
MM5739	9 digit, 4 function, 9V battery operation 22 pin	2-78

MEMORIES

1101	256 bit RAM MOS 16 pin	£1-09
1103	1024 bit RAM MOS 18 pin	1-97
1702A	2048 bit static PROM elect. prog. - UV eras. 24 pin	10-50
2102 (2602)	1024 bit static RAM DTL/TTL comp. 1 ms 16 pin	2-00
2102-1	Same as 2101 except 500ns	2-25
5203	2048 bit static PROM elect prog. - UV eras. 24 pin	7-55
5260	1024 bit dynamic RAM MOS 16 pin	1-35
5261	1024 bit dynamic RAM MOS 16 pin	1-35
5262	2048 bit dynamic RAM MOS 22 pin	1-55
7489	64 bit ROM TTL 16 pin	1-79
82S23	256 bit PROM SCHOTTKY 16 pin	2-75
F93410	256 bit RAM bi-polar 16 pin	1-50
74187	1024 bit ROM TTL 16 pin	4-00
74200	256 bit RAM tri-state 16 pin	4-39

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.1 mfd	35V	15p	10 mfd	16V	21p
.33 mfd	35V	15p	10 mfd	25V	22p
1 mfd	35V	15p	15 mfd	10V	22p
2.2 mfd	20V	15p	22 mfd	16V	22p
2.2 mfd	35V	15p	33 mfd	10V	25p
4.7 mfd	16V	18p	47 mfd	6V	25p
6.8 mfd	6V	18p	56 mfd	6V	25p
6.8 mfd	50V	21p			

SHIFT REGISTERS

MM5013	1024 bit accum. dyn. 8 pin	£1-20
MM5016	500/512 bit dyn. 8 pin	1-10
SL5-4025	Quad 25 bit	95
2504	1024 bit multiplexed dyn 8 pin	3-40

UNIVERSAL BREADBOARD
Silver plated copper circuit board 3-3/16" x 5-1/16". 2 rows of 27 holes for DIP IC's + space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuitry £1

MISC DEVICES

ULN 2208	FM gain block 34dB mDIP	£1-03
ULN2209	FM gain block 48dB mDIP	1-03
2513	64 x 8 x 5 character generator	7-00
CA 3046	Transistor array 14 pin DIP	55

8038 FUNCTION GENERATOR
Voltage controlled oscillator sine, square, triangular output 16 pin DIP with data £2-50

CLOCK CHIPS

MM5311	6 digit multiplexed BCD, 7 seg 12-24 Hr, 50-60 Hz 28 pin	£3-07
MM5312	4 digit multiplexed BCD, 7 seg 1 pps. 12-23 Hr, 50-60 Hz 24 pin	2-23
MM5313	6 digit multiplexed BCD, 7 seg 1 pps, 12-24 Hr, 50-60 Hz 28 pin	3-07
MM5314	6 digit multiplexed 12-24 Hr, 50-60Hz 24 pin	3-07
MM5316	4 digit, 12-24 Hr, 50-60 Hz, alarm 40 pin	2-78
CT7001	6 digit, 12-24 Hr, 50-60 Hz, alarm, timer and date circuits 28 pin	4-80

LED'S

ME4	Infra-red TO-18	29p
MV50	Mini LED red emitting - axial	10p
NSL100	Mini red LED - point	10p
NSL102	Mini red LED - diffused	10p
XC209-R	Mini red LED - diffused	12p
MV5020	Jumbo red - diffused	12p
MV5020	Jumbo green - diffused	15p
MV5020	Jumbo clear	12p
MV5020	Jumbo amber	12p

LED DISPLAYS

MAN1	Red .27" CA	£1-50
MAN2	Red 5x7 dot matrix .35"	2-95
MAN3A	Red .127" CC	-15
MAN5	Green .27" CA	2-03
MAN6	Red .6" CA	2-93
MAN7	Red .27" CA	-97
MAN8	Yellow .27" CA	2-03
MAN66	Red .6" CA spaced seg	2-03
DL10A	Red .26" CA	2-08
NSN71L	Red .27" CA	-89
FND70	Red .25" CC	-49

MULTIPLE DISPLAYS

NSN33	3 digit .12" red LED	£ -89
HP5082-7405	5 digit .11 red LED	1-80
HP5082-7414	4 digit .11 red LED	1-70
SP-425-09	9 digit .25 gas disch.	1-50

Date sheets on request. Add 20p ea. if item is priced below 50p each.

LINEAR CIRCUITS

300	Pos V Reg (super 723) TO-5	£ 49
301	Hi Perf Op Amp mDIP TO-5	21
302	Volt follower TO-5	49
304	Neg V Reg TO-5	56
305	Pos V Reg TO-5	60
307	Op AMP (super 741) mDIP TO-5	44
308	Mciro Pwr Op Amp mDIP TO-5	69
309K	5V 1A regulator TO-3	1-25
310	V Follower Op Amp mDIP	75
311	Hi perf V Comp mDIP TO-5	67
319	Hi Speed Dual Comp DIP	82
320T	Neg Reg 5, 12, TO-220	1-12
320K	Neg Reg 5.2, 12 TO-3	1-32
322	Precision Timer DIP	69
324	Quad Op Amp DIP	1-23
339	Quad Comparator DIP	1-06
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3	1-48
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220	1-23
370	AGC/Squelch AMPL DIP	92
372	AF-IF Strip detector DIP	51
373	AM/FM/SSB Strip TO-5	35
376	Pos V Reg mDIP	38
380	2w Audio Amp DIP	93
380-8	.6w Audio Amp mDIP	1-02
381	Lo Noise Dual preamp DIP	1-13
382	Lo Noise Dual preamp DIP	1-13
531	High Slew rate Op Amp	2-07
540	Power driver TO-5	1-38
550	Prec V Reg DIP	62
555	Timer mDIP	44
556A	Dual 555 Timer DIP	1-02
560	Phase Locked Loop DIP	2-23
562	Phase Locked Loop DIP	2-23
565	Phase Locked Loop DIP TO-5	1-38
566	Function Gen mDIP TO-5	1-38
567	Tone Decoder mDIP	1-38
709	Operational AMP TO-5 or DIP	31
710	Hi Speed Volt Comp DIP	24
711	Dual Difference Compar DIP	51
723	V Reg DIP	44
733	Diff. video AMPL TO-5	63
739	Dual Hi Perf Op Amp DIP	75
741	Comp Op Amp mDIP TO-5	29
747	741 Dual Op Amp DIP or TO-5	51
748	Freq Adj 741 mDIP	31
1304	FM Mulpx Stereo Demod DIP	75
1307	FM Mulpx Stereo Demod DIP	52
1456	Op Amp mDIP	91
1458	Dual Comp Op Amp mDIP	44
1800	Stereo multiplexer DIP	1-73
3900	Quad Amplifier DIP	38
7524	Dual core memory sense Amp	1-20
7525	Dual core memory sense Amp	92
8038	Voltage contr. osc. DIP	3-68
8864	9 DIG Led Cath Drvr DIP	1-58
75150	Dual Line Driver DIP	1-27
75451	Dual Perepheral Driver mDIP	24
75452	Dual Peripheral Driver mDIP	24
75453	(351) Dual Periph Driver mDIP	24
75491	Quad Seq Driver for LED DIP	58
75492	Hex Digit driver DIP	63

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Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC117K	*0·30	AF178	*0·51	BC169	0·10	BC440	*0·31	BF117	*0·46
AC126	*0·18	AF179	*0·51	BC169C	0·10	BC460	*0·37	BF118	*0·71
AC126	*0·14	AF180	*0·51	BC170	0·09	BD115	*0·63	BF119	*0·71
AC127	*0·11	AF181	*0·51	BC171	0·09	BD116	*0·81	BF152	0·56
AC128	*0·11	AF186	*0·51	BC172	0·09	BD121	*0·61	BF153	0·46
AC128K	*0·26	AF239	*0·38	BC173	0·09	BD123	*0·67	BF154	0·46
AC141	*0·10	AL102	*0·75	BC174	0·15	BD124	*0·70	BF155	*0·71
AC141K	*0·80	AL103	*0·75	BC175	*0·22	BD131	*0·36	BF156	*0·49
AC142	*0·19	BC107	*0·08	BC177	*0·16	BD132	*0·40	BF157	*0·56
AC142K	*0·26	BC108	*0·08	BC178	*0·16	BD133	*0·67	BF158	0·56
AC153K	*0·24	BC109	*0·08	BC179	*0·16	BD135	0·41	BF159	0·61
AC176	*0·11	BC113	0·10	BC180	*0·25	BD136	0·41	BF173	*0·15
AC176K	*0·26	BC114	0·16	BC181	0·25	BD137	0·46	BF176	0·36
AC180	*0·20	BC115	0·16	BC182	0·09	BD138	0·51	BF179	*0·31
AC180K	*0·30	BC116	0·16	BC182L	0·09	BD139	0·56	BF180	*0·31
AC181	*0·20	BC117	0·19	BC183	0·09	BD140	0·61	BF181	*0·31
AC181K	*0·30	BC118	0·09	BC183L	0·09	BD155	*0·81	BF194	0·10
AC187	*0·17	BC119	*0·31	BC184	0·09	BD175	*0·61	BF195	0·10
AC187K	*0·23	BC120	*0·81	BC184L	0·09	BD176	*0·61	BF196	0·92
AC188	*0·19	BC137	0·16	BC186	*0·20	BD177	*0·67	BF197	0·12
AC188K	*0·23	BC139	*0·41	BC187	*0·20	BD178	*0·67	BF198	0·12
AD140	*0·49	BC140	*0·31	BC207	0·11	BD179	*0·71	BF199	0·12
AD142	*0·55	BC141	*0·31	BC208	0·11	BD180	*0·71	BF257	*0·28
AD143	*0·49	BC142	*0·31	BC209	0·12	BD185	*0·67	BF258	*0·36
AD149	*0·45	BC143	*0·31	BC212	0·10	BD186	*0·67	BF259	*0·46
AD150	*0·65	BC145	0·46	BC212L	0·10	BD187	*0·71	BF262	0·56
AD161	*0·36	BC147	0·09	BC213	0·10	BD188	*0·71	BF263	0·56
AD162	*0·36	BC148	0·09	BC213L	0·10	BD189	*0·77	BF270	*0·36
AD161 &		BC149	0·09	BC214	0·10	BD190	*0·77	BF271	*0·31
AD162(MF)		BC150	0·19	BC214L	0·10	BD195	*0·87	BF272	*0·81
	*0·89	BC151	0·20	BC225	0·26	BD196	*0·87	BF273	0·36
AF114	*0·22	BC152	0·18	BC226	0·36	BD197	*0·92	BF274	0·36
AF115	*0·22	BC153	0·29	BC251	0·10	BD198	*0·92	BFX29	*0·25
AF116	*0·22	BC154	0·20	BC301	*0·28	BD199	*0·98	BFX84	*0·19
AF117	*0·22	BC157	0·11	BC302	*0·25	BD200	*0·98	BFX85	*0·25
AF118	*0·32	BC158	0·11	BC303	*0·31	BD205	*0·81	BFX86	*0·22
AF124	*0·28	BC159	0·11	BC304	*0·37	BD206	*0·81	BFX87	*0·22
AF125	*0·28	BC160	*0·46	BC327	0·12	BD207	*0·98	BFX88	*0·22
AF126	*0·26	BC161	*0·51	BC328	0·12	BD208	*0·98	BFY50	*0·13
AF127	*0·28	BC167	0·10	BC337	0·12	BDY20	*1·02	BFY51	*0·13
AF139	*0·31	BC168	0·10	BC338	0·12	BF115	*0·15	BFY52	*0·13

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
BFY53	*0·13	OC75	*0·16	2N706	*0·08	2N2646	*0·34	2N3703	0·09
BSY19	*0·16	OC76	*0·16	2N706A	*0·09	2N2904	*0·14	2N3704	0·08
BSX20	*0·16	OC77	*0·26	2N708	*0·11	2N2904A	*0·18	2N3705	0·08
BSY25	*0·16	OC81	*0·16	2N914	*0·15	2N2905	*0·18	2N3706	0·08
BSY26	*0·16	OC81D	*0·16	2M918	*0·18	2N2905A	*0·18	2N3707	0·08
BSY27	*0·16	OC82	*0·16	2N1131	*0·18	2N2906	*0·12	2N3708	0·08
BSY28	*0·16	OC82D	*0·16	2N1132	*0·18	2N2906A	*0·14	2N3709	0·08
BSY29	*0·16	OC83	*0·20	2N1302	*0·15	2N2907	*0·15	2N3710	0·09
BSY38	*0·19	OC139	*0·20	2N1303	*0·15	2N2907A	*0·16	2N3711	0·09
BSY39	*0·19	OC140	*0·23	2N1304	*0·18	2N2923	0·15	2N3819	*0·14
BSY40	*0·29	OC169	*0·26	2N1305	*0·18	2N2924	0·15	2N3820	*0·40
BSY41	*0·29	OC170	*0·26	2N1306	*0·21	2N2925	0·15	2N3823	*0·16
BSY95	*0·13	OC171	*0·26	2N1307	*0·21	2N2926G	0·09	2N3903	0·12
BSY95A	*0·13	OC200	*0·26	2N1308	*0·24	2N2926Y	0·09	2N3904	0·12
BU105	*1·90	OC201	*0·29	2N1309	*0·24	2N2926O	0·08	2M3905	0·14
MJE521	*0·56	OC202	*0·29	2N1613	*0·16	2N2926R	0·07	2N3906	0·14
MJE2955	*0·88	OC203	*0·26	2N1711	*0·16	2N2926B	0·07	2N4287	0·18
MJE3055	*0·57	OC204	*0·26	2N2147	*0·73	2N3053	*0·15	2N4288	0·18
MJE3440	*0·51	OC205	*0·38	2N2148	*0·58	2N3054	*0·40	2N4289	0·18
MPF102	*0·28	OCP71	*0·44	2N2218	*0·18	2N3055	*0·40	2N4290	0·18
MPF104	*0·28	ORP12/		2N2218A	*0·19	2N3402	*0·21	2N4291	0·18
MPF105	*0·28	NSL4931	*0·46	2N2219	*0·18	2N3403	*0·21	2N4292	0·18
OC19	*0·36	ORP60	*0·41	2N2219A	*0·19	2N3404	*0·29	2N4293	0·18
OC20	*0·80	ORP61	*0·41	2N2220	*0·22	2N3405	*0·43	2N5172	0·12
OC22	*0·47	TIP29	*0·40	2N2221	*0·18	2N3614	*0·69	2N5457	*0·28
OC23	*0·49	TIP30	*0·45	2N2222	*0·10	2N3615	*0·76	2N5458	*0·28
OC24	*0·57	TIP31A	*0·52	2N2368	*0·18	2N3616	*0·76	2N5459	*0·28
OC25	*0·39	TIP32A	*0·60	2N2369	*0·12	2N3646	0·09	40361	*0·30
OC26	*0·38	TIP41A	*0·65	2N2369A	0·12	2N3702	0·09	40362	*0·35
OC28	*0·60	TIP42A	*0·72						
OC29	*0·60	TIS43	*0·25						
OC35	*0·45	UT46	*0·20						
OC36	*0·51	ZTX107	0·07						
OC41	*0·20	ZTX108	0·07						
OC42	*0·25	ZTX109	0·07						
OC44	*0·16	ZTX300	0·07						
OC45	*0·13	ZTX500	0·09						
OC70	*0·10	2N696	*0·10						
OC71	*0·10	2N697	*0·11						
OC72	*0·15	2N698	*0·20						
OC74	*0·15	2N699	*0·36						

VAT CHAT

Please add 8% to prices marked *. Remainder add 12½%. Do not add VAT to prices marked †.

SUPER UNTESTED PAKS

Pak No.		Description	Price
U 1	120	Glass Sub-min. General purpose Germ. diodes	0·60
U 4	30	Germanium transistors like OC81, AC128	*0·60
U 5	60	200mA sub-min. silicon diodes	*0·60
U11	20	PNP Sil. planar trans. TO-5 like 2N1132, 2N2904	*0·60
U15	20	NPN Sil. planar trans. TO-5 like 2N696, 2N697	*0·60
U19	20	Silicon NPN transistors like BC108	*0·60
U26	30	Fast switching silicon diodes like IN914 Micro-Min.	0·60
U29	10	1 Amp SCR's TO-5 can. up to 600 CRS/25-600	*£1·20
U32	25	Zener diodes 400mW DO-7 case 3-36 volts mixed	0·60
U36	20	Silicon planar NPN transistors TO-5 BFY50/51/52	*0·60
U45	7	3A SCR. TO66 up to 600 PIV	*£1·20
U46	20	Unijunction transistors similar to TIS43	*0·60
U48	9	NPN Sil. power transistors like 2N3055	*£1·20

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

DIODES

Type	Price	Type	Price	Type	Price	Type	Price
BA100	*0·10	BB104	*0·15	OA10	*0·14	OA91	*0·07
BA116	*0·21	BY100	*0·16	OA47	*0·07	OA95	*0·07
BA126	*0·22	BY126	*0·15	OA70	*0·07	OA200	*0·07
BA148	*0·15	BY127	*0·16	OA79	*0·07	OA202	*0·07
BA154	*0·12	BY128	*0·16	OA81	*0·07	1N914	*0·06
BA156	*0·14	BY164	*0·51	OA85	*0·09	1N916	*0·06
BA173	*0·15	BYX38/30	*0·43	OA90	*0·07	1N4148	*0·06

THYRISTORS

PIV	0·6A TO18	0·8A TO92	1A TO5	3A TO66	5A TO66	5A TO64	7A TO48	10A TO48	16A TO48	30A TO48
10	*0·13	*0·15	—	—	—	—	—	—	—	—
20	*0·15	0·13	—	—	—	—	—	—	—	—
30	*0·19	*0·22	—	—	—	—	—	—	—	—
50	*0·22	*0·28	*0·20	*0·25	*0·36	*0·36	*0·48	*0·51	*0·54	*1·18
100	*0·25	*0·30	*0·25	*0·25	*0·48	*0·48	*0·51	*0·57	*0·58	*1·43
150	*0·31	*0·38	—	—	—	—	—	—	—	—
200	*0·38	*0·44	*0·25	*0·30	*0·50	*0·50	*0·57	*0·62	*0·62	*1·63
400	—	—	*0·30	*0·39	*0·55	*0·57	*0·62	*0·71	*0·77	*1·79
600	—	—	*0·39	*0·48	*0·69	*0·69	*0·78	*0·89	*0·90	—
800	—	—	*0·58	*0·65	*0·81	*0·81	*0·92	*1·22	*1·39	*4·07

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100	0·05*	0·07*	IN4002	0·06*	0·09*	0·16*	0·21*	0·69*
200	0·06*	0·09*	IN4003	0·07*	0·12*	0·20*	0·23*	0·93*
400	0·07*	0·14*	IN4004	0·08*	0·14*	0·28*	0·35*	1·25*
600	0·08*	0·13*	IN4005	0·09*	0·18*	0·33*	0·42*	1·76*
800	0·11*	0·18*	IN4006	0·10*	0·18*	0·35*	0·51*	1·94*
1000	0·13*	0·28*	IN4007	0·11*	0·23*	0·44*	0·60*	2·31*
1200	—	0·32*			0·28*	0·54*	0·69*	2·88*

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7404	0·13	0·12	0·11
7405	0·13	0·12	0·11
7406	0·25	0·24	0·23
7407	0·25	0·24	0·23
7408	0·15	0·14	0·13
7409	0·15	0·14	0·13
7410	0·09	0·09	0·08
7411	0·23	0·22	0·21
7412	0·26	0·25	0·24
7413	0·26	0·26	0·25
7416	0·28	0·27	0·26
7417	0·28	0·27	0·26
7420	0·12	0·11	0·10
7422	0·28	0·27	0·26
7423	0·30	0·28	0·26
7425	0·30	0·28	0·26
7426	0·30	0·28	0·26
7427	0·30	0·28	0·26
7428	0·42	0·38	0·36
7430	0·12	0·11	0·10
7432	0·30	0·28	0·26
7433	0·39	0·37	0·35
7437	0·30	0·28	0·26
7438	0·30	0·26	0·26
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7443	£1·10	£1·05	£1·00
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7448	0·80	0·78	0·76
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7453	0·12	0·11	0·10
7454	0·12	0·11	0·10
7460	0·12	0·11	0·10
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7472	0·22	0·21	0·20
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7474	0·27	0·25	0·23
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7492	0·43	0·42	0·41
7493	0·43	0·42	0·41
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BP944	0·15	0·14	0·13
BP945	0·28	0·26	0·23
BP946	0·14	0·13	0·12
BP948	0·28	0·26	0·23
BP951	0·65	0·60	0·56
BP962	0·14	0·13	0·12
BP9083	0·42	0·40	0·38
BP9094	0·42	0·40	0·38
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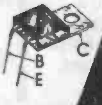

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UIC86 =	5 × 7486	0·60
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TAPPING THE GLASS

ONE of the earliest indications of a positive recovery trend in economic affairs should be a resurgence in business amongst the makers of electronic capital equipment. In general, any re-equipping and modernising of factories implies extensive use of electronic products, whether in the form of computers, machine tool and process control systems, or multifarious instruments and devices for equally multifarious uses. Investment in such capital equipment is an essential prelude to the economic miracle we all fervently await.

Thus the fortunes of a sector of the electronics industry are, in a sense, a barometer of the national economic condition. The current reading based largely on comment heard at some trade exhibitions earlier this year is set "Fair". Probably nothing more definite can be interpreted at this stage in our affairs, but this is a reasonably happy state and, in comparison with 12 months ago, gives cause for hope.

But it will take time for any recovery to work its way through to all strata of the economy. In the electronics consumer area for example, home entertainment products are still in the doldrums and may remain there for some time to come. The reduction in the rate of VAT has done little, it appears, to alleviate the general shortage of cash in the pocket. The long hot summer has aggravated the situation, of course.

When the consumer market revives this will be taken as a sure sign of national recovery. Yet it may not herald a full and complete recovery in the U.K. electronics industry, for it cannot be assumed that the home industry will reap most of this trade. On present form, overseas competitors, especially those in the Far East, are set to capture a large and it is feared ever increasing share of the radio, television and audio market.

The real threat to the future of our own electronics industry must not be ignored. Already we have seen the colour tube manufacturing capacity of the U.K. drastically cut, with the resultant loss of self-sufficiency and of jobs, because of the great influx of Japanese television sets. This could extend to other types of components. Our component industry exists essentially to supply the needs of our set and equipment makers. If the latter are hit by increasing imports, our component makers likewise suffer. Any diminution in range or quantity of components made could in turn seriously affect all other parts of our electronics industry including the makers of capital goods. Naturally, any weakening here would give greater opportunities for overseas competitors to get a foothold in that most valuable sector of U.K. electronics which has an eminent position, often leading the field worldwide.

The home constructor's personal interest in the components situation is self-evident.

What is the answer—higher tariffs or some form of limitation of imports by quotas? The latter course has been strongly advocated by Jack Akerman, Managing Director of Mullards, the largest electronic component manufacturers in Britain. It has to be faced that the average person will not take kindly to any restriction on his access to cheaper goods, no matter that they could mean in the long term the death knell for the British electronics industry. Such defensive action by the Government thus seems unlikely. But something so basic to modern life as the electronics industry must somehow be protected so that it can perform its rightful role in the vanguard of our economic affairs and be widely recognised as a genuine barometer of national prosperity.

F.E.B.

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CROSS-HATCH GENERATOR

By A. A. BIRCH

THE cross-hatch generator is primarily intended for use when correcting colour television receiver convergence errors. However, the generator's usefulness extends to geometry correction of both colour and black and white 625-line receivers. In the design to be described, the squares of the cross-hatch pattern have a height to width error of less than 1 per cent.

BLOCK DIAGRAM

Referring to Fig. 1a, the heart of the cross-hatch generator is a master oscillator, the output of which is applied to a series of dividers shown in more detail in Fig. 1b. Four frequencies are derived which correspond to the vertical and horizontal components of the cross-hatch video, and also line and field sync. The mark-space ratios of each of these four waveforms are set by means of timing circuits consisting of C/R differentiators and integrators. Further timing circuits derive line and field blanking pulses which along with the four waveforms previously mentioned are applied to a system of gates. The resulting two waveforms, "mixed and blanked video" and "mixed sync", are themselves mixed in the video/sync mixer. Finally, the composite video waveform thus produced is used to modulate a u.h.f. carrier.

CIRCUIT OPERATION (Fig. 2)

The master oscillator is formed using two of the six inverting amplifiers in the CD4069 package, IC4a and IC4b. The frequency of this oscillator is adjusted by

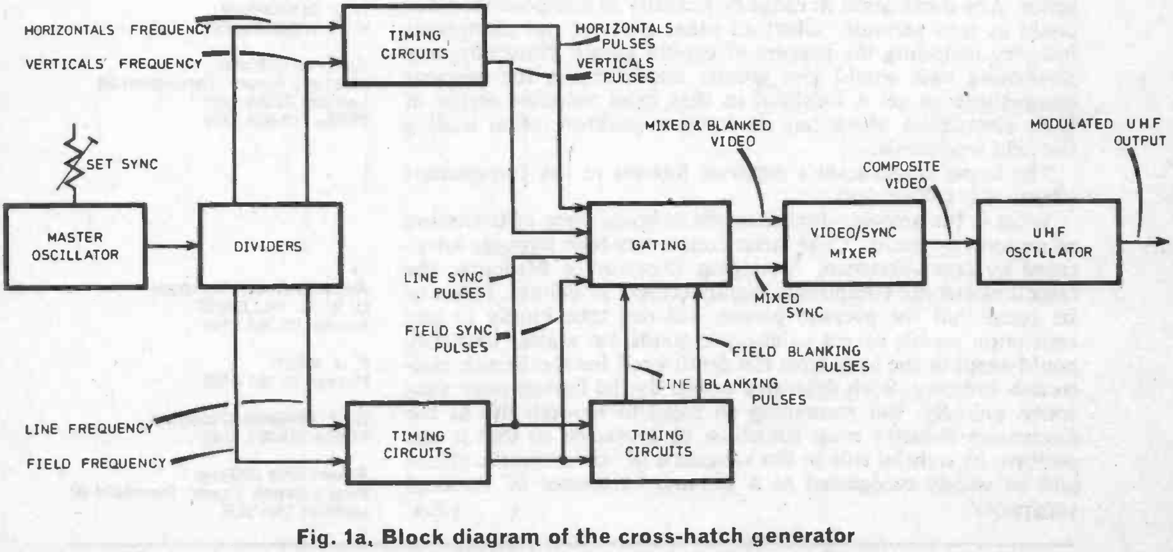
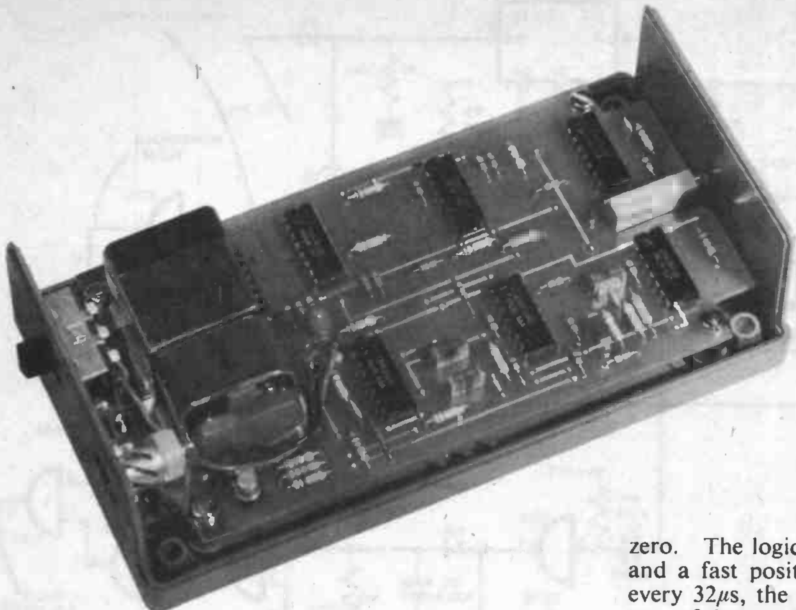


Fig. 1a. Block diagram of the cross-hatch generator



View of the completed cross-hatch generator. Note that the tags of the switch and coaxial socket must be cut back to 4mm to clear the battery case

means of VR1, SET SYNC, and is normally 625·0kHz. The rounded square wave at pin 10 of IC4b is applied to the input of a seven-stage binary counter (only the first five stages are used). The first stage acts as a buffer, providing a more square waveform at half master oscillator frequency at the output Q1. The differentiator formed by C4, R8 and IC6a converts the 312·5kHz, one-to-one mark space square wave to narrow positive-going pulses of approximately 400ns in duration. These define the width of the vertical lines in the cross-hatch pattern. The 2nd, 3rd, 4th and 5th stages in IC1 are arranged to divide by ten. D1, D2 and R2 form an AND gate which detects the binary number 1010 (decimal 10). At this instant the logical 1 is buffered by IC5a and used to reset the counter to zero. The logical 1 falls to zero as the counter resets, and a fast positive pulse results. These pulses occur every 32μs, the duration of each pulse is equal to the sum of the propagation delays in the loop circuit.

MONOSTABLE

Inverters IC4c and IC4d plus associated components form a monostable with a time constant of approximately 48μs, i.e. 1½ times the input pulse rate. The monostable thus acts as a divide-by-two stage, the output frequency being 15·625kHz. This is applied to the differentiator formed by C5, R11 and IC4e. The resulting compressed pulses are 4μs in duration at line frequency. These are line sync pulses. The 15·625kHz waveform is also applied to the input of the counter IC2, again only the first five stages of this binary counter are used. The counter is arranged to divide by 21 by the detection of the binary number 10101 which initiates reset pulses in the same way as IC1.

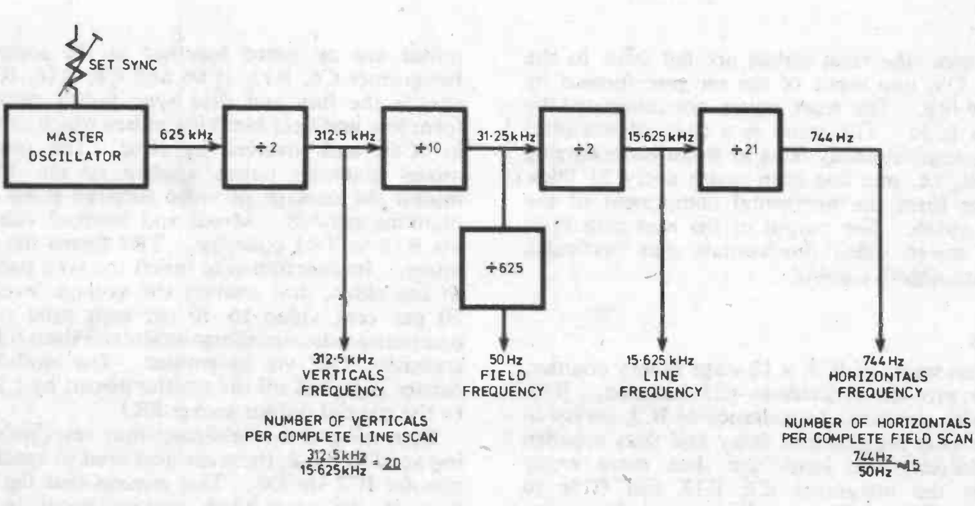


Fig. 1b. Basic arrangement of the frequency divider chain

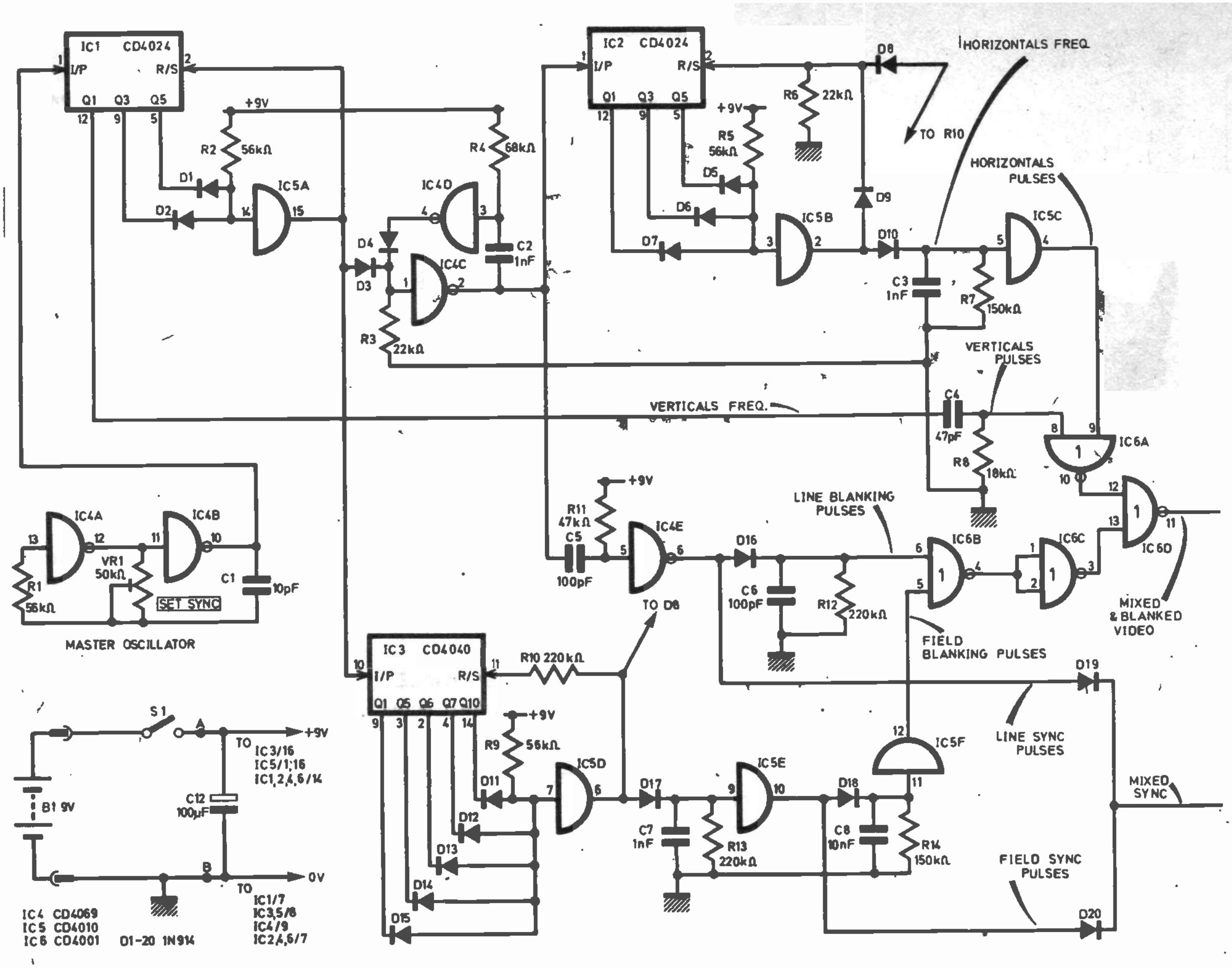


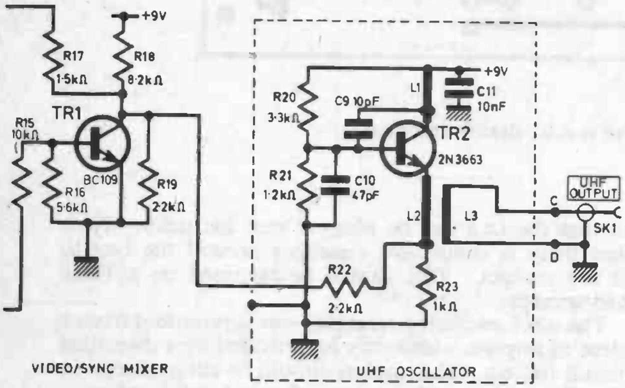
Fig. 2. Circuit diagram of the complete cross-hatch generator

In this instance, the reset pulses are fed back to the counter via D9, one input of the OR gate formed by D8, D9 and R6. The reset pulses are integrated by C3, R7 and IC5c. The result is a train of stretched pulses, each approximately 60µs in duration occurring every 1·34ms, i.e. one line scan width every 21 lines. These pulses form the horizontal component of the cross-hatch video. The output of the NOR gate IC6a consists of mixed video (horizontals plus verticals), the pulses are negative-going.

DIVIDERS

The first ten stages of IC3, a 12-stage binary counter, are used to provide a divide-by-625 function. R10, combined with the input capacitance of IC3, serves to increase the loop propagation delay and thus broaden the reset pulses. The latter are thus more easily stretched by the integrator C7, R13 and IC5e to approximately 300µs. These pulses are at 20ms rate and are the field sync pulses. Line and field sync pulses are OR gated together at the input of TR1. Integrators C6, R12, IC6b and C8, R14, IC5f further stretch the line and field sync pulses respectively to form line and field blanking pulses which are combined in IC6b and inverted by IC6c. The positive-going mixed blanking pulses applied to pin 13 of IC6d inhibit the passage of video through IC6d during the blanking periods. Mixed and blanked video is taken via R17 to TR1 collector. TR1 forms the video/sync mixer. Its function is to invert the sync pulses relative to the video, and convert the voltage levels giving a 70 per cent video to 30 per cent sync ratio. This composite video waveform modulates the u.h.f. oscillator transistor TR2 via its emitter. The modulated u.h.f. carrier is picked off the emitter circuit by L3 and taken to the coaxial output socket SK1.

Returning to the field-frequency reset pulses appearing at IC5d pin 6, these are also used to synchronise the counter IC2 via D8. This ensures that the horizontal lines in the cross-hatch pattern occur in the same relative position in every field.



CONSTRUCTION

A printed circuit board (see Fig. 3) is necessary for this project as the u.h.f. oscillator can most easily be fabricated in this form. The oscillator components are soldered directly to the copper areas on the under side of the p.c.b., see Fig. 4b. No holes are required to be drilled in this area. A screening can is mounted over the u.h.f. oscillator components. A double-sided p.c.b. is required not only to help produce a more condensed and tidy unit, but also to provide an unetched area of copper to complete the screening for the u.h.f. oscillator. This copper screening on the top side of the board also prevents any movement of the battery from detuning the oscillator. Layout of the remaining parts of the board is not excessively critical, therefore deviation from the p.c.b. design or specified components is most likely to result in mechanical rather than electrical difficulties.

Having produced the p.c.b., assembly should start with the 46 through connections; these are represented

COMPONENTS . . .

Resistors

R1	56kΩ	R13	220kΩ
R2	56kΩ	R14	150kΩ
R3	22kΩ	R15	10kΩ
R4	68kΩ	R16	5·6kΩ
R5	56kΩ	R17	1·5kΩ
R6	22kΩ	R18	8·2kΩ
R7	150kΩ	R19	2·2kΩ
R8	18kΩ	R20	3·3kΩ
R9	56kΩ	R21	1·2kΩ
R10	220kΩ	R22	2·2kΩ
R11	47kΩ	R23	1·0kΩ
R12	220kΩ		

All $\frac{1}{3}$W 5% carbon film

Potentiometer

VR1 50kΩ linear $\frac{3}{4}$in multiturn cermet (RS Components)

Capacitors

C1	10pF 63V sub. min. plate ceramic
C2	1nF 250V MKM polycarbonate
C3	1nF 250V MKM polycarbonate
C4	47pF 63V sub min. plate ceramic
C5	100pF 63V sub min. plate ceramic
C6	100pF 63V sub min. plate ceramic
C7	1nF 250V MKM polycarbonate
C8	10nF 250V MKM polycarbonate
C9	10pF 63V sub min. plate ceramic
C10	47pF 63V sub min. plate ceramic
C11	10nF 100V Wee-C ceramic
C12	100μF 10V bead tantalum elect

Note: MKM polycarbonate capacitors are available from Electrovalue Ltd. Remainder from RS Components (access through Doram)

Semiconductors

D1–D20	1N914 (20 off)
TR1	BC109
TR2	2N3663
IC1	CD4024AE
IC2	CD4024AE
IC3	CD4040AE
IC4	CD4069BE
IC5	CD4010AE
IC6	CD4001AE

Miscellaneous

Plastic instrument case, 150 × 80 × 50mm (RS Components, Inst. Case Code 509-591—or available with transparent top from Vero Electronics Ltd. Code 90-30-081)

Double sided copper clad fibreglass laminate, 142 × 72mm (5·6 × 2·85in)

Slide switch d.p.d.t. (RS Components)

Coaxial socket, flush mounting (RS Components)

Battery connector, size PP3/PP6. 4 spacers, 6BA × 10mm (0·375in) (Electrovalue). 6 Soldercon i.c. pins (optional 88 extra pins, see text). Tinplate and battery bracket plus sponge rubber, see Fig. 5. TO18 transistor mounting pad. 4 printed circuit terminal pins. 1 solder tag, 6BA, screws, wire, solder etc.

L1, L2 and L3 are formed by adjacent copper tracks

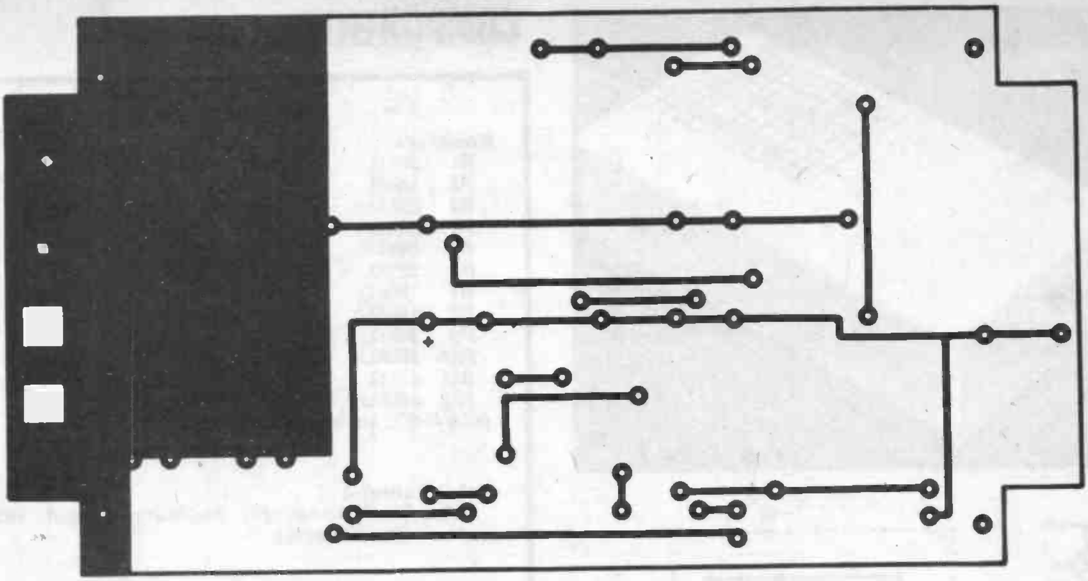


Fig. 3a. Upper side pattern of the p.c.b., drawn full size

by dots in Fig. 4a. All components should be mounted in profile order, that is, starting with the lowest profile components and working up, with the exception of the i.c.s which should be left until last. Reference should be made to Figs. 4a and 4b and the photographs when mounting p.c.b. components. The usual precautions should be taken when handling the CMOS i.c.s to eliminate possible damage caused by static electricity. A properly earthed soldering iron must be used. If the constructor prefers, Soldercon i.c. pins may be used so that the i.c.s can be plugged into the p.c.b. Note that there is insufficient clearance around the i.c.s to fit full sockets. TR1 should be mounted on a TO18 pad/spreader.

The u.h.f. oscillator screening can is produced from a piece of tinplate which may be provided by a discarded biscuit tin, etc. The tinplate should be cut as shown in Fig. 5a and any paint taken off using paint remover. The four sides are bent at right angles. The screening can is held in place on the p.c.b. using six modified

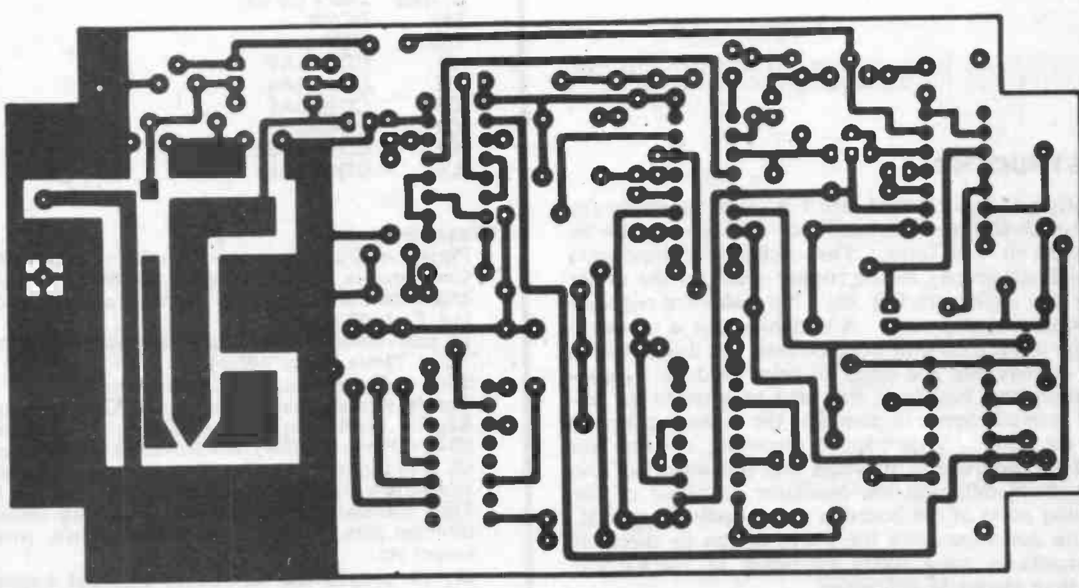


Fig. 3b. Under side pattern of the p.c.b., drawn full size

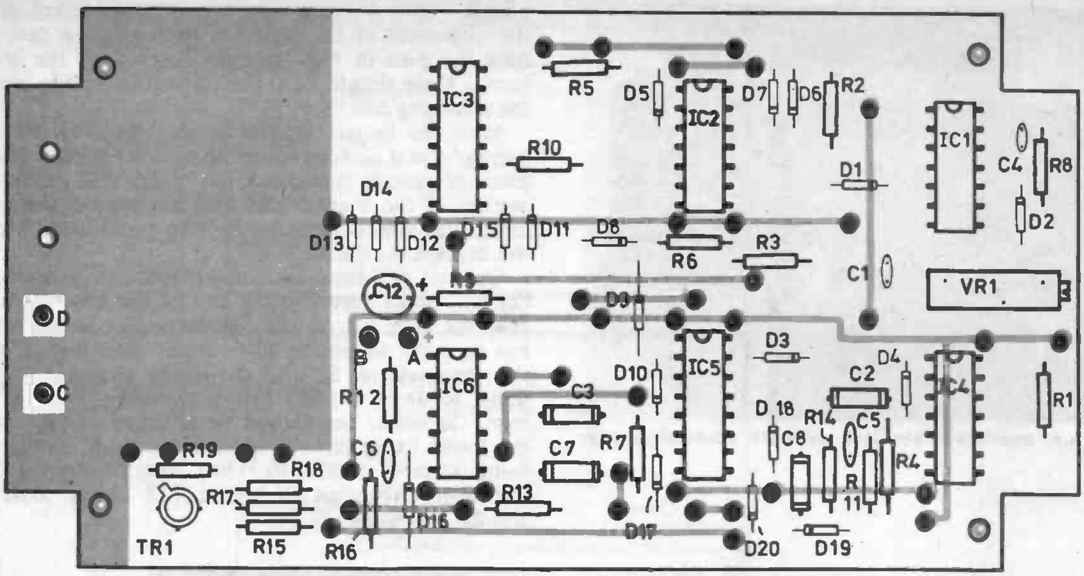
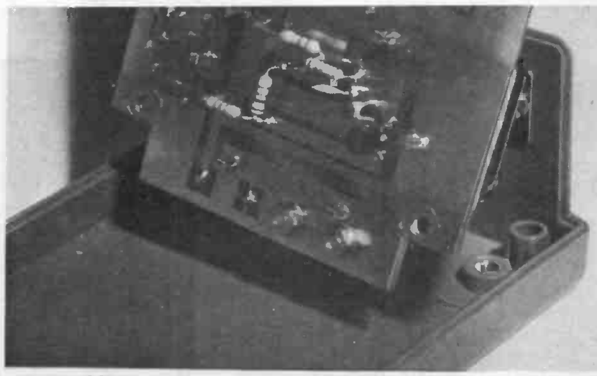


Fig. 4a. Component layout of the p.c.b. (upper side). Note that the print pattern shown here is that on the upper side of the board. The blobs represent through connections to the underside print pattern (Fig. 3b)

Soldercon i.c. pins. This method of mounting allows rapid access to the oscillator components for any future frequency trimming, and also the screening can edges are raised from the surface of the p.c.b. sufficiently to prevent short circuiting copper tracks. Referring to Fig. 4b, break the two side pieces and the tail off six i.c. pins. Mark the six mounting positions on the p.c.b. as shown, and very lightly tin them with solder. Also tin the bases of the six pins and push them onto the edges of the screening can in the appropriate



View of the u.h.f. oscillator section

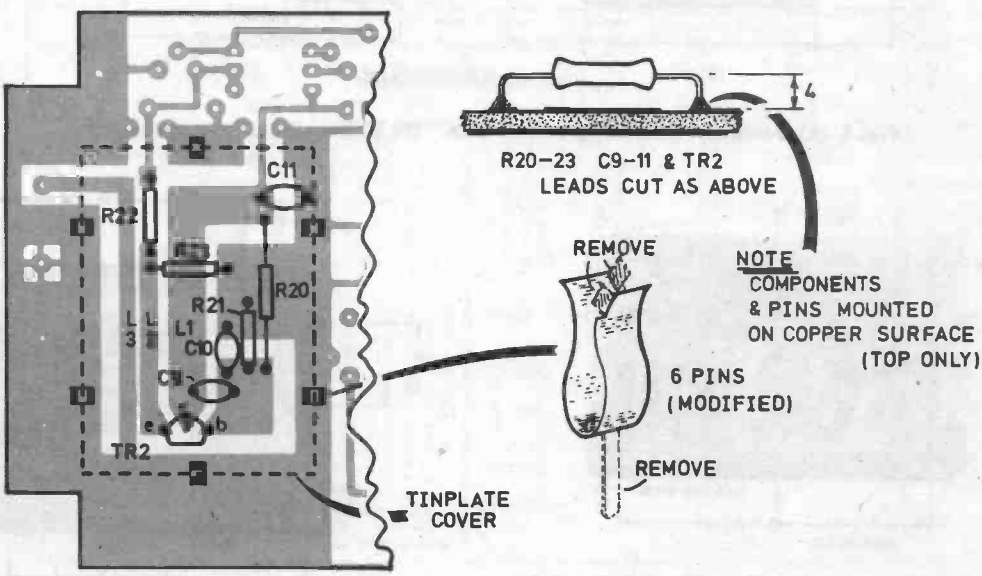
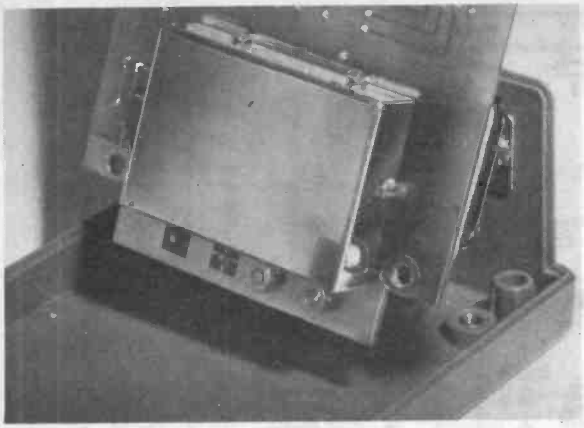


Fig. 4b. Component layout and mounting details for the u.h.f. oscillator (p.c.b. underside)



The u.h.f. oscillator section with its screening can fitted

places. Offer the screening can up to the board, check the alignment of the pins and the screening can, and heat the pins in turn at their bases until the solder runs. Care should be taken not to solder the pins to the screening can.

Make the battery bracket as shown in Fig. 5b from springy metal such as rolled phosphor bronze. Stick a piece of sponge rubber on the under side of the top section of the bracket and also a piece on the p.c.b. in the area where the battery will be positioned. Mount the bracket on the p.c.b.

Cut and drill the ends of the plastic case as shown in Fig. 6. Make sure that the end of the case that will bear the slide switch and coaxial socket is that which has its p.c.b. mounting studs closest together. Cut all the terminals on S1 and the centre terminal of SK1 down to 4mm (0·15in) before mounting them in the case. A solder tag should be attached to SK1 using the lower fixing screw. Mount the p.c.b. in the case using spacers 10mm (0·375in) long; note that the four screws required are metric, M3 15mm. Wire S1, and SK1 as shown in Fig. 2.

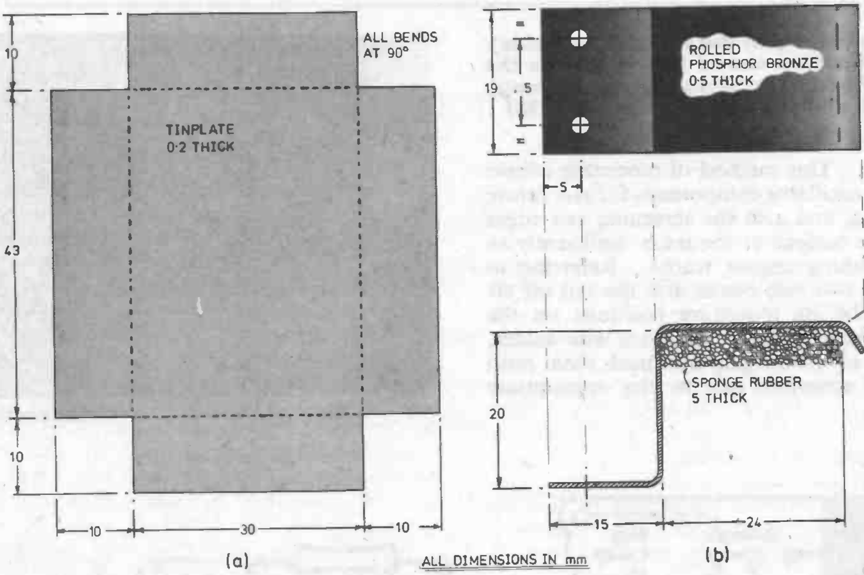


Fig. 5. (a) Oscillator screening can details. (b) Battery bracket dimensions

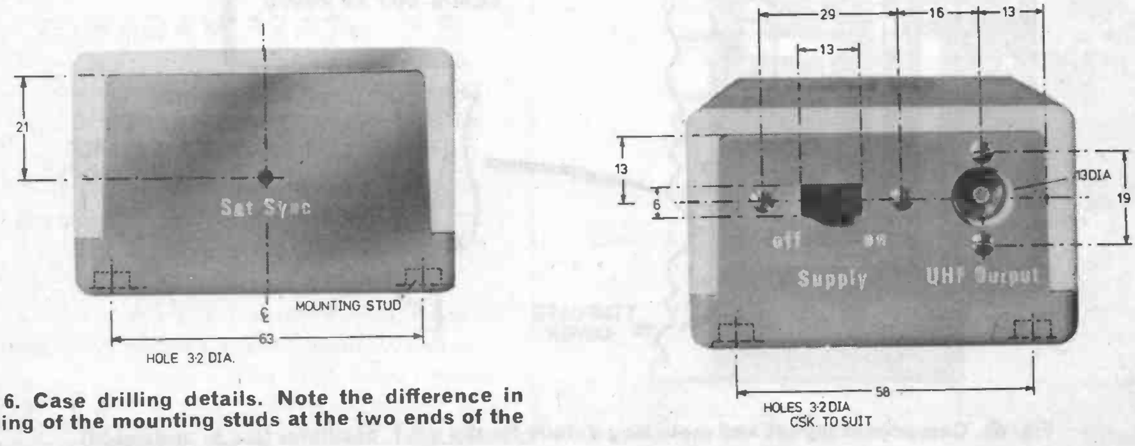
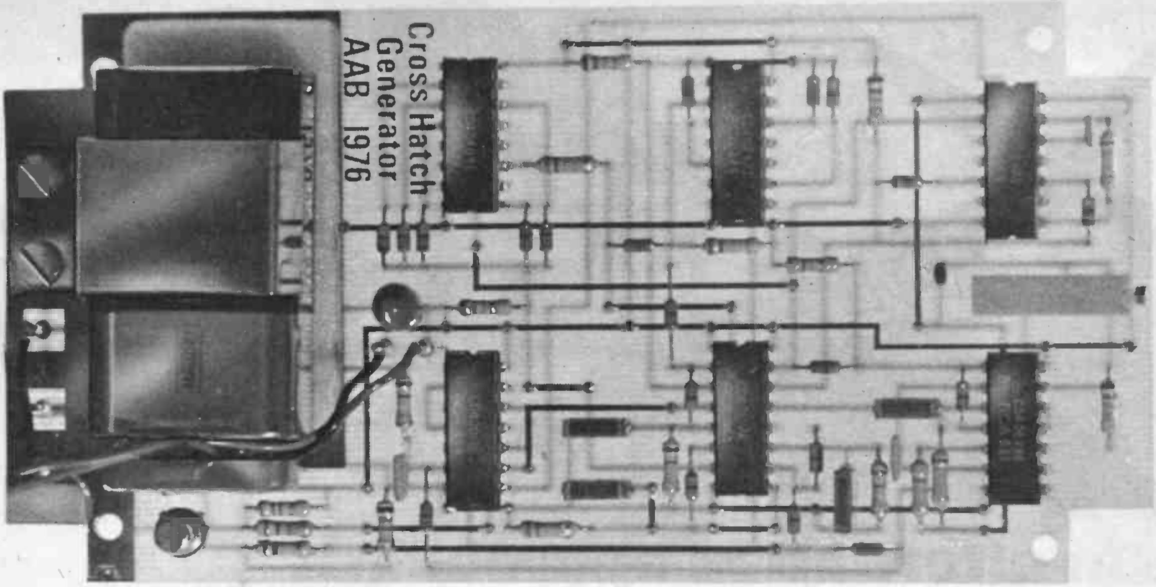


Fig. 6. Case drilling details. Note the difference in spacing of the mounting studs at the two ends of the case



The completed p.c.b. lit from behind to show the relationship of the two track patterns

TESTING AND ADJUSTMENTS

Install a PP3 battery and bridge the contacts of S1 with a milliammeter. If all is well, a reading of approximately 12mA should be observed. Connect the output of the cross-hatch generator to the aerial socket of a 625-line television receiver and tune the receiver to approximately channel 50, where the signal should be located. If more than one signal is present, the strongest of these should be selected. If the pattern is not locked, adjust VR1, but do not disturb the hold controls of the receiver. Tune the receiver to give optimum definition, a reduction in brightness setting may be necessary.

The CMOS gates used have a spread in input transfer voltage of up to 33 per cent of supply voltage. It may thus be found necessary to trim one or two of the timing circuits in the cross-hatch generator. The following list may be used to identify and correct any observed pattern malformations.

1. Verticals too narrow, or too wide in comparison to the horizontals.
   Remedy—increase or reduce respectively the value of R8.
2. Horizontals not present at right-hand side of screen, or double thickness at left-hand side of screen.
   Remedy—increase or reduce respectively the value of R7.
3. Field flyback lines showing, or no video present at top of screen.
   Remedy—increase or reduce respectively the value of R14.
4. Line flyback lines/striations showing, or no video present at left-hand side of screen.
   Remedy—increase or reduce respectively the value of R12.

Having established a satisfactory cross-hatch pattern, VR1 should be given a final accurate trimming. Most modern television receivers will lock to the output of the cross-hatch generator over a wide range of sync frequency. Care should be taken to set the sync as near as possible to the correct frequency to minimise possible pattern distortion caused by the generator. For those constructors not having access to an oscilloscope, the following procedure should be carried out. Making bodily contact with a metal object such as a small screwdriver blade, bring the latter into contact with pin 5 of IC5c. This causes the length of the displayed horizontals to be modulated at mains frequency. The observed beat frequency should be reduced to zero by adjusting VR1. This adjustment should be checked periodically, but it will be found that the master oscillator is quite stable under changing conditions of temperature and supply voltage. To improve supply voltage stability and thus prolong optimum performance, a Mallory Duracell battery type MN1604 may be fitted which will give approximately six times the life of the standard battery.

Finally if it is required to alter the frequency of the u.h.f. oscillator, C9 should be changed in value. ★

RADIO CONTROL SYSTEM

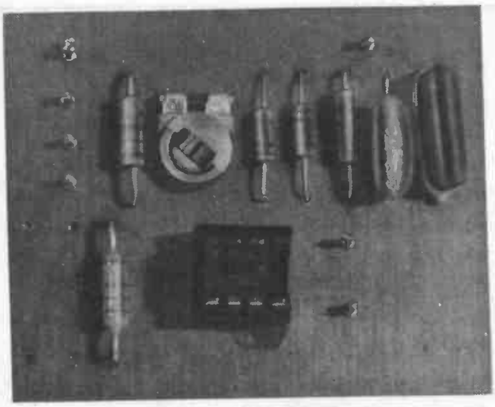
By J. D. WHITELEY

An alternative approach... using TONE CODING

THE recent Radio Control series (*Practical Electronics*: June–August) has met with such popularity that we have decided to continue it and publish details of an alternative system which can be used with the same transmitter and receiver, and which provides multi-channel switched output rather than the fully proportional capability of the original system.

This section therefore, is aimed at the constructor who requires a switched output system (e.g. for use with escapement type actuators commonly used in the control of model gliders and light aircraft).

System operation depends on the transmission of tones of different frequencies (one for each channel) which are decoded at the receiver and used to provide on/off control for each channel. The tone generator at the transmitter uses a 566 function generator, and at the receiver decoding is performed by a 567 tone decoder i.c. The 567 is basically a phase locked loop with additional circuitry to detect the "locked" condition.



Tone Generator Board

THE TONE GENERATOR

The circuit diagram of the tone generator is shown in Fig. 1. The NE566 (IC1) is a voltage controlled function generator producing a square and triangle wave output from pins 3 and 4 respectively. The oscillator frequency can be adjusted over a 10 to 1 range by selecting the appropriate resistance using the same value of capacitance. The frequency can also be adjusted by altering the voltage to the control terminal pin 5; this is the method adopted in this case.

The triangle wave output is used in preference to the square wave due to the problem of harmonics being generated in the receiver at the frequencies selected.

The frequency can be determined from the following formula:

$$f_0 \simeq \frac{2}{R\,C_1}\left[\frac{V_{cc}-V_c}{V_{cc}}\right] \text{ Hz}$$

where V_{cc} is the supply voltage V_c is the voltage at the control terminal R is the total resistance (between 2kΩ and 20kΩ).

Adjusting VR1 will correct all three frequencies if three channels are selected, thus making alignment a simple process.

CONNECTION TO THE TRANSMITTER

At this stage it is worth referring to the circuit diagram of the transmitter which was published in the June issue of *Practical Electronics*, page 488. The tone generator is connected to the modulator input (R22 on the transmitter board). Capacitor C2 on the generator board isolates the output d.c.-wise, and resistors R3 and R4 set the bias of the modulator stage TR7 and TR6 (also on the transmitter board).

TONE GENERATOR

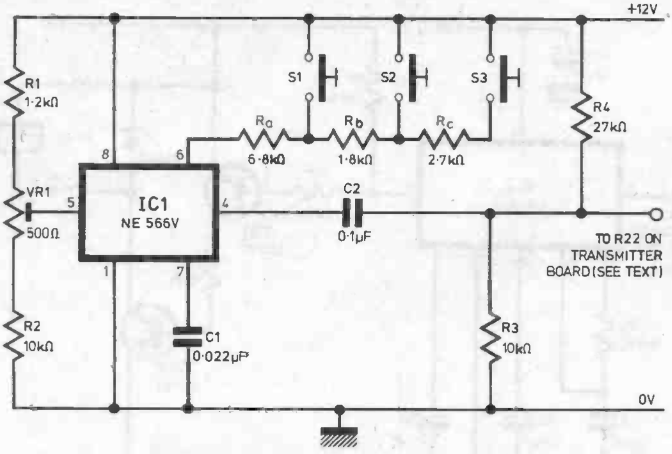


Fig. 1. Circuit diagram of the tone generator

COMPONENTS . . .

TONE GENERATOR

Resistors
R1 1·2kΩ
R2 10kΩ
R3 10kΩ
R4 27kΩ
*Ra 6·8kΩ 2%
All resistors ⅛W 5% carbon, unless otherwise stated

Potentiometer
VR1 500Ω min. preset (0·1in. matrix)

Capacitors
C1 0·022μF plastic
C2 0·1μF plastic

Semiconductors
IC1 NE566V function generator

Miscellaneous
Single sided p.c.b. 55mm × 45mm
P.c.b. pins
8 pin d.i.l. i.c. socket
S1–3 Single pole switches (push to make, release to break)

*Given for channel A only (1,860Hz). See Table 1 for values for other channels.

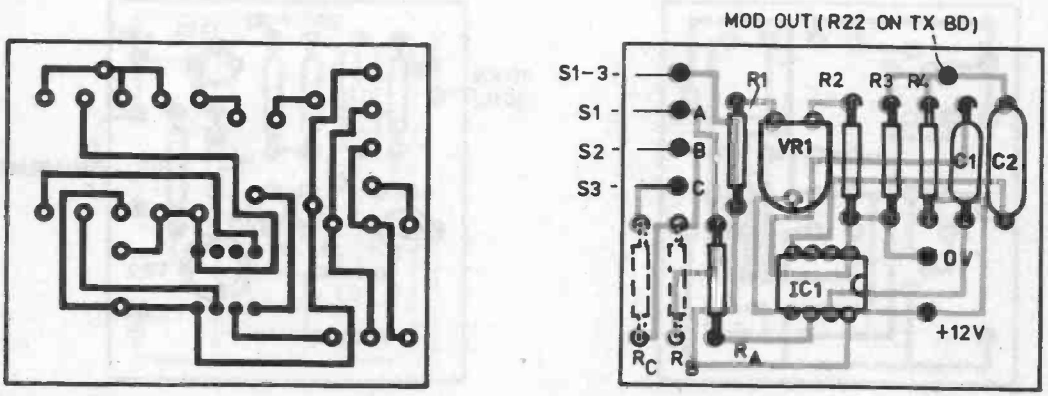


Fig. 2. Tone generator p.c.b. master and component layout

TONE DECODER

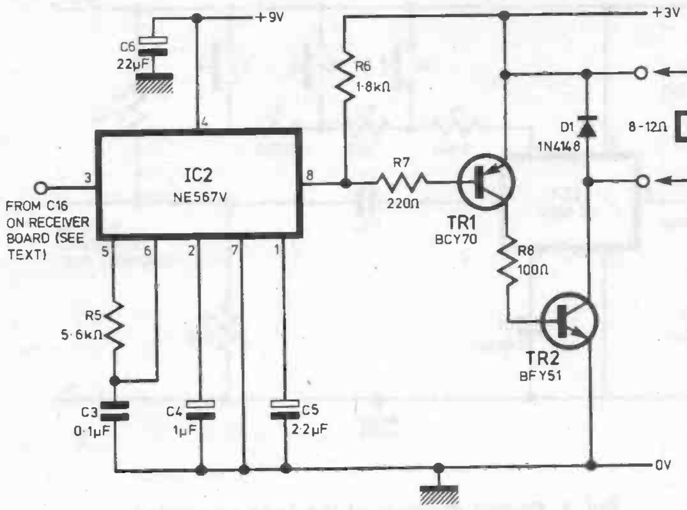


Fig. 3. Circuit of the tone decoder

COMPONENTS . . .

TONE DECODER

Resistors
- *R5 5·6kΩ
- R6 1·8kΩ
- R7 220Ω
- R8 100Ω
- All resistors ⅛W 5% carbon

Capacitors
- C3 0·1µF plastic
- C4 1µF 16V tantalum
- C5 2·2µF 16V tantalum
- C6 22µF 16V tantalum

Semiconductors
- IC2 NE567V p.l.l tone decoder
- TR1 BCY70
- TR2 BFY51
- D1 1N4148

Miscellaneous
- Single sided p.c.b. 48mm × 48mm
- P.c.b. pins
- 8 pin d.i.l. i.c. socket
- *Given for channel A only (1,860Hz). See Table 1 for values for other channels.

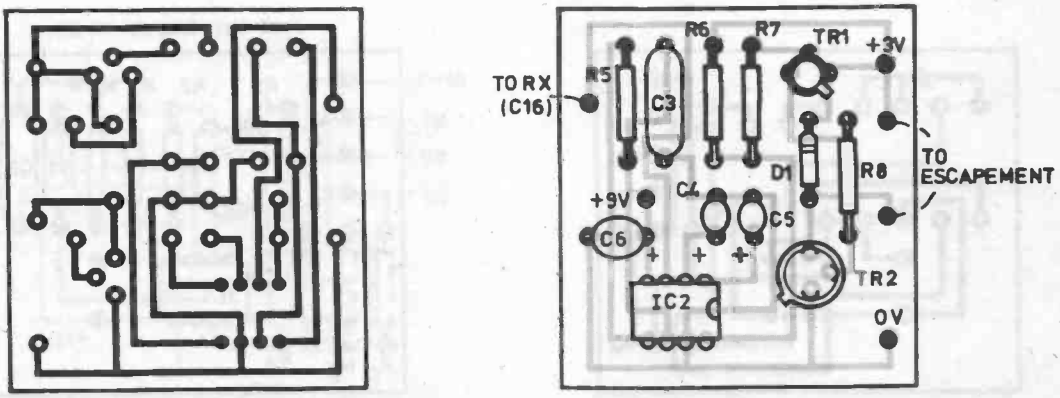


Fig. 4. Tone decoder p.c.b. master and component layout

Table 1

Channel operation frequencies and resistor values for generator and decoder circuits. The values in brackets indicate how the resistance given is made from standard resistors

Channel	fo (Hz)	Tone generator resistor Ra, b, c	Decoder resistor R5
A	1860	6·8kΩ	5·7kΩ (3·9kΩ + 1·8kΩ)
B	1438	8·6kΩ (6·8kΩ + 1·8kΩ)	7·6kΩ (6·2kΩ + 1·5kΩ)
C	1109	11·3kΩ (6·8kΩ + 1·8kΩ + 2·7kΩ)	10kΩ

THE DECODER

The decoder circuit diagram is shown in Fig. 3, and as can be seen, is built around a NE567 tone decoder. The decoder receives its drive from the output of the receiver (C16 on the receiver circuit diagram shown on page 569 of the July issue).

The 567 is a highly stable phase locked loop which contains additional circuitry to detect when the loop is in a locked condition. When a phase locked loop is locked to an incoming signal, the p.l.l. v.c.o. is in phase quadrature with the input signal, and therefore the locked condition can be detected by a quadrature phase detector monitoring both the v.c.o. output and the input signal. The detector causes pin 8 of the 567 to go low when the loop is locked.

The capture range (bandwidth) of the p.l.l. can be independently controlled and the detection frequency is set by means of an external resistor and capacitor. The maximum voltages which can be applied are 10V to pin 4 and +15V to the resistor connected to the open collector output at pin 8 (I_c max 100mA).

CIRCUIT DESCRIPTION

The phase-locked-loop free running frequency f_0 is set by R5 and C3 using the formula $f_0 \simeq 1{\cdot}1/R5\ C3$.

The bandwidth for inputs greater than 200mV is a function of f_0 (Hz) and C4 (μF) and in this case will be about 14 per cent. This can, however, be reduced to around 7 per cent by increasing C4 to 2·2μF. The capacitor C5 (whose value is not critical) is used to prevent chatter at the output (pin 8).

Tone Decoder Board

As stated above when the selected frequency is present pin 8 is driven low. This causes TR1 to be switched on which in turn switches on TR2. It will be noted that the supply rail voltage for the output stage is 3 volts and this should not be exceeded otherwise TR1, TR2 may be damaged, since typical escapements have winding resistances of between 8 and 12 ohms. The diode D1 is included for protection of TR2.

Further tone decoders may be connected simply by connecting the inputs in parallel as shown in Fig. 5.

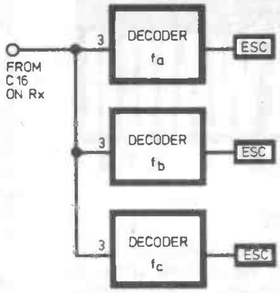


Fig. 5. Method of connecting three tone decoders. If further channels are required, they should be connected similarly

CONSTRUCTION

The circuit boards are etched to the pattern given in Fig. 2 and Fig. 4 and the components soldered in the positions shown. As before, pins are used for wire take-off points. It was felt best to use i.c. sockets on these printed circuit boards since the i.c.s are rather costly and if found to be faulty probably could not be replaced if they have been soldered.

TESTING AND SETTING UP

The circuits can be tested independently of the transmitter and receiver by connecting the boards together via a 0·1μF capacitor and a 27kΩ resistor in series. The selected tone is generated by operating a switch, and with an ammeter in the tone decoder supply (0–100mA) a current rise from 10mA to about 18mA should indicate the presence of a tone when VR1 is adjusted. By rotating the pot about the "operate" position, the centre of the capture range of the p.l.l. can be located. From Table 1 the values of R5 for the other boards can be determined.

LICENCE

We would like to warn constructors that a licence is required to operate any Radio Control system. This licence may be obtained from: The Home Office, Radio Regulatory Department, Waterloo Bridge House, Waterloo Road, London SE1 8UA. (A licence for 5 years costs £2.40)

★

BY FRANK W. HYDE

SPACE SEEDS

Seeds of Canadian spruce brought back from space have been sown in the botanical gardens of the Academy of Sciences in Moscow. These seeds were part of the exchange made between the U.S.S.R. cosmonauts and the American astronauts during the joint link up of the *Soyuz-Apollo* mission.

The Americans handed over Canadian spruce seeds and the Russians handed over seeds of pine from the Volga region, larch from Tuva, balsam fir from the north Caucasus and cedar from the banks of the Yenesei river in Siberia.

It was decided that the two crews should on their return home sow the seeds as a commemoration of the first joint Space Flight. The members of the crews were Alexei Leonov and Valeri Kubasov from Russia and Tom Stafford, Vance Brand and Donald Slayton from the USA.

Academician Tsitsin, director of the botanical gardens, said he hoped the Soviet seeds would thrive on American soil. Every seed sent to space was checked with the help of X-rays and the best ones were selected for the flight.

INTERCOSMOS

The space vehicle *Intercosmos 15* was launched by the Soviet Union on June 19. Its purpose is to conduct large scale scientific research in the field of flight conditions, testing new systems of operation, including telemetry.

A number of countries associated with the U.S.S.R., East Germany, Hungary, Poland, and Czechoslovakia took part in the development and manufacture of the telemetry system. Specialists from the participating countries prepared the equipment for launching and are controlling its operation. The single system of telemetry will be in action for the first time.

The principal ground stations which are receiving signals are in East Germany, Hungary and the U.S.S.R. This will also extend to Czechoslovakia. Previously only the Soviet ground stations collected the data and processed it, now other countries are participating.

It is seven years since the first Intercosmos was launched and a great deal had been learned during that time. When the whole network is complete there will be nine participants which will include Bulgaria and Cuba.

The scientific research is mainly in the communication field, and space physics. These include meteorology, biology, medicine and allied subjects. During the past experiments new data had been acquired regarding the mechanism of solar terrestrial links and the Earth's atmosphere. The study of radiation round the Earth is enabling the medical researchers to predict more accurately the safe periods for manned flight.

The Satellite orbital period is 94·6min, perigee 487km, apogee 521km and the orbital inclination 74·0 degrees.

VENUS PROBES

A year has passed since the launching of the *Venus 10* automatic station and eight months since it went into orbit round Venus. A great deal of scientific information has been received from the station during this time. The on-board systems and equipment are operating normally.

The *Venus 9* and *Venus 10* automatic stations fulfilled the main flight programme by March 22 this year, after which each continued their studies under additional individual programmes. *Venus 9* completed the additional programme and has now ceased functioning. *Venus 10*, which is now at a distance of 260 million km from the earth, is continuing its research work.

From the point of view of an observer on Earth the planet is now passing behind the sun. This opens up a rare opportunity to carry out a radio trans-illumination of near-solar space with the aim of studying the solar corona. On June 16, a radio beam sent to earth by *Venus 10* passed within 1½ million km from the surface of the sun.

An analysis of the parameters of radio signals coming from *Venus 10* shows that the streams of near-solar plasma are very heterogeneous and subjected to rapid changes in time.

Subsequent processing of this data will produce quantitative characteristics of these conditions. Also studied during the radio sessions was the possibility of receiving information and controlling spacecraft which depends on the radio beam condition during its passage near the sun.

SALYUT RESEARCH

The speed of plasma reaches 50km/sec in the active regions of the sun. This observation, says cosmonaut Dr Konstantin Feoktistov, is among the most interesting results of investigation carried out in the *Salyut* orbital station. The solar telescope installed has helped to obtain hundreds of spectrograms of such active regions on the sun as flares, prominences and floculli.

The data collected by two expeditions aboard the Soviet station last year are still being processed. The irregularities of radiation have been measured from well-known X-ray sources such as those in the constellations of Scorpius, Cygnus and Virgo.

CHECK UP ON EINSTEIN

A test of the general theory of relativity has been carried out by the use of a probe launched from Wallops Island, Virginia.

It was named *GP-A* (Gravity Probe-A). The sensitivity of this experiment will be some 500 times more sensitive than any method so far used. The test will be of the principle of gravitational and inertial equivalence.

The principle states that within small regions of space the effect of accelerating a body cannot be distinguished from the effect of a gravitational field on the body. This could be put another way by saying that if an observer is enclosed in a vehicle he has no way to determine whether he is stationary in a gravitational field or is accelerating in the absence of a gravitational field.

The observer in one system observes the changes such as length or time in the other. Checks are made of these parameters and both length and time can be referred to clocks. Such changes, however, are minute and very difficult to measure.

Now a hydrogen maser clock has been devised with a stability of one part in 10^{15}. This means it could gain or lose not more than about 2 seconds in a hundred million years.

It is planned to use the clock developed by the Smithsonian Astrophysical Observatory in this experiment. The clock will fly in a two hour elliptical trajectory over the Atlantic and the readings compared with a similar clock on the ground. The probe borne clock will, because of the weaker gravity field, appear to run faster than the earth based clock.

The accuracy of the synchronisation is about 5 thousandths of one per cent. The cost of the experiment is of the order of 6 million dollars.

SEMICONDUCTOR UPDATE... By R.W. COLES

ICM7205 **SN76008N**
A7800 **SN76018**

DOING THE SPLITS

Sports fans will be electrified by the new **ICM7205** from Intersil, because it crams into a 24-pin plastic package all the electronic springwork of a sophisticated two function stopwatch. Not just a modified clock-chip this, but a set of circuit functions optimised for use in the demanding sporting environment, designed to provide accurate interval timing over periods of up to one hour with hundredths-of-a-second precision.

The chip uses CMOS technology for low power battery operation, and will drive a small six digit l.e.d. display without the need for interface components. The internal oscillator is synchronised by an external 3·2768MHz crystal for high accuracy, control inputs are provided for great versatility of timing circuit and display operation, and the thoughtful designers have even added a "low battery" indication output which can drive the display decimal points or a discrete l.e.d.

Two timing modes can be switch selected, "Taylor" or "Split". In the Taylor mode the clock can be reset to zero and will commence counting when the START/STOP switch is pressed; when the START/STOP switch is next pressed the display indicates the time so far, but the counter is reset to zero and then continues counting. On subsequent presses the display changes to indicate the new "lap" time, but not an overall total.

In the split mode the "lap" times are accumulated and the display updated at each press of the START/STOP switch so that a running total of lap times are recorded. In both modes the display is stationary between presses of the START/STOP switch unless the "DISPLAY UNLOCK" is pressed to allow the display to catch up with the counter, and "RESET" can be activated at any time to restart the process.

To sports fans the promise of this new chip will be obvious but I wouldn't mind betting that a lot more applications will be found for this exciting device.

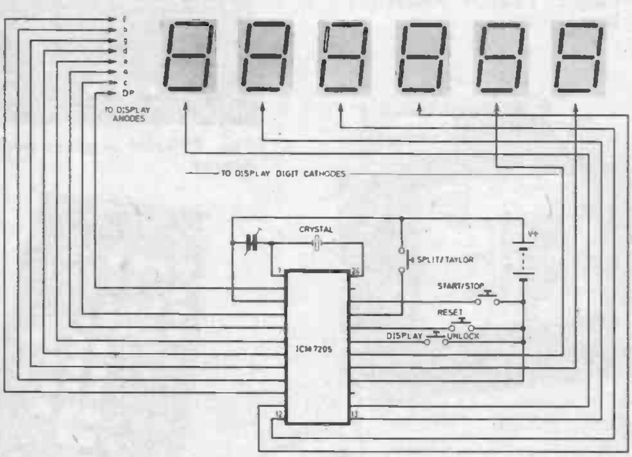


Fig. 1. The ICM7205 as a full-function stopwatch

FAMILY REGULATOR

Fixed voltage, three terminal, positive regulator integrated circuits have been around for a few years now, and I for one have certainly not stopped appreciating them! When I think of the trouble I had to go to to get a really stable output voltage in the face of varying loads and line voltages before these devices came along, I offer up a silent prayer of thanks.

"Well O.K." I can hear you saying "they're very good, but what's new?" The Signetics micro **A7800** series is new, that's what, and it is not just a single regulator i.c. but a whole family of regulators for different output currents and different voltages.

The 7800 family must cover 90% of regulator requirements; if you want a voltage of 2·6V, 5·0V, 6·0V, 8·0V, 12·0V, 15·0V, 18·0V or 24·0V—no problem, they're all standard. A 1A current rating? no problem either. How about that audio preamplifier though, you only need 20mA at 12V for that, it wouldn't seem right to have to use a TO3 can regulator, would it?

Well, why not use the μA78L12S which comes in the little TO-92 plastic small-signal-transistor package and offers a 100mA current rating. You don't like plastic packages? Then use the A78L12DB, which also has a 100mA rating but comes in a little TO39 metal can.

This plastic/metal can choice is not limited to the 100mA tiddlers either; the 1A versions can be had in the traditional TO3 metal pack, or the TO220 power-tab plastic pack.

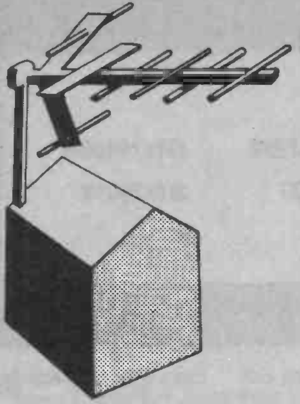
POWER PAK

A couple of new audio amplifier circuits have been introduced by Texas Instruments, and as befits the easy-to-use electronic design, a new easy-to-use plastic package, called Power Pak, has been designed to house them.

The Power Pak package is a simple 5-pin plastic power transistor arrangement which can be easily heat-sunk with a single, central, nut and bolt without the problems associated with the more usual d.i.l. designs.

The new devices are the **SN76008N** and the **SN76018**, each of which will deliver a creditable 10W of audio power at full output. The difference between the two lies in the design load impedance and supply voltage, the SN76008N delivering 10W to a 4 ohm load while the SN76018N will deliver the same to an 8 ohm load at a higher supply voltage.

These devices are not in the hi-fi class, and the T.H.D. starts to climb rapidly after about 8W, but at less than £3 apiece, what can you expect?



HEDA
SHOW REPORT
By G.C. ARNOLD

HEDA—the International Home Electronics and Domestic Appliances Exhibition—was the second big electronics and electricals show to be staged at the new Birmingham National Exhibition Centre. It was open to trade visitors only from May 23–27, but the home electronics section carried on under the name Sound and Vision '76, open to the public from May 28–31.

TELEVISION

Developments in television were principally in two fields, remote control and teletext reception. Cordless, ultrasonic remote-controlled receivers were displayed by amongst others Rank Radio International (Bush), Thorn Consumer Electronics (Ferguson), Tandberg, Roberts Video, Telefunken and ITT. All of these provide channel selection and most also allow sound muting or volume control from the comfort of your armchair.

Also on some ITT sets is a button called Ideal Colour—otherwise known as a "Granny Button". When pressed, this returns the display to predetermined levels of colour and contrast, regardless of control settings—very helpful for those who are baffled by the multiplicity of controls on a colour TV receiver. On ITT's latest models, this feature is extended even further by the addition of a photo-electric cell which adjusts the Ideal Colour levels to compensate for changes in room brightness.

TELETEXT

On the teletext front, several manufacturers were showing experimental receivers, and there were also comprehensive exhibits on the BBC and IBA stands. The question mark which has been poised over the future of the teletext services has to a large extent been removed by the recent BBC decision to make a continuing financial provision for the Ceefax service. In fact, a second service, providing a second magazine, was inaugurated on BBC 2 on the HEDA Exhibition opening day.

Two manufacturers have demonstrated their faith in the future of teletext by announcing launch dates for production models of a complete teletext receiver and an add-on adaptor. The receiver, to be sold under the Bush marque, is due to go into production at Rank's Plymouth factory during August. Price for a 22 inch model with full cordless remote control will be about £1,100.

The add-on adaptor comes from Labgear, part of the Pye group, and provides all normal teletext facilities without need of any internal connections or modifications to the TV receiver. The adaptor, which makes use of TIFAX l.s.i. decoder circuits from Texas Instruments, fits into the lead between the aerial and any standard 625-line set, colour or monochrome. The unit is expected to be on sale in 1977 at a price in the region of £200.

VIEWDATA

Viewdata, the Post Office system for displaying information on TV receivers, was being shown on several setmakers' stands and also on the Post Office Telecommunications stand. Here, two Viewdata terminals were on view, one based on a domestic television receiver and the other a prototype specially designed for office use and known as "Viewdataphone". The Viewdata system is now undergoing pilot trials, a full public trial period is planned to commence in the autumn of 1977.

The Labgear Teletext Adaptor in operation

SOUND

In the hi-fi department there seemed to be little that was really new; generally it was a case of "bigger, better and more features". Telefunken were introducing their TRX2000 AM/FM 4-channel receiver. A digital read-out is included which displays tuned frequency on radio, or otherwise operates as a 24-hour clock. Providing 50W r.m.s. per channel, and with enough knobs and dials to satisfy the most demanding, the TRX2000 incorporates an SQ-matrix decoder. Price is yet to be announced.

From Bib Hi-Fi Accessories Limited comes a natty little instrument called a Cassette Opener. Made of tempered steel and spring operated, this opens welded cassettes safely in seconds. Price including VAT is 48p.

FIGURES

Coming finally to calculators, CBM Business Machines Limited announced the first of their new range of third generation scientific calculators. This one, the Commodore Statistician, offers a wide range of pre-programmed functions for the statistician, plus all the usual mathematical and trig functions. The display handles a ten digit mantissa and two digit exponent and signs for each. Price is £99·95 including mains adaptor/charger.

The TRX2000 receiver from Telefunken

The CBM Statistician calculator

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2N918	0·34
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TO99	0·40
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NE561	4·48
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TAA661B	1·32
TBA641B	2·50
TBA651	1·80
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TBA810	1·28
TBA820	1·02
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CD4018	1·01
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CD4510	1·54
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SN7416	0·43
SN7417	0·43
SN7420	0·16
SN7423	0·26
SN7425	0·27
SN7427	0·27
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SN7432	0·27
SN7437	0·35
SN7438	0·35
SN7440	0·16
SN7441	0·76
SN7442	0·55
SN7445	0·94
SN7446	0·86
SN7447	0·81
SN7448	0·85
SN7450	0·16
SN7451	0·16
SN7453	0·16
SN7454	0·16
SN7460	0·16
SN7470	0·32
SN7472	0·26
SN7473	0·30
SN7474	0·30
SN7475	0·40
SN7476	0·36
SN7480	0·45
SN7481	1·10
SN7482	0·67
SN7483	0·92
SN7484	0·85
SN7485	1·25
SN7486	0·29
SN7490	0·43
SN7491	0·68
SN7492	0·43
SN7493	0·43
SN7494	0·74
SN7495	0·59
SN7496	0·78
SN74100	1·15
SN74107	0·30
SN74118	0·90
SN74119	1·80
SN74121	0·34
SN74122	0·45
SN74123	0·40
SN74141	0·72
SN74145	0·74
SN74150	1·20
SN74151	0·77
SN74153	0·73
SN74154	1·29
SN74155	1·20
SN74157	0·68
SN74160	1·20
SN74161	1·20
SN74162	1·20
SN74163	1·20
SN74164	0·93
SN74165	0·93
SN74167	3·70
SN74174	1·06
SN74175	0·94
SN74176	0·86
SN74180	1·23
SN74181	2·58
SN74190	1·33
SN74191	1·33
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PATENTS REVIEW...

COLLARED

A dog collar which emits a signal when the dog has been away from the owner for greater than a preset length of time, and is thus regarded as being lost, is described in a patent (BP 1 418 680) taken out by Herbert, Enid and Mary Corbin together with Mary Nicholas.

The circuit, built in a small box mounted on the collar (Fig. 1), includes a field effect transistor with source and drain electrodes connected, via R2, across the supply and the gate connected to VR1 and S1b. The drain is also connected to a Darlington pair, TR2 and 3, which switches the multivibrator, TR4 and 5, and causes the lamp LP1 to flash. The timing of the multivibrator is determined by C2 and R5.

Before the start of a dog walk the owner closes S2 and S1 to charge C7. The gate and source electrodes of TR1 settle at the same potential, the Darlington conducts and power is supplied to the multivibrator and LP1 flashes on and off.

As the walk commences S1 is switched back to the position in Fig. 1 and C1 begins to discharge, applying a voltage between the f.e.t. gate and source causing it to cease conduction and LP1 to be extinguished. After a predetermined time, set by VR1, the capacitor C1 has discharged to such a value that the voltage across the gate and source of TR1 is reduced sufficiently to allow conduction to commence again. TR2 and 3 again become conductive and LP1 begins to flash.

The lamp will generally be arranged behind a translucent panel carrying the legend "I am Lost" or similar wording.

VOICE BOX

There have recently been granted several patents for gadgetry to help would be singers join in with a record in their own homes. In BP 1 427 607, the Sony Corporation, of Tokyo, Japan, patents a sophisticated system of artificially improving the quality of the amateur singer's voice, to make it resemble the sound of a voice recorded in a professional studio.

As shown in Fig. 1, the stereo record player feeds left and right signals through a conventional audio train to left and right loudspeakers. The singer "sings along" into the microphone, Mic. 1, and the signal is amplified and fed direct into a mixer to blend with the left-hand channel sound. But the signal is also fed to an "effects circuit, which adds delay and vibrato to the voice before blending it in the right channel mixer.

BP 1 418 680

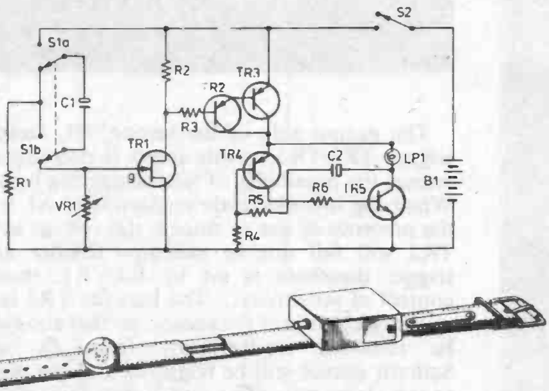


Fig. 1.

BP 1 427 607

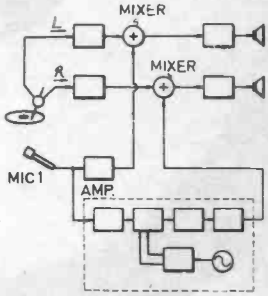


Fig. 1.

The effects circuit includes variable delay, in which the microphone signal is delayed and frequency modulated. This is achieved by using a bucket-brigade device (BBD) in which a series of f.e.t.s are provided with capacitors connected between their source and gate electrodes.

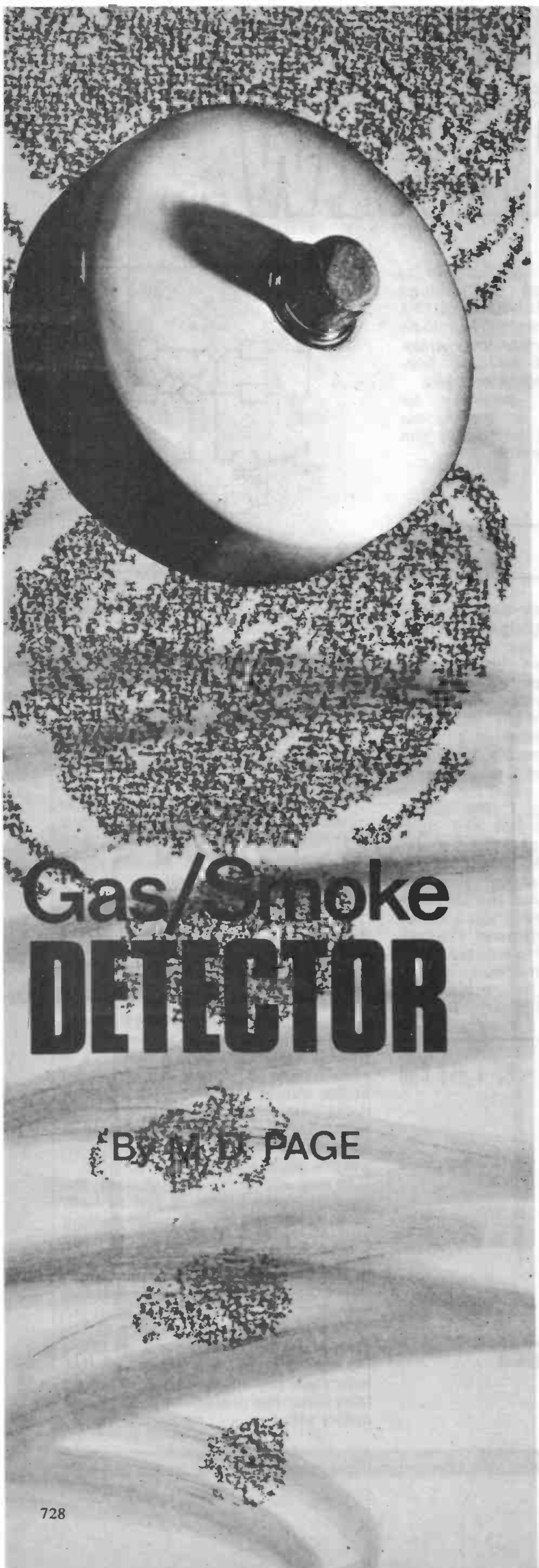
The gate electrodes of the odd-numbered f.e.t.s are connected to a first clock pulse input terminal, and the gate electrodes of the even numbered f.e.t.s are connected to a second clock pulse input terminal. The clock oscillator produces first and second clock pulses which are shifted in phase by 180° relative to each other and applied to the terminals.

The resultant alternate switching of the f.e.t.s causes the charge stored in the first capacitor to be shifted through the capacitor chain. As a result, delayed signals are delivered at the output terminal. The order of delay time envisaged is a few tens of milliseconds, this time being made variable by making the oscillator an astable multivibrator.

In one alternative embodiment, the delayed voice signal is fed to both stereo channels. A further interesting suggestion is a matrix differencing circuit used to eliminate the centre-front (in-phase, equal amplitude) content of the professionally recorded stereo pair and permit its replacement by the injected delay signal.

Most professional recordings place the lead singer centre-front, so this technique enables the amateur singer to replace the professional at sound centre stage.

Copies of Patents can be obtained from the Patent Office Sales, St. Mary Cray, Orpington, Kent Price 75p each



Gas/Smoke DETECTOR

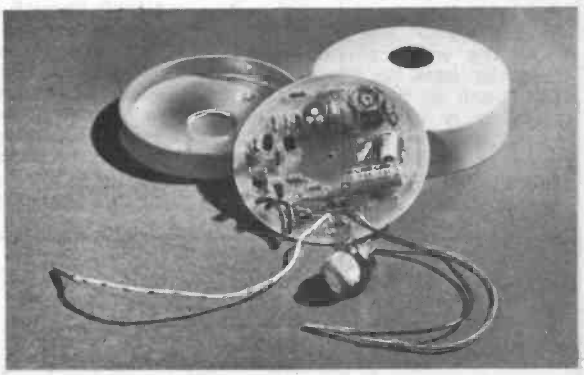
BY M. D. PAGE

THIS unit is designed to monitor the level of gas or smoke concentration in an enclosed space, and to operate an external warning device (e.g. lamp or syren) when a predetermined threshold is exceeded. The sensing device is a thermal gas sensor, whose operation was described in detail in *Practical Electronics*, September 1973 (back copies are not available). Briefly, it consists of two electrodes encapsulated in a bead of doped semiconductor material, one of the electrodes acting as a heater. In the presence of oxygen, a high resistance of some 10–50kΩ exists between the electrodes. In contact with a deoxidising gas or vapour, ionic action increases the number of free electrons in the material, and the interelectrode resistance falls to about 1kΩ. A flash-proof wire mesh shield surrounds the device, also helping to reduce the cooling effects of draughts.

The particular sensor used in this design is the TGS105 made by Figaro Engineering. This was chosen for its fast warm-up time of 1½ minutes, fast response and fast decontamination. It does not respond to steam or dust. Connections are by four pins which are arranged so that the sensor may be mounted in a B7G valve base.

CIRCUIT DESCRIPTION

The thermal gas sensor requires a heater supply of 1 volt at 600mA which is supplied by a high efficiency sine-wave inverter TR1/T1 (see Fig. 1). Transistor TR1 and C1 have to withstand a voltage several times that of the supply line due to the inductive effects of transformer T1. Therefore C1 should be a good quality, high voltage capacitor, and TR1 the quoted specially chosen high voltage device, though these are less critical for the 12V version. Base bias for TR1 is provided by R1, R2 and decoupled by C2.



The output side of the sensor, X1, feeds a Schmitt trigger TR2/TR3, whose input is decoupled by C3 to reduce the possibility of false triggering by noise spikes. When the interelectrode resistance of X1 is reduced in the presence of gas or smoke, the voltage at the base of TR2 will fall due to potential divider action. The trigger threshold is set by R4/VR1, thus providing control of sensitivity. The bias for TR2 is fed via the output electrode of the sensor, so that should the sensor be removed inadvertently from its socket, the Schmitt circuit will be triggered and the output will go to the alarm state. The unit is thus fail-safe under these conditions, though TR1 may be damaged as a result of the oscillator output being unloaded.

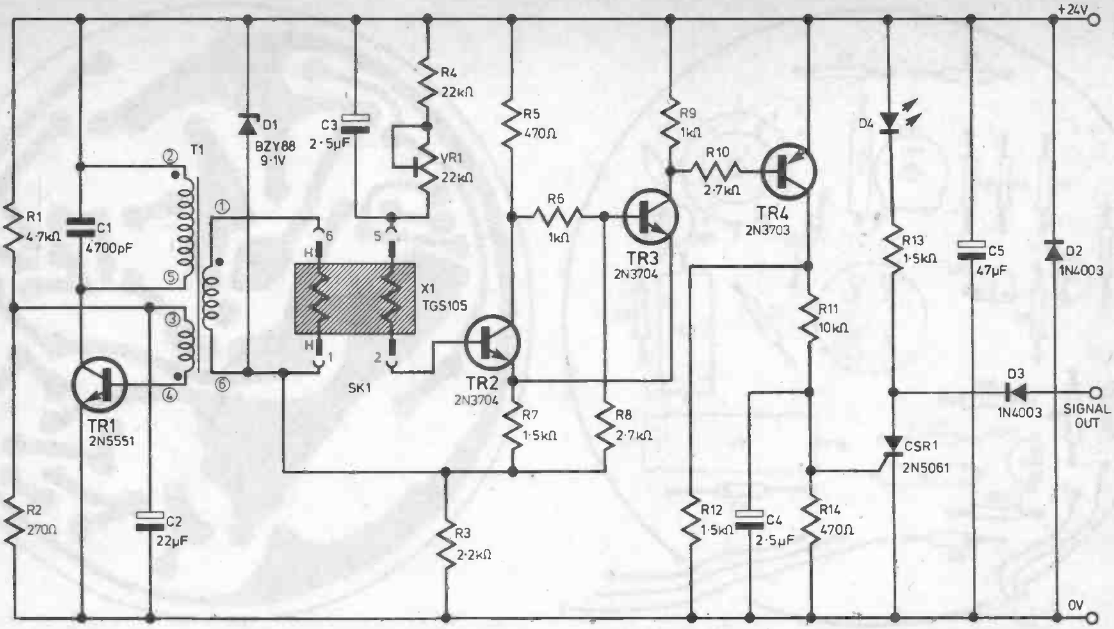
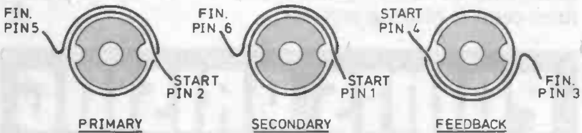


Fig. 1. Circuit diagram for the Gas/Smoke detector. See components list for changes in 12V version

The output of the Schmitt trigger is taken to TR4 which acts as a driver stage for a miniature thyristor CSR1. The network R11, R14, C4 is for decoupling. When fired, CSR1 completes the circuit to the 0V rail for the external load (which will normally be a relay) and also for the local l.e.d. indicator, D4 with its associated dropping resistor R13. The l.e.d. is included so that when several units are used in an installation, the particular unit which has triggered may be identified. The diode D3 is to isolate the output when units are paralleled.



WINDING	24V	12V	GAUGE
PRI	25½ T	11½ T	30 SWG
SEC.	1½ T	1½ T	26 SWG
F.B.	1½ T	1½ T	30 SWG

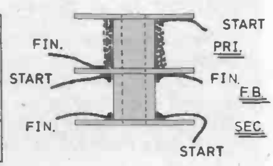


Fig. 2. Winding details for T1

The supply lines are decoupled by C5, and the circuit protected from damage due to supply polarity reversal by D2. The Schmitt trigger is provided with its own stabilised nine volt supply by D1 and R3, again to provide immunity to supply line fluctuations.

COMPONENTS

As mentioned above, several of the components around the sine-wave inverter are rather critical, and the types specified in the components list should be adhered to. Winding details for T1 are given in Fig. 2 and the associated table. The printed board layout is shown in Fig. 3.

COMPONENTS . . .

Resistors

†R1 4·7kΩ	R5	470Ω	R9	1kΩ	R13	1·5kΩ	
†R2 270Ω	R6	1kΩ	R10	2·7kΩ	R14	470Ω	
†R3 2·2kΩ	R7	1·5kΩ	R11	10kΩ			
R4 22kΩ	R8	2·7kΩ	R12	1·5kΩ			

All resistors 5% ¼W

†For 12V version, R1 1·5kΩ, R2 120Ω, R3 330Ω

Potentiometer

VR1 22kΩ miniature horizontal preset

Capacitors

C1 4,700pF 100V d.c. ceramic
C2 22μF 10V elect.
C3, C4 2·5μF 16V elect. (2 off)
C5 47μF 35V elect.

Semiconductors

*TR1 2N5551 (Motorola) or ZTX341/342 (Ferranti)
TR2, TR3 2N3704 (2 off)
TR4 2N3703
D1 BZX83 or BZY88 9·1V Zener
D2, D3 1N4003 (2 off)
D4 Min l.e.d. (⅛in)
CSR1 2N5061

Inductor

T1 Pot core transformer using Siemens components:
Coil former, 2-section Polyacetal GV B65542-A0000-H002
Pot core, 14 × 8 Siemens Matl. N28 B65541-K025-A028
P.C.B. mounting assembly (6-pin) B65545-A0010-X000
For winding details see Fig. 2

Miscellaneous

*X1 Sensor, Figaro TGS105
SK1 B7G valveholder (pins 3, 4 and 7 removed)
P.C.B. and housing.

* These items are available from P.H. Electronics Ltd., Sandwich Industrial Estate, Sandwich, Kent.

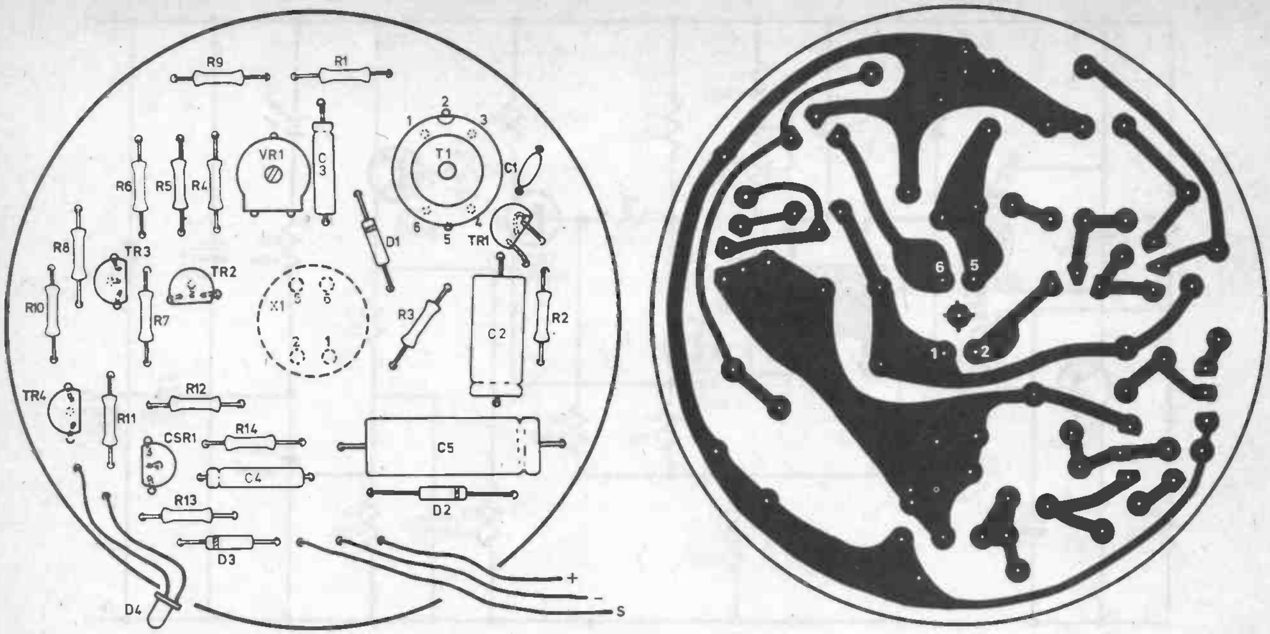


Fig. 3. Component layout and printed circuit board master

APPLICATIONS

The unit has only three external connections and thus lends itself to an installation using standard three-core mains lead for the wiring. Many units can be wired in parallel. The thyristor specified has a maximum rating of 800mA, and is capable of driving a low power 24V or 12V lamp, or a relay to control higher powered or mains voltage equipment. Care should be taken not to short the output lead to the positive supply rail as this will result in a blown thyristor.

Intending constructors should note that the 24V version has proved to be more reliable in operation, and is to be preferred where a choice of supplies is available. The total quiescent current consumption is only 45mA on 24V and 90mA on 12V. A cable size of 16/0·2mm (14/0·0076in) should be adequate for runs up to 30m (100ft) on 24V or half this distance on 12V. For reliable operation, the power supply voltage should be maintained within ±10% of the nominal value.

The unit will find uses in the home, boat or caravan as a fire alarm, gas detector, and also as a carbon monoxide detector in the boiler house of oil or gas fired central heating systems. ★

Copper side of board showing mounting of the B7G (SK1) valveholder base

POINTS ARISING

SHOOT *(April 1976)*

Several readers have reported that their game produces a circulating chain of illuminated l.e.d.s, instead of the pattern described in the article. This would appear to be due to the track break under the top end of R14 (Fig. 2, p. 320) having been missed, so applying a permanent +5·5V to pin 8 of IC3 and thus to one input of IC4a.

DIGITAL FREQUENCY METER *(May 1976)*

In the circuit diagram on page 378, the pin connections for IC1 pins 1 and 14 should be transposed (i.e. pin 14 should be connected to GND line).

P.E. DIGI-PROBE *(April 1976)*

In Fig. 7, page 292, the component below R3 should be annotated D1. Also, diode D3 anode should be connected to the junction of R3 and D2 (i.e. strip above).

There should be a link from IC2/P11 to IC3/P3. The link from pin 7 to 8 of IC3 should be moved at the right-hand end to allow a break between IC3/P8 and C1 negative (and IC3/P7 via above link).

There should be a link from the negative end of C1 to TR3 emitter

CITIZENS' BAND...

The Pros and Cons

By P. HAWKER

ANYONE who has crossed the Atlantic recently can confirm the tremendous upsurge in the use being made of the 27MHz Citizens' Band two-way radio in the United States and the corresponding "General Radio Service" in Canada. Or again, in some countries in Europe, including the Federal German Republic, CB operation Is legally established; in others it is, in effect, tolerated.

It would be contrary to our curious Wireless Telegraphy Acts for me to describe what anyone in the U.K. can hear on 27MHz whenever "Sporadic E" conditions prevail, since none of those many, many stations are either "authorised broadcasting stations for general reception" or "licensed amateur stations".

Six million U.S. citizens—including innumerable long-distance lorry drivers and ordinary motorists—have two-way radios in their vehicles as an interactive traffic information service; others have "base" units in their homes or offices to talk to the drivers or to one another. Countless others use compact two-way hand-held transceivers which, if the output power is less than 100mW, do not even require registering.

New Language

A whole new communications industry has been created; a new colourful jargon of CB slang has emerged and one finds, among many other publications for the CBers, "slanguage" dictionaries running into hundreds of pages. The radio shops, department stores, discount houses and auto-suppliers feature CB equipment under the brand names of Regency, Lafayette, Johnson, Panasonic, Sony, Craig, Pace, Radio Shack, Hallicrafters, Cobra, etc. Many equipments are for single-sideband (s.s.b.) operation with synthesiser systems for channel switching, fully as modern in concept and design as current professional and amateur radio equipment, often costing several hundred dollars.

Some of the equipment is made in the United States where even television factories are being converted for CB production; much of it comes from Japan. Amateur radio enthusiasts complain of the shortage of crystals and components diverted to CB; a new outlet for technicians—servicing CB radio—is blossoming. CB pop songs have made the hit parade. Everyone seems to want a CB radio; some of them are even prepared to acquire a licence to operate!

Is it all a transient craze that, like the yo-yo and the hula hoop, erupts across a nation for a few months or a few years, only to fade away? Or is the present popularity a genuine reflection of the pent-up demand for, and usefulness of, a low-cost (or relatively low-cost) communications facility of an inherently different nature to the orthodox "business radio" service and the long-established amateur radio service?

Then again there is the possibility that the frequencies assigned to CBers will become so congested that effective communications, even at short range, may become virtually impossible so that the whole system could collapse under its own popularity.

There is no provision for authorised CB operation in the United Kingdom. Indeed, under Section 7 of the Wireless Telegraphy Act, 1968, the licensing authority (nowadays this is the Radio Regulatory Division of the Home Office) has specifically prohibited the import or manufacture of such equipment.

Until that Act was passed, CB equipment was widely offered for sale in the U.K. and possibly up to almost 100,000 small hand-held units, mostly from Japan, were sold. Many still exist, and recently such units seem to be reappearing in the shops; certainly they can be bought over the counter in many European countries. But few of the more elaborate base and vehicle s.s.b. units have been seen here.

How CB developed

Why has CB boomed in some countries while severely frowned upon and harassed in others? *Should* two-way radio communication be freely available to the ordinary citizen without formality?

To examine such questions it is necessary to go back almost 30 years to the beginnings of the "Citizens' Radio Service", inaugurated in the U.S.A. in 1947 to provide two-way radio for the private citizen in the conduct of his personal affairs or business activities. The FCC authorised this service to use frequencies from 460 to 470MHz, at powers up to 50W. At that time 460MHz was a virtually unexploited band, at least for such applications as land mobile communications.

There was no early rush to take advantage of this new service, and very few firms marketed suitable u.h.f. equipment. Indeed interest remained very slight, and firmly within the United States, until 1958 when a new Class D system was established, using frequencies around 27MHz (currently 23 channels between 26·965 and 27·255MHz).

This new Class D facility quickly registered an appeal to a type of user for which the service was not originally intended, the "hobby" enthusiast; many with a largely frustrated interest in radio communication but who, for various reasons, were not prepared to study for and sit the technical and Morse examinations needed to obtain an "amateur" licence. The CB regulations were intended to discourage hobby operation, by limiting the power to 5W, restricting the height of aerials, prohibiting inter-State operation.

CB Permit

But even with communication officially limited to around 15 miles, the CB permit seemed a far softer option than the amateur licence. Furthermore, as the American licensing authority (the Federal Communications Commission) quickly found out: it is one thing to try to tell the citizen what he should and should not do with his two-way radio; quite another matter to enforce such regulations.

It would have needed an army of inspectors, equipped with every type of surveillance equipment, to have traced the most flagrant offenders or to limit the amount of interference caused to television in urban centres.

At times of high sunspot activity 27MHz signals are effectively reflected by the F-layer of the ionosphere and bounce down at good strength hundreds and thousands of miles away. At many other times unpredictable "Sporadic E" conditions may allow communication over hundreds of miles.

Soon the number of CB permits had passed the quarter-million mark. From around 50,000 in 1959 to around a million in 1971–72. It was the energy crisis of late 1973 and the subsequent 55 m.p.h. speed limit in the U.S.A. that proved a further turning point: American long-distance truckers began using CB to help colleagues locate petrol supplies and to avoid speed traps.

Unofficial Service

In no time an unofficial traffic information service was attracting the attention of millions of motorists. Not all the lorry drivers bothered with the formality of a licence. In 1974 a check of 36,000 vehicles revealed that 7,000 were carrying CB equipment, more than half of them unlicensed and many exceeding the power regulations.

CBers and Radio Amateurs

The Class D Citizens' Band system fell foul of the American amateur radio movement from the outset. The 27MHz frequencies, although not internationally allocated to amateurs, had for some years been made available to them in a number of countries, including the United States. So they felt that CB had deprived them of valuable frequencies. Further, any transgressions by CBers (and there were many) were usually written up in the press as being due to "amateur" or "ham" operators, particularly when it was a matter of interference to television reception.

There was also undoubtedly a strong feeling that CBers had obtained their privileges without personal effort or training, whereas the amateur licence involves months of study. The amateurs soon noted that the so-called "5-watt" CB stations were often running at powers up to 1kW, using beam antennas and operating under virtually the same conditions as the amateurs.

It was also soon obvious that, following the introduction of Class D CB, the growth of amateur radio in the United States slowed down and for many years remained static. CB was clearly absorbing many hobby enthusiasts who might otherwise have persevered and obtained an amateur licence.

A further blow came in 1974 when the FCC proposed a new Class E CB service using frequencies in the 220MHz region that were part of an American amateur band. Again it looked as though amateur radio would lose frequencies to CB, but strong opposition has apparently caused the FCC to think again, and Class E is at present on the shelf.

More recently the FCC has formally decreed that CB can legally be used "as a hobby or diversion", with interstate contacts and with Channel 11 designated as a national calling frequency.

Very few American amateurs can find a good word to say in favour of CB and the resentment still runs deep, despite recent attempts to patch up the quarrel.

The International Scene

The international situation of CB was equally fraught with problems. Almost all countries throughout the world are members of the International Telecommunications Union, ITU (an agency of the United Nations), and have agreed that in assigning radio frequencies they will be bound by the "Radio Regulations"—a very formidable treaty document that carefully assigns radio frequencies to specific uses and defines the various services that may use them.

The amateur service is formally defined as "a service of self-training, intercommunication and technical investigations carried on by amateurs, that is, by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest".

But nowhere in the current Radio Regulations is there any mention of or any definition of anything resembling a Citizens' Radio Service. What has become numerically the largest of all radio-communication services is entirely ignored, both in the Atlantic City (1947) and the Geneva (1959) Radio Regulations.

If it does not exist officially how can it be assigned *any* frequencies? The answer is to be found in footnotes to the ITU frequency table. Certain spot frequencies, with an agreed tolerance, have been assigned to "industrial, scientific and medical" (i.s.m.) purposes, including 27,120kHz$\pm$0·6%. The Radio Regulations make no attempt to define precisely what it meant by i.s.m. equipment—a low-priority communications service can presumably be regarded as an industrial use of the frequency.

Then again, there is nothing to prevent any country from allocating any frequency for any purpose it chooses if this is deemed incapable of causing interference to the services of other countries. For example, FCC could, within the terms of the Radio Regulations, allocate 220MHz to CB, but would have to ensure either that no such stations were located within range of the Canadian border or alternatively to secure the agreement of the Canadians to this variation of the ITU allocations.

The FCC are now proposing to shift the very low power hand-held transceivers to the frequency band 49·82 to 49·90MHz. It could equally decide to put CB around 40·68MHz, another of the i.s.m. spot frequencies.

There is thus still a lot of power invested in national administrations to set up CB should they wish to do so, even when bound by the Radio Regulations that appear not to recognise such a service.

CB and the U.K.

So why no CB in the U.K.? The standard reply is that the 27MHz i.s.m. allocation is already in use for radio-paging and by many thousands of radio-control modellers—and that both these services would be seriously jeopardised by CB operation. If anyone attempted to shift CB operation into the amateur 28MHz band it would not only incur the wrath of radio amateurs throughout the world but under Radio Regulations the licensing authority would be obliged to ensure that no harmful interference could be caused to amateurs in any country outside the U.K.—a virtual impossibility with "Sporadic E" and F-layer propagation.

But it would be naive, as the American experience shows, for the Home Office to claim that *no* frequencies could possibly be found for CB or even for radio-controlled garage door openers. For example, large blocks of frequencies in the U.K. were reserved for military communications at a time when channel-widths were much wider than are now necessary, and when British military commitments were very different from today.

But the will would have to be there. And everything in the history of radio in the U.K. shows the reluctance of the licensing authorities, whether the Post Office or the Home Office, to extend the use of radio by the public unless gradually worn down by external pressures.

In the early 1920s they hesitated long before allowing the man-in-the-street to have "oscillating detector" receivers and delayed the start of broadcasting. In 1925 they attempted to stifle all communication overseas by radio amateurs . . . the list is a long one.

The Home Office is of course well aware that even low-power CB transmitters can be used for odd purposes or may cause an embarrassing amount of interference. The escape of the Russian double-agent, George Blake, from prison was facilitated by the use of illegal CB equipment. The Baker Street bank robbers of September 1971 used CB radio to their look-out man, unaware that their messages were being intercepted. Some of the smaller CB units can be used as radio "bugs".

Amateur Opposition

The Radio Society of Great Britain as the body representing British radio amateurs, goes along with the Home Office in opposing the extension of CB to the U.K. saying: "No support can be given to the establishment of a communications band in this part of the spectrum. Reports of CB activities in the U.S.A. show gross violations of the regulations, leading in some cases to heavy fines and prison sentences. The Society has no desire to see the spread of these practices to the U.K."

The author, holder of an amateur licence for 40 years, finds it difficult to support fully this view, though recognising that amateurs have very real reasons to fear and resent some aspects of CB operation. It is easy to imagine how those with a Class B amateur licence, who have had to pass the Radio Amateurs' Examination to use frequencies above 144MHz, would resent the issue of lower-frequency CB licences on request. There is plenty of evidence that licences that are obtained without personal effort are but little respected by the hobbyist.

Friendly Service

Yet the American Radio Relay League, the national society of American and Canadian amateurs, is currently striving to reduce tensions between amateurs and CBers, pointing in glowing terms to some of the more socially useful aspects of CB operation and carefully distinguishing between the hobby users of CB (who the League feels should be encouraged to become amateurs) and those who simply want low-priority communications.

Even the much-publicised "Smokey Bear" warnings of police speed traps are now often tolerated and made use of rather than opposed by the American law enforcement agencies. A Channel 9 emergency service —"REACT"—exists in many areas and has been credited with useful services rendered to the public.

Sailing and power-boat enthusiasts often use CB equipment as a safety measure in circumstances where normal marine radio would be far too costly. Mountain rescue teams have made good use of CB radio.

Much of the argument for CB is philosophical. Two-way radio has been developed to the stage where it can be used by the public with only a small element of risk to others. Are we then right to deny such a service to the citizen on the grounds that it would inevitably be abused by a small minority? We do not try to deny the public access to the telephone service because a few people use it to make obscene calls.

If six million transmitters in the U.S. can be accommodated in only 23 channels and yet the public still find it worthwhile acquiring more CB units, is there not an obligation on the U.K. licensing authorities to find some space for such a service?

The radio spectrum is a national resource but not one that is diminished by use. It is a wasting asset only if it is not well managed and fully utilised for the public good. We need to weigh the pros and cons carefully, not to argue from our prejudices.

Good Citizen

In brief, the Home Office Radio Regulatory Division should surely be encouraged to explore how modern two-way radio systems could be extended to the public domain for such purposes as traffic information and "companionship", and for the original concept of assisting the private citizen in the conduct of his personal affairs or business activities. On the other hand there is a strong argument for firmly channelling the hobbyist into amateur radio, where he belongs, with its self-training and technical investigations, possibly by provision of temporary novice or beginner licences, but with a built-in incentive to progress to the standard licences.

Short-range two-way radio has reached the stage where the public at large can benefit by the facilities it provides—is it not time that the U.K. licensing authorities recognise this?

NEWS BRIEFS

New VAT Leaflet

A VAT Leaflet No. 8/76/VLA, "Higher Rate of VAT: Electrical and Electronic Components" is due to be published at the end of August. This lists recent alterations of rate and changes of interpretation as they affect components. Traders not in receipt of regular VAT bulletins can obtain a copy from their local Customs and Excise office.

Fog Bound

THE Royal Aircraft Establishment is to research the vertical structure of fog using a new visual range monitoring equipment, MET-1, developed by Marconi Radar Systems Ltd.

Two MET-1 (Marconi Environmental Transmissometer Mk 1) equipments are to be supplied for use by RAE at Bedford and Cardington, for joint Civil Aviation Authority and Ministry of Defence experiments.

The system was developed by Marconi Radar Systems Ltd as a visual range measuring system for use on airfields, motorways, ships and in ports, industrial areas, tunnels and underpasses and in any situation where accurate measurement of visibility is required in the presence of fog, dust, rain, snow, smoke or other pollutants in the atmosphere.

Microprocessor Symposium

THE Society of Electronic and Radio Technicians is holding a residential symposium on microprocessors and their applications at Sussex University from 26–29 September 1976. Associated with the symposium is a competition for an application of MPUs by the home constructor which is simple, economic, original and useful or entertaining. First prize is £150.

Details from the MPU Secretariat, SERT, 8–10 Charing Cross Road, London, WC2H 0HP.

Courses

THE Bury Radio Society will be running a RAE course in the 1976/77 session:

Enrol: Tuesday Aug 31 and Sept 7, time, 8.00 p.m. at the Mosses Youth and Community Centre, Cecil Street, Bury.

The Shelburne Radio Club are starting a new RAE course aimed at the December 1977 exams to allow time for practical experience.

Comm.: Monday Sept 6 at the Shelburne Radio Club, White Lion Street School, London, N.1.

A course for the RAE City & Guilds No. 765 giving tuition in theory, Morse and practical work is being run by the Walsall College of Technology.

Enrol: Wednesday September 8, time, 6.30 p.m. at the Walsall College of Technology, Walsall, WS1 1XN.

SONAX ELECTRONICS

We are advised that Sonax Electronics are now in liquidation and that all claims outstanding against this company are being handled by the Official Receiver at Atlantic House, Holborn Viaduct, London, EC1N 2HD.

INDUSTRY NOTEBOOK

By Nexus

INVESTMENT/ EXPANSION

Far too much is heard from the groaners about lack of investment in British industry. Investment, of course, is one of those things you can't have too much of but investment doesn't come out of thin air.

The tax-payer foots the bill, like it or not, for nationalised industries, at least for the unprofitable ones which means most. For private enterprise, new investment must come out of profits, which are hard to come by, or from investors who, these days, are more timid than they used to be having suffered from dividend restraint and then being taxed to the hilt on the dividends they get.

Far from grumbling about how little is invested I find it astonishing that, in all the circumstances, there is so much.

Take Mullard, part of the Philips international group. The new clean room facility for the production of N-MOS memory circuits has cost £3 million as a first instalment. Only one third of it is in current use and by the time it is full up the grand total invested will be more like £6 million.

The Mullard semiconductor plant at Southampton is being turned into the main European manufacturing centre for MOS circuits. The products will be marketed as Signetics, the Californian based company which Philips acquired last year and the first product line is to be the Signetics 4k RAM.

The decision to build the new facility was taken, however, before the acquisition of Signetics, taken in fact at the very depth or nearly so of the recession.

Ploughing in a steady £400,000 a year into new plant and machinery is Marconi Instruments. British Physical Laboratories (Racal Electronics Group) has just opened an extension to its factory at Radlett, part of a £100,000 expansion scheme. Racal Communications has also just moved receiver production to a larger factory—it needed more space.

Flushed with success from world-wide demand for EMI-Scanner X-ray equipment, EMI has had to find new premises for what is virtually a brand new business. The Medical Electronics Group has acquired a £2 million 40,000sq ft. office complex at Slough. By the end of the year some 200 staff will have moved in, increasing to 260 during 1977. The staff will be mainly administration and sales with some engineering support. Building the EMI-Scanner takes half a dozen manufacturing centres, all of which have needed investment in equipment and people.

This, in turn, has caused another spin-off in investment. SE Labs (EMI) Ltd. has increased turnover by £5 million in the past year, some of it coming from the supply of instrumentation to EMI's medical group. So SE Labs has had to expand, too, and has taken over the 40,000sq ft. factory at Frimley previously occupied by Shandon Southern Instruments, who themselves have moved on to Ash Vale.

SE Labs' Frimley plant is additional to SE's existing plants. It's a nice acquisition for SE Labs because they have taken over a number of skilled people already employed on the site who didn't want to move and will be recruiting another 150 people over the next year.

PLENTY OF ACTION

If you just look at worn-out industries, sure you won't see much movement. Look at electronics where there is a big future and there's still plenty of action.

Trade figures are looking better all the while. ICL, once the slumbering giant of the computer industry, had a record six months to the end of March. Turnover up 23 per cent to £136 million, operating profit up 35 per cent to £10·5 million over the comparable period in 1975. STC, the British end of ITT, reports turnover up 15 per cent at £383 million with exports up 20 per cent from £57 million to £68 million. Net income, however, was down £4 million but, on the other hand, over £4 million extra was spent on R and D.

Order books are firm with some nice single contracts like a £1·25 million flight simulator from Redifon destined for Brazil, and a colour TV broadcast contract worth £5 million for EMI from Nigeria. Of course there is still anxiety and uncertainty in some quarters of the industry, particularly over the general economic situation, but there is still plenty of business to be had for those who are prepared to go and get it. But the consumer market is still in the doldrums. A rumour that the CTV licence fee is going up to £27 is discouraging buyers and has already nullified the hoped-for boost from the VAT reduction recently made.

COMMUNICATIONS

I was one of the crowd of 14,000 sweltering in the heatwave which coincided with the Communications '76 Conference and Exhibition at Brighton. Both the conference and the exhibition were a triumph for organiser Tony Davies. There were 160 companies and organisations in the show and the conference attracted 659 delegates from 32 countries. The British Overseas Trade Board did a great job in organising a sponsored tour of British manufacturers for buyers from over 40 countries.

I hope to discuss some of the commercial implications of the communications business in future issues but here are a few statistics to be getting on with. Today's U.K. population of mobile two-way radios, excluding the military, is some 200,000 installations with an anticipated increase to 500,000 by 1985.

London's Post Office public radio paging system, due to open in a few weeks, will eventually cater for 100,000 users although only 20,000 are being allowed for in the first period of operation. A central solid state 100W transmitter is situated atop the Post Office Tower and a ring of at least nine supplementary transmitters will give coverage over the whole of the capital. A user can be paged from anywhere in the U.K. automatically through STD.

But these figures are small fry in comparison to those postulated for Citizens Band radio for the U.K., if it comes, and there is plenty of commercial pressure to make CB come (*see special article elsewhere in this issue—Ed.*). Expect an announcement shortly.

If we look to the United States for the pattern we find over six million CB licences already issued and the authorities now grappling with half a million licence applications a month. Scale down to the U.K. population size and we could have a 1·5 million CB radios in action in a few years. Chaos! But nice revenue for the Government and a bonanza for set manufacturers.

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WIRE BENDING GAUGE

A useful workshop aid for the home constructor. Suitable for horizontally or vertically mounted components, with graduated spacing for 0·1 and 0·15 inch matrix layouts

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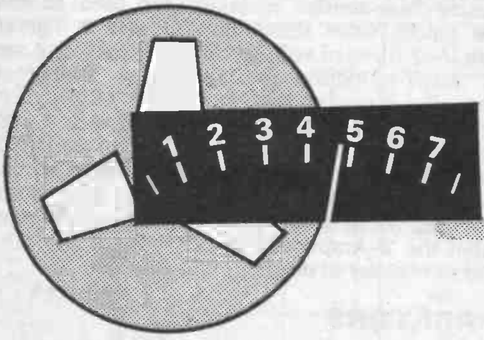
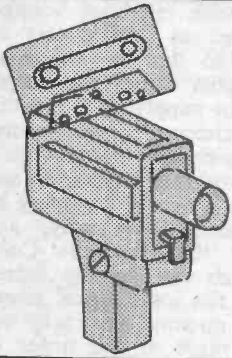


DIGITAL PPM

This l.e.d. Peak Programme Meter possesses the same characteristics as the standard p.p.m. (attack and decay times, etc.), but uses two columns of 16 l.e.d.s for the display rather than the expensive stereo meter movements normally used. An added benefit of the system is that it allows a greater dynamic range to be displayed.



CINE/TAPE SYNCHRONISER

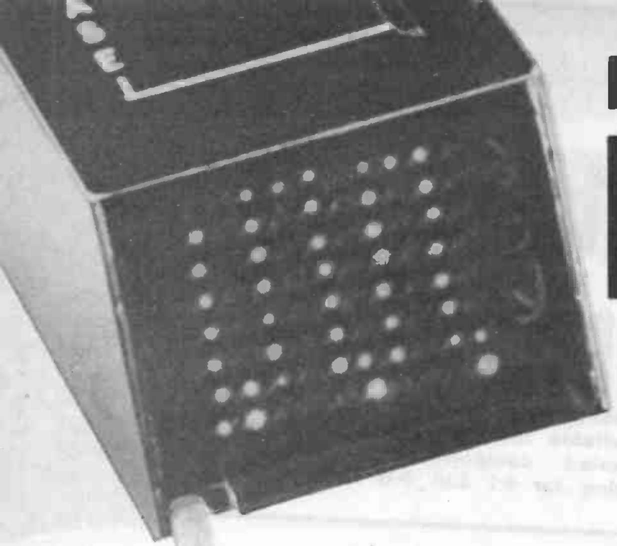
This circuit uses digital techniques to count and compare trains of pulses coming from the cine projector and the associated tape recorder, which may be either stereo or mono. The article describes how to use the resulting signals to control the speed of various types of projector motor in common use. Automatic starting of the projector is also provided

PRICE INCREASE—As from the October issue, the cover price of Practical Electronics will be 40p. This increase is regretted, but rising production costs make this unavoidable

PRACTICAL
ELECTRONICS

PLEASE NOTE:
It is in *your* interest to place a firm order with your newsagent—in advance. Back numbers are not available, so make sure of your copy now!

OUR OCTOBER ISSUE WILL BE PUBLISHED ON FRIDAY, SEPTEMBER 10, 1976



PE DIGISCOPE

By R.W. Coles and B. Cullen

PART 3

THE lower deck of Digiscope is based on a piece of strip board identical to that used for the upper deck and it carries the circuitry which makes up the Reference Generator, Comparators, Row Decoder, Blanking Gates, Row Drivers, Trigger Generator, Trigger Latch and Sweep Generator.

You may remember from Part 1 that the output of the Y-Amplifier is "digitised" with the aid of a series of comparator circuits each connected to a unique reference voltage differing from its neighbours by about 800mV.

REFERENCE GENERATOR

The reference voltages required by the Comparators are generated by the Reference Generator circuit which is made up of a series string of forward biased silicon diodes so that the basic reference increment is the V_f of the diodes or about 800mV.

The choice of reference voltage increment is fundamental to the design of Digiscope since it sets the gain required of the Y-Amplifier and determines the d.c. trace shift error with time and temperature. Using Zener diodes in the Reference Generator could make each increment more precise and increase stability against temperature fluctuations but would require the use of larger voltage increments because Zener diodes start at about 3V and are not much good up to about 5V. Even using 3V devices the voltage required at the Y-Amplifier output would be excessive and difficult to achieve in practice without resort to expensive types of op-amps. Reducing the reference increment below 800mV would be possible if suitable, dependable, reference diodes were available although large reductions would not be possible anyway, because the d.c. drift at the output of the Y-Amplifier would cause a significant shift in trace position with time and temperature. A resistor chain could be used to set these reference increments but the supplies to the chain would have to be floating with respect to other Digiscope supplies because Y-shift is achieved by connecting an appropriate point on the reference chain to 0V via an eight way switch.

In practice the 800mV reference provided by forward biased diodes works very well and gives a cheap and easy to implement system with repeatable results.

Transistor base-emitter junctions are used as the reference diodes since these tend to give a tighter spread on their forward voltage characteristics, and are also in easier-to-handle packages. The Reference Generator circuit can be seen to the left of Fig. 3.1. R42 and R43 set the diode current to between 4 and 7mA depending on the setting of S3. C14 and C15 decouple any h.f. noise which could cause jitter at the Comparator outputs, and S3 is, of course, the Y-shift control. Using S3 to control the reference chain zero means that the Y-Amplifier can run without any d.c. offset and so is easier to design.

COMPARATORS

The Comparators are required to give a logic-type output indication of whether their common input is above or below their particular reference voltage. 741-type op-amps can be used as comparators by operating them "open-loop" so that a very small voltage difference at their inputs causes the output to switch to one or other of the supply rails, but this solution is not practical for Digiscope for two reasons. First, the output of a standard op-amp operated as a comparator is not compatible with TTL logic levels and so would require level shifting circuitry to achieve an interface with the Row-Decoder. Secondly, and perhaps more fundamentally, the Digiscope Comparators are required to switch very rapidly indeed from one state to another as the input signal passes their threshold, and standard op-amps are really too slow for this job, requiring times in the order of 1 microsecond to switch states. When you consider that an input signal of 1MHz will have completed one whole cycle during the 1 microsecond transition period you will be able to see why a purpose built comparator integrated circuit is necessary with switching times at least an order of magnitude faster.

Fortunately there is a cheap solution to the problem in the form of the 710 high speed voltage comparator which has been around for quite a while now, available in a variety of package styles. The 710 runs from plus 12V and minus 5V supplies and has an output with TTL voltage levels. The response time is a mere 40 ns which guarantees a faithful display of high TTL voltage levels. The response time is a mere

As can be seen in Fig. 3.1, nine 710 devices are used in all, each with its non-inverting input connected to a unique reference voltage from the Reference Generator circuit. The Y-Amplifier output drives all the inverting inputs of the Comparators in parallel, so that the same signal voltage is applied to each. R41 and the back-to-back Zeners form a limiter circuit to prevent the Y-Amplifier output swinging further than about plus and minus 6V from ground, this being necessary to comply with the data sheet ratings for the 710 input voltages during overload conditions, when the Y-Amplifier attenuator is set wrongly, for example.

ROW DECODER

The nine Comparator outputs drive the Row Decoder inputs, and the operation of these two circuit blocks together is best understood by referring to Fig. 3.2, which is a simplified block diagram. For the sake of this diagram, an instantaneous Y-Amplifier output voltage of $5\frac{1}{2} \times V_{ref}$ is assumed, and the Y-shift control is set so that the lowest comparator reference is at 0V. Since the input is equivalent to $5\frac{1}{2}.V_{ref}$ then the outputs of comparators 1, 2, 3, 4, 5 and 6 will switch to give a logic 1 out, and comparators 7, 8 and 9 will give a logic 0 out.

The Row Decoder consists of a series of EXCLUSIVE-OR gates whose purpose is to detect the transition point between Comparator outputs which are 1's and those which are 0's. The EXCLUSIVE-OR gates are of the TTL 7486 type, and unlike familiar NAND and NOR gates each 7486 gate gives a logic 1 output only when its two inputs are different, i.e. 10 or 01, and a logic 0 output when its inputs are the same, i.e. 00 or 11.

For any instantaneous value of input voltage, then, only one of the eight Row Decoder outputs will be a logic 1 and this output will light up a particular row on the l.e.d. matrix. Because only one column of the matrix is enabled by the Sweep Generator, however, only a single l.e.d. in the matrix can be on at any instant.

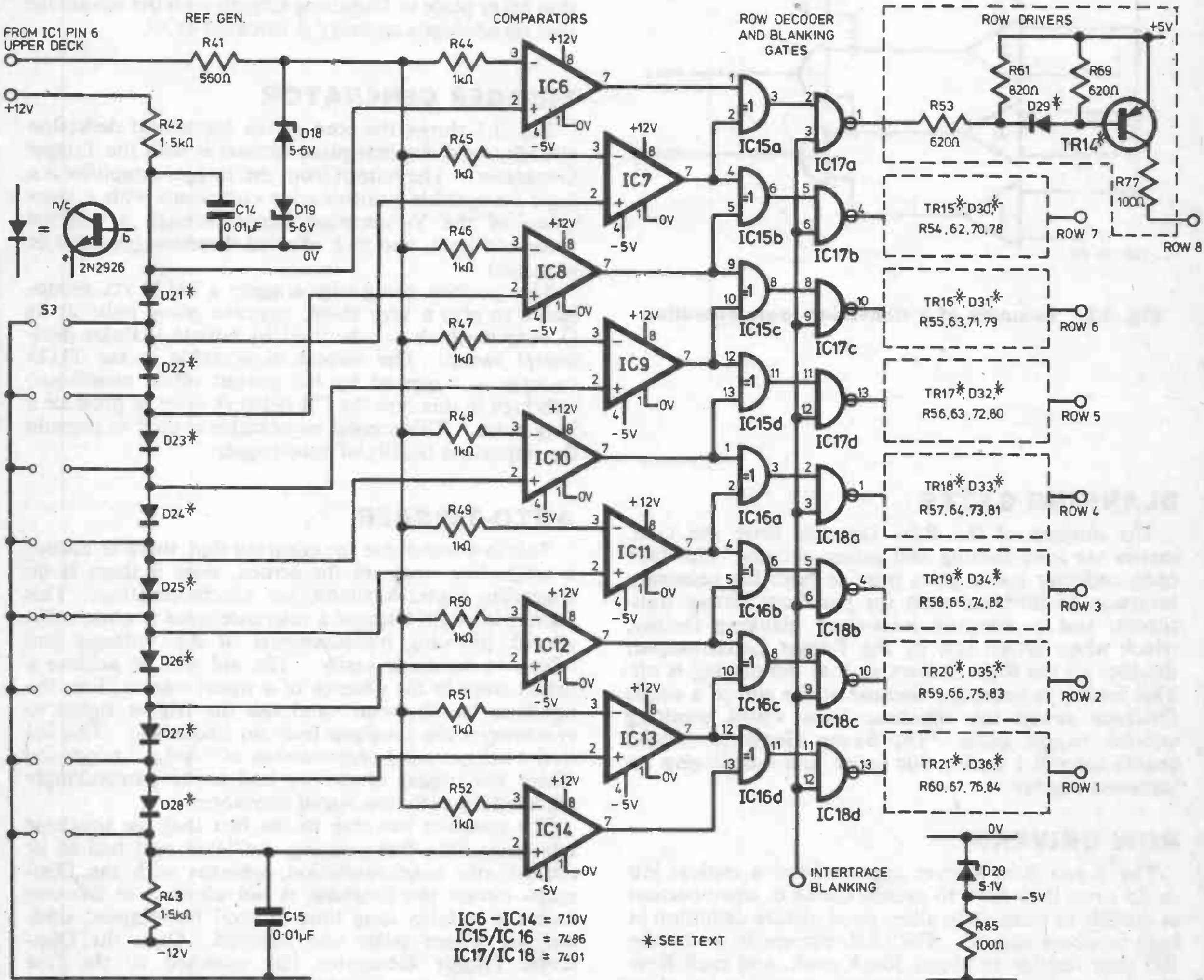


Fig. 3.1. Reference Generator, Comparators, Row Decoder, Blanking Gates, Row Drivers, Trigger Generator, Trigger Latch and Sweep Generator. The diode chain is made up of transistors as indicated

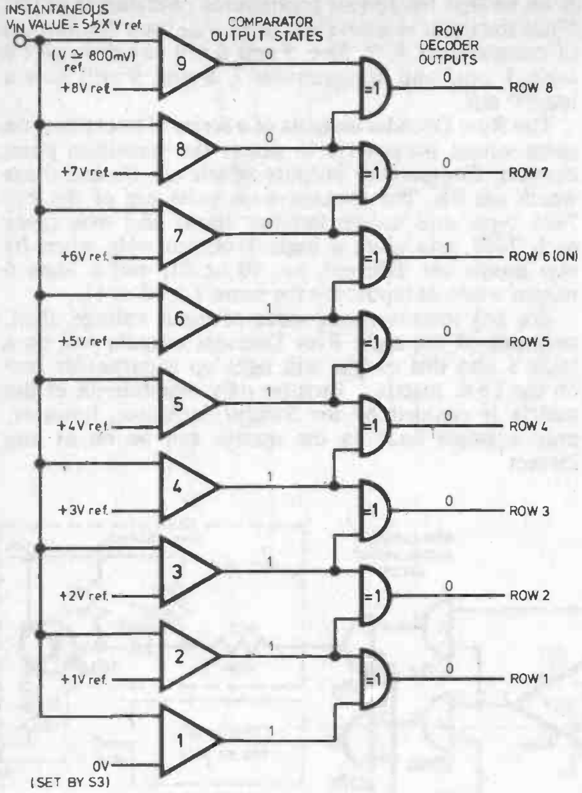


Fig. 3.2. Example of Y deflection logic operation

BLANKING GATES

The outputs of the Row Decoder drive the l.e.d. matrix via level shifting and gating circuits. The 7401 open collector NAND gates provide both the necessary inversion to interface with the *pnp* Row Driver transistors, and a common inter-trace blanking facility, which when driven low by the Trigger Latch output, disables all the Row Drivers so that the display is off. This facility is necessary because at the end of a single timebase sweep the timebase halts whilst awaiting another trigger pulse. The Sweep Generator would enable column 1 during this pause and would give an incorrect display.

ROW DRIVERS

The 8 *pnp* Row Driver circuits have a critical job to do since they have to switch the l.e.d. drive current as quickly as possible to allow good picture definition at high timebase speeds. The l.e.d. current is set by the 100 ohm resistor to about 30mA peak, and each Row Driver has to be able to switch this current in less than 100ns. General purpose silicon *pnp* transistors were used to achieve this performance in the prototype, but no doubt an improved performance could be achieved with a transistor optimised as a fast switch.

HORIZONTAL DEFLECTION

We have now followed the vertical deflection system from the Y-Amplifier to the Row Drivers, and now need to consider the remaining parts of the horizontal deflection system which follow the timebase system described last month. In a conventional oscilloscope, horizontal deflection is achieved by driving the X plates of the c.r.t. with a high voltage, linear, ramp waveform. This has the effect of moving the spot across the tube face from left to right during the linear rising ramp period, and causing it to return rapidly to the left during the fly-back period.

Since Digiscope does not employ an electron beam to drive its display the word "deflection" is really a misnomer, and in fact no high voltage ramp is necessary, only a simple binary counter and decoder. The rising ramp is simulated by the binary counter starting from zero and incrementing on each clock pulse until the terminal count is reached, and the flyback occurs as the counter returns to zero on the next clock pulse.

Initiation of the ramp is of course normally brought about by the triggering circuitry, and a similar operation takes place in Digiscope though with the advantage that no analogue circuitry is involved at all.

TRIGGER GENERATOR

Fig. 3.3 shows the core of the horizontal deflection circuitry, and the best place to start is with the Trigger Generator. The output from the Trigger Amplifier is a logic compatible positive edge coincident with a transition of the Y-Amplifier signal through a selected threshold level, and in a selected direction (positive or negative).

This positive going edge triggers a 74123 TTL monostable to give a very short, negative going pulse at its $\bar{Q}$ output which can be used to initiate a single horizontal sweep. The second monostable in the 74123 package is triggered by the output of its neighbour, although in this case the CR network is set to produce a long pulse. This second monostable is used to provide the important facility of auto-trigger.

AUTO-TRIGGER

This is a technique for ensuring that there is always a bright-line trace on the screen, even if there is no triggering signal available for synchronisation. This facility is useful because a reference trace is always displayed, allowing measurements of d.c. voltages and offsets to be made easily. The old way to achieve a bright trace in the absence of a signal was to allow the timebase to "free-run" and use the trigger signal to synchronise the timebase free-run frequency. This led to the exasperating phenomenon of "dodgy" triggering where the trigger sensitivity had to be painstakingly adjusted for each new signal waveform.

The problem was due to the fact that the timebase was basically a free running oscillator, and had to be coaxed into synchronisation, whereas with the Digiscope circuit the timebase is not allowed to free-run unless a suitably long time interval has elapsed since the last trigger pulse was received. Once the Digiscope Trigger Generator has switched to the free running mode then a single trigger pulse will cause it to switch back instantly to the triggered mode whereupon it will again wait for a period before reverting once more to the free-run mode if no further trigger pulses are received.

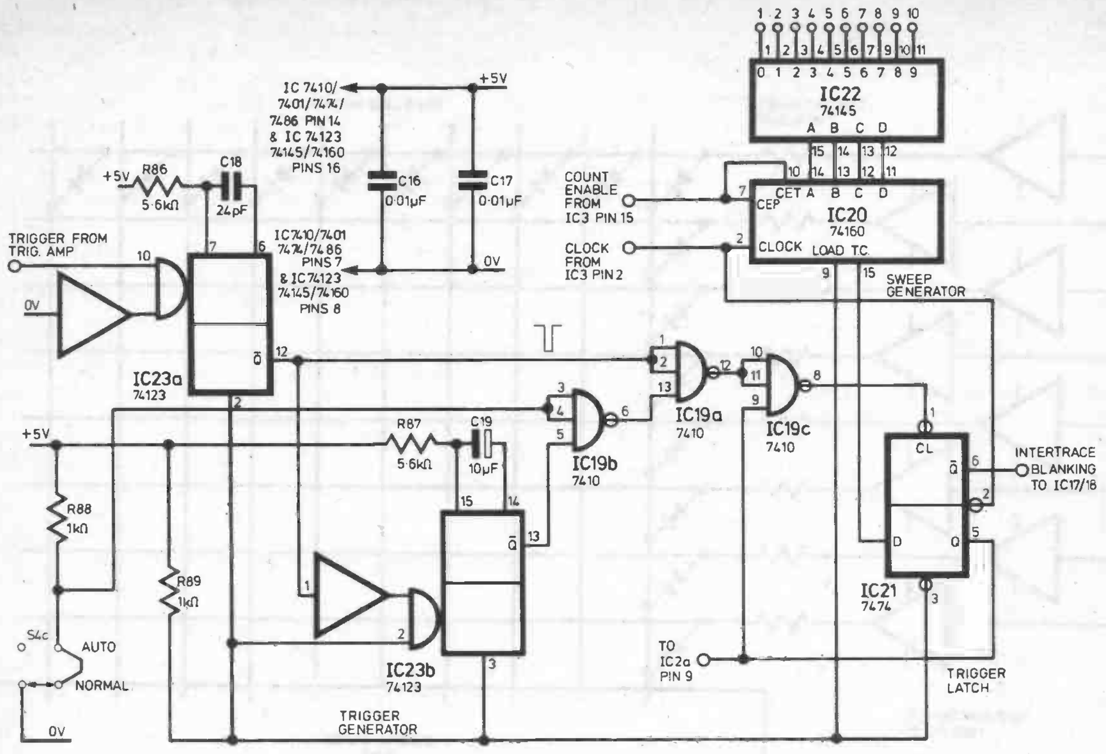


Fig. 3.3. Horizontal display circuitry

OPERATION

The length of period is set by the time constant of monostable IC23b, and the operation of this novel circuit can be followed with reference to Fig. 3.3.

When a normal input signal is present then each transition causes IC23a to be triggered to produce a single, narrow, negative-going output pulse which is presented to the input of IC19a and to IC23b. The time constant of IC23b is long, at about 40 milliseconds, so that an input frequency of greater than about 25Hz will cause this monostable to retrigger so that its $\overline{Q}$ output remains in the logic 0 state. The $\overline{Q}$ output is inverted by IC19b so that the second input to IC19a is a logic one and the trigger pulses from IC23a are allowed through to the Trigger Latch.

If the trigger pulses stop, or their frequency drops below about 25Hz then IC23a and IC23b are not triggered, although of course the $\overline{Q}$ output of IC23b cannot return immediately to a logic 1 because of its long time constant. When it does go to a logic 1 then the output of IC19a is forced to the logic 1 state, enabling IC19c and initiating another sweep by clearing the Trigger Latch. If no more trigger pulses are generated then IC19c remains enabled so that the Trigger Latch clears itself at the end of each sweep to give a virtual "free-running" timebase.

The circuit will remain in this state until further trigger pulses are detected so that a continuous trace is produced on the screen even with d.c. input signals.

TRIGGER LATCH

The Trigger Latch is a D type flip-flop and is normally set by the terminal count output of the SN74160 at the end of a sweep and cleared via IC19c on the receipt of a trigger pulse. The outputs of the Trigger Latch control both the Timebase Oscillator and the Blanking Gates as previously described.

SWEEP GENERATOR

The Sweep Generator consists of a 74160 synchronous TTL decade counter and a 74145 four line to ten line decoder driver. The clocking of the Sweep Generator is performed by the Timebase Oscillator and is enabled by the output of the Timebase Dividers giving a range of clock periods from 100ns to 10s depending on the control settings. The four line b.c.d. output from the counter drives the decoder inputs to give ten unique outputs per sweep to drive the ten column inputs of the l.e.d. matrix, each output remaining on for one clock period only.

After nine clock pulses the terminal count goes high to prime the Trigger Latch, and on the tenth clock pulse the counter returns to a count of zero and the Timebase Oscillator is gated off by the Trigger Latch until another sweep is initiated by a trigger pulse.

The 74145 decoder has ten high sink-current outputs and is ideal for driving the heavy load represented by the l.e.d. matrix drive current.

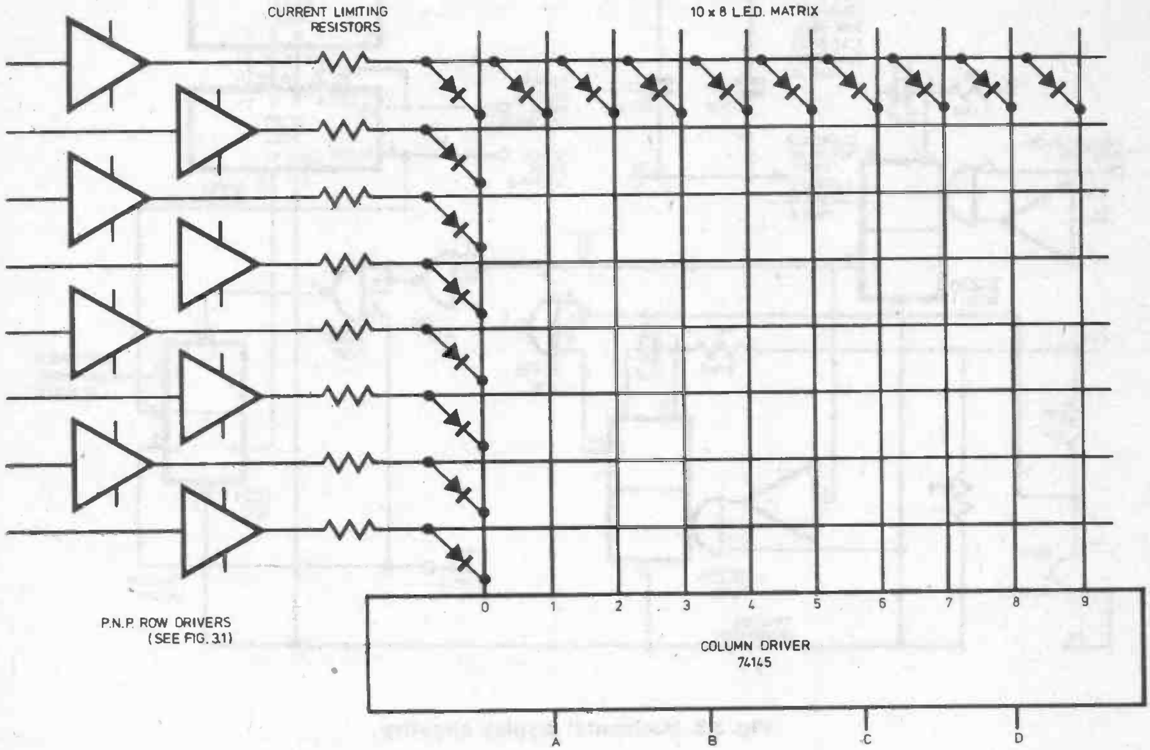
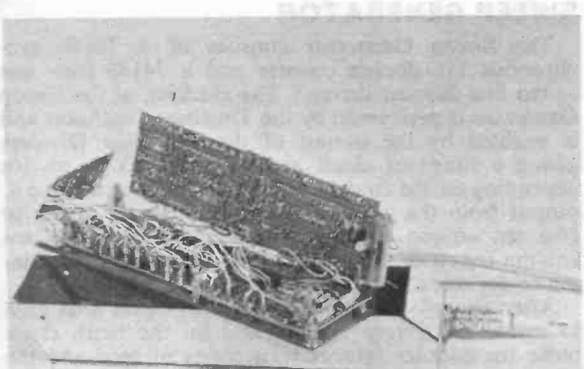


Fig. 3.4. Simplified display schematic

DISPLAY MATRIX

Fig. 3.4 is a simplified schematic of the l.e.d. display and its associated drives, and at this point it is possible to tie together the X and Y deflection systems to see how the display operates. The essential thing to remember is that at any instant, only one l.e.d. in the matrix can be on, and the particular l.e.d. required is selected by the intersection of a valid row drive and column drive. The Row Drivers are driven asynchronously by the Y input signal, and the Column Drivers are driven synchronously by the Timebase Oscillator so that the combination of these two drives results in a graph of the input signal being plotted, relative to time, on the points of the display matrix.



LOWER DECK CONSTRUCTION

The construction of the lower deck circuits follows the same pattern as the upper deck, and, as before, the use of fine connecting wire and miniature components is absolutely essential. Terminal pins were used extensively on this board, in particular to allow the distribution of power supply voltages via tinned copper wire buses on the upper side of the board, as shown in Fig. 3.5.

The outputs from the Reference Generator diodes are also terminated on pins, as are the main supply voltage inputs from the power pack. The minus 5V for the 710 comparator circuits is derived from the minus 12V rail by a resistor/Zener network mounted under the board near the main supply inputs, since there is little point in producing a separate minus 5V supply in the power pack when the current drain on this rail is so low.

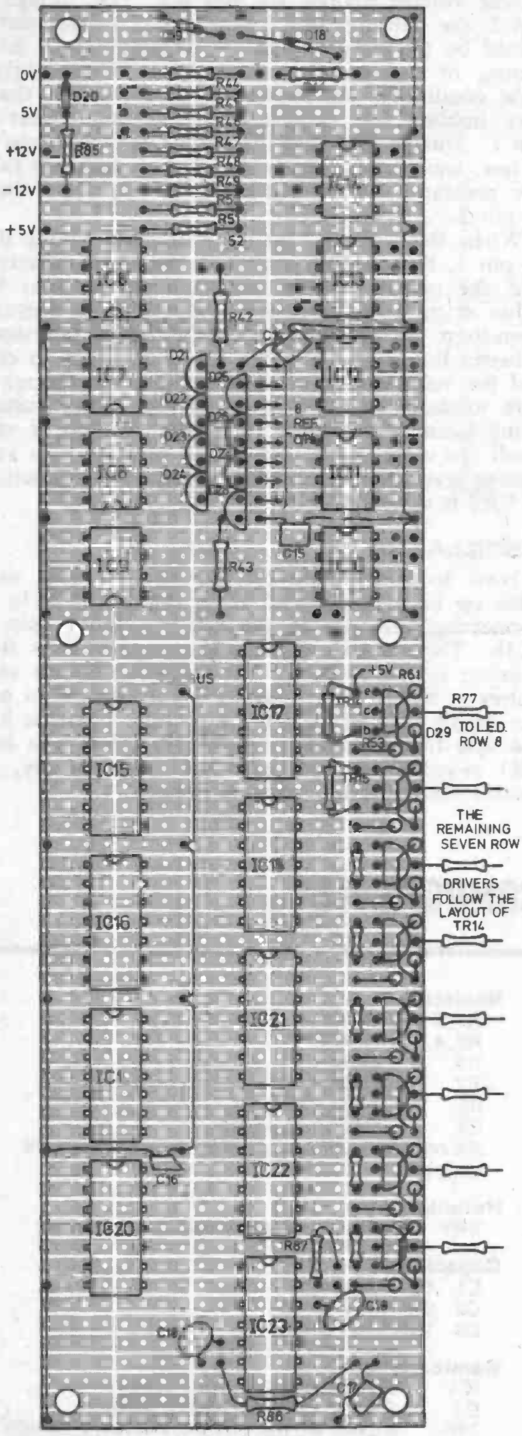


Fig. 3.5 Component layout of lower deck. For interwiring details reference should be made to the appropriate circuits

COMPONENTS . . .

Resistors

R41	560Ω
R42, R43	1·5kΩ
R44–R52	1kΩ
R53–R60	620Ω
R61–R68	820Ω
R69–R76	620Ω
R77–R84	100Ω
R85	100Ω
R86	5·6kΩ
R87	5·6kΩ
R88	1kΩ
R89	1kΩ

Capacitors

C14–C17	0·01μF ceramic
C18	24pF
C19	10μF elect 25V

Semiconductors

TR14*–TR21*	Any silicon *pnp* (plastic)
D18–D19	BZY88 5·6V 400mW Zener (2 off)
D20	BZY88 5·1V 400mW Zener
D21*–D28* (TR6–TR13)	2N2926 (8 off) (see text)
IC6–IC14	710 d.i.p. (9 off)
IC15–IC16	SN7486 (2 off)
IC17–IC18	SN7401 (2 off)
IC19	SN7410
IC20	SN74160
IC21	SN7474
IC22	SN74145
IC23	SN74123

The 710 circuits themselves can be obtained in a wide variety of package styles some of which are incompatible with the board layout so it is important to shop around for the correct type. The 8 pin mini-d.i.p. style was used in the prototype, coded N5710V from Signetics, but there is no real reason why the TO5 style package should not be used if you don't mind all the lead forming necessary to mate with the "square" hole matrix.

CIRCUIT TESTING

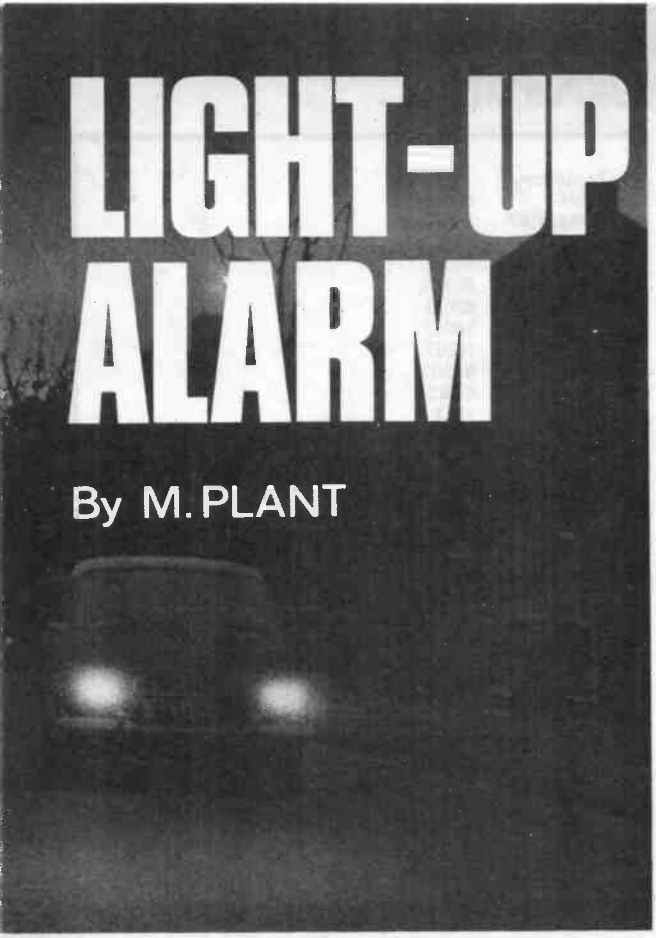
It is probably best to wait until the overall interconnections (to be detailed next month) are completed before testing the Trigger Generator, Trigger Latch and Sweep Generator, but the Reference Generator, Comparators and Row Decoder can be tested in isolation if desired. The lower end of TR13 should be connected to 0V (to simulate the d.c. level shift control) and voltage source variable between zero and about 8V should be connected between 0V and the left hand end of R41. (A variable power supply or a potentiometer could be used). With appropriate power supplies connected the voltage source can be adjusted while individual comparator outputs are observed with a multimeter.

The performance of the Comparator outputs should conform to the principles described in Fig. 3.2, and of course, using the same test set-up, the Row-Decoder outputs can be checked against this figure also.

Next month: Final construction and power supply details.

LIGHT-UP ALARM

By M. PLANT



THE "law" is becoming increasingly impatient with drivers who fail to switch on their lights soon enough during the approach of darkness or in conditions of poor daylight generally. Commercially-made units which provide an audible warning of lighting-up time are costly, but the circuit described below shows how to build a low-cost warning system which can be installed in the car simply and unobtrusively. The circuit provides the warning by flashing a lamp and is designed to stop flashing as soon as the lights are switched on.

CIRCUIT

The circuit uses a dual operational amplifier in integrated circuit form. This is the 747 type which contains two identical op amps of the common 741 variety. As a matter of interest, this dual op amp is good value for money since it can be bought for less than the price of two individual 741s. Note that the two op amps share the same negative supply connection but have independent positive supply pins. Otherwise the two internal circuits are quite separate from each other.

Fig. 1 shows how the two integrated circuit op amps are used to provide the alarm circuit. The dotted line divides that part of the circuit which responds to the failing daylight from that part designed to flash the warning lamp.

First the circuit employing IC1a. This is used to detect the sign of the voltage difference between the midpoints of the bridge of the four resistors VR1, R9, R1 and R2. The inverting input (pin 1) of IC1a is held at half the supply voltage by means of the voltage divider R1 and R2. The voltage at pin 2, the non-inverting input, is at a voltage determined by the resistance of the photocell for a given setting of the preset resistor VR1. Under bright light conditions, the resistance of R9 is low, therefore holding the voltage at pin 2 below that of pin 1. This ensures that the output voltage at pin 12 is low, usually just above 0V. But as darkness falls, the resistance of R9 increases, raising the voltage at pin 2.

When this voltage reaches a fraction above that at pin 1, the op amp amplifies the small difference and the output voltage rises sharply to near the value of the supply voltage. Since IC1a is operated open-loop, no feedback resistor being connected between the output and the inverting input to control the voltage gain of the amplifier, the change in light intensity required to make the output voltage swing from near zero to the supply voltage is very small. In other words, the circuit operates at a very precise level of light intensity. The required setting of VR1 is described later.

OSCILLATOR

Now to concentrate on the way IC1b is used. This op amp is powered from pin 12 of IC1a by connecting this pin to the positive supply pin of IC1b. This second op amp is connected as a free-running astable multivibrator providing square wave pulses at pin 10 varying from just above 0V to near the supply voltage. When the output voltage is low, the *npn* transistor TR1 is off, and when it is high TR1 switches on and lights the lamp. Briefly, the astable multivibrator works as follows.

COMPONENTS . . .

Resistors

R1, 2	470kΩ
R3, 4, 5	100kΩ
R6	33kΩ
R7	47kΩ
R8	100Ω ½W
R9	ORP12 or similar

All resistors ⅛W carbon 10% unless otherwise stated

Potentiometer

VR1 47kΩ min. preset for 0·1in matrix board

Capacitors

C1 10μF 25V elect.
C2 2·2μF 16V elect.
C3 100μF 16V elect.

Semiconductors

IC1	747 (SN72747, μA747C etc.)
D1	OA200, OA202, OA91, 1N4001 etc.
TR1	BC107, BC108, 2N2926, 2N3704, ZTX3000 etc.

Miscellaneous

LP1 6V, 60mA LES lamp and holder
0·1in stripboard 3in × 1·5in
5-way terminal block
Suitable case

If capacitor C1 is initially charged so that the voltage at pin 7 is higher than at pin 6, the output voltage is low. However, C1 will discharge through R6 so that the voltage at pin 7 decreases exponentially. When this voltage falls just below that at pin 6, the op amp immediately drives the output into positive saturation, thereby driving on TR1 causing LP1 to light. Capacitor C1 now begins to charge up through R6 and the voltage at pin 7 rises. When once again this voltage exceeds that at pin 6, the output voltage sharply drops to near zero and the cycle repeats. The repetition rate is determined by the value of C1 and all the values R3 to R6, decreasing for higher values of C1 and of R3, R4 and R6, but for lower values of R5. For the values indicated in the circuit diagram, the lamp flashes at a frequency of about 1·5Hz. The lamp used in the prototype was a generally available 6V, 60mA type in a lamp holder and lens and its voltage necessitated the inclusion of a 100 ohm resistor in series with it in the collector load of the transistor. Capacitor C2 in parallel with the photocell ensures that the side or headlights. This positive voltage at pin 7 ensures that capacitor C1 remains charged and the lamp remains off.

ASSEMBLY

As illustrated in Fig. 2, the circuit board can be a 30 × 14 hole 0·1in matrix stripboard. The components may be assembled in a different way to that shown, if their physical size necessitates this.

Once the components are soldered into place and excess component lead showing underneath removed, the stripboard should be cut in the places indicated. Leads are then taken out from this board to the terminal block as also shown in Fig. 2. Having decided where the unit is going to be firmly fixed in the car (e.g. behind the steering column), you must determine the length of leads required for the lamp and the photocell, the lamp being mounted preferably on the dashboard, and the photocell positioned somewhere near a window so that ambient light is caught by it. You should take care to make

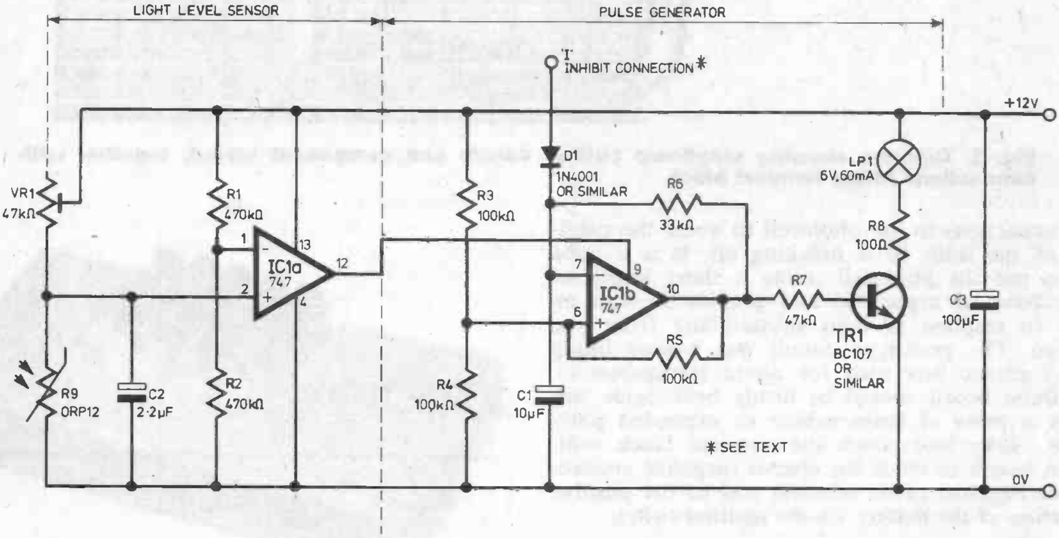


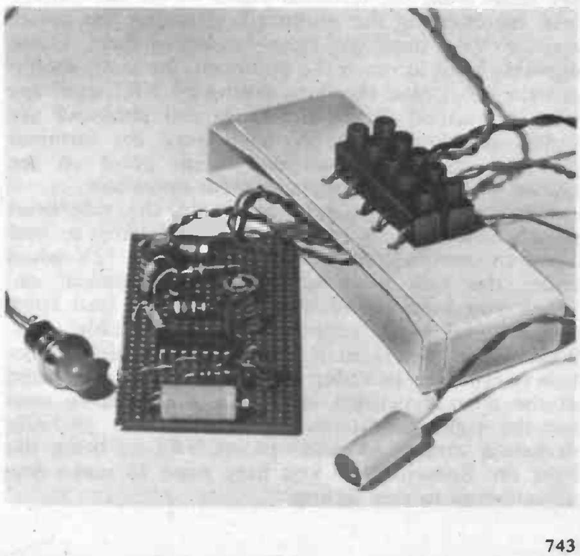
Fig. 1. Circuit diagram of the Car Light-up Alarm

the lamp is not momentarily switched on by sudden changes in light intensity. Capacitor C3 across the supply lines ensures that the operation of the circuit is immune to the effects of voltage spikes on the vehicle's electrical circuitry.

LAMP CONTROL

There are two methods for ensuring that the lamp ceases to flash as soon as the sidelights or headlights of the car are switched on. The first method requires that the photocell is positioned inside the lamp housing so that it becomes illuminated by the car's lights as soon as they are switched on. This arrangement, however, is only possible if the headlights are not of the sealed-beam type.

The second method relies upon the circuit being able to detect the rising voltage across the lamp which is being switched on. A diode D1 is connected as shown with its cathode to pin 7 and its anode to the switch terminal on the car rising from 0V to 12V when the switch is operated to bring on



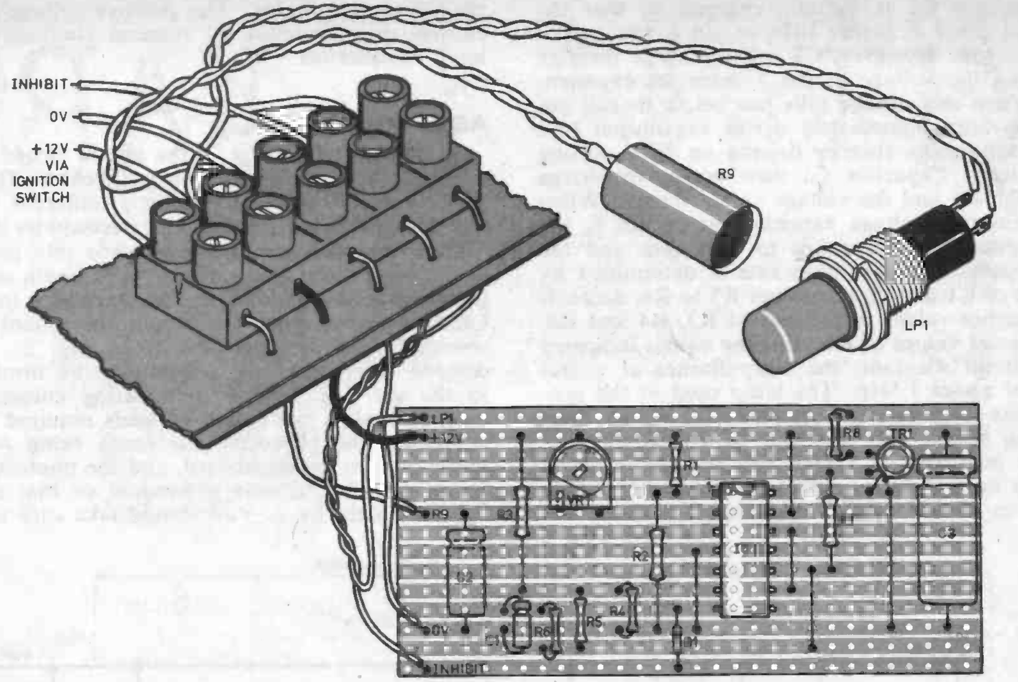
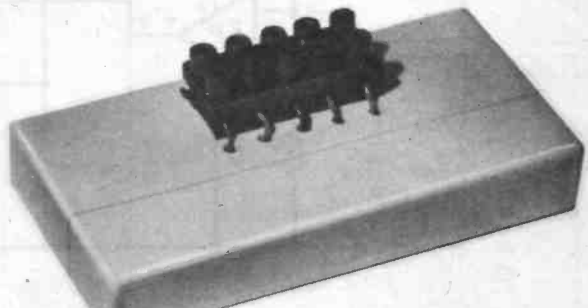


Fig. 2. Diagram showing stripboard cutting details and component layout, together with connections to the terminal block

firm connections to the photocell to avoid the possibility of the leads to it breaking off. It is a good idea to put the photocell inside a short length of plastic tube to protect it and provide it with an ability to respond to light substantially from one direction. The prototype circuit was housed inside a small plastic box used for photo transparencies. The circuit board should be firmly held inside this box by a piece of foam rubber or expanded polystyrene. Take leads from the terminal block sufficient in length to reach the chassis (negative connection for negative earth vehicles) and to the positive connection of the battery via the ignition switch.



INSTALLATION

The circuit should be tested by connecting the supply leads from the terminal block to the car battery and, by covering the photocell, adjusting the preset resistor VR1 until the lamp begins to flash. Upon allowing light to reach the photocell, the lamp should remain off. Leave the final setting of VR1 until the unit is installed. When the lamp and photocell are firmly positioned, the 0V lead from the terminal block is connected to a convenient point on the chassis of the car for negative earth operation.

You will need to gain access to the side/head switch and to use a voltmeter or 12V lamp to find a switch terminal which rises from 0V to 12V when either the side or head lamps are switched on. When you have found this terminal, the lead from the terminal block connected to the "inhibit" connection I is joined to it, ensuring that the connection is reliable. In order to set the circuit to respond at the correct twilight level you will need to wait for the right conditions (or drive into a partially darkened garage) in order to set VR1 to bring the light on. Subsequently you may need to make fine adjustments to this setting.

COMPONENT VALUES

Many of the components in the circuit are not critical although the values used in the prototype are listed. VR1 may range from 100kΩ to 22kΩ. R1 and R2 may each be 100kΩ or 220kΩ. C3 may be as high as 1000μF if room can be found for it but, to be effective, should not be less than the value listed. Simliarly, C2 may be as high as 220μF. D1 may be any general purpose silicon or germanium diode. The values of C1 and R6 are open to experiment since they determine, more significantly than the other components, the rate at which the lamp flashes. However, to obtain approximately the same flashing rate as in the prototype (about 1·5 per second), an increase of R6 to, say, 120kΩ requires C1 to be decreased to about 2·2μF. The transistor can be any medium current switching transistor capable of handling the maximum filament current of the lamp (i.e. about 100mA). Alternative transistors are listed. ★

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.

"HEADS-TAILS" INDICATOR WITH VARIABLE PROBABILITY

Numerous circuits have been published for "heads/tails" indicators, based on multivibrators. These usually consist of a gated astable multivibrator with a 1:1 mark to space ratio, running at a frequency such that individual states cannot be recognised during the gating period. The 1:1 mark to space ratio ensures equal probability of either state being achieved.

Many games use a random indication of one of two states, but require a weighting to be applied to these states such that there is *not* an equal probability of either state being achieved. An obvious though not very satisfactory way of achieving this uses an astable multivibrator with a variable mark to space ratio.

The circuit shown in Fig. 1 overcomes most of the difficulties and consists of three main blocks:
(a) A resettable binary counter with a decoded decimal output of 0–99. It uses two 7490s, each wired to divide by 10, the output from the first driving the second. The respective BCD outputs from each are decoded to a decimal form using two 7442s.
(b) A gated astable multivibrator using 3 of the 4 gates of an SN7400. The frequency of the 1:1 square wave output is controlled by the value of capacitor C1 (1nF produces a frequency of approximately 1 MHz).

Oscillation is achieved by the application of a logic 1 signal to the enable gate IC7c.
(c) The gating and parity detecting circuitry of IC6 (SN 7427) together with half of a D-type flip-flop (SN 7473), control the resetting of the BCD counters to zero, and the alternate enabling of two reset gates IC6a and b.

Assume that the "heads" probability is set to 40 and the "tails" probability to 60; the BCD counters IC1 and IC2 to zero (Q_A, Q_B, Q_C and Q_D all at logic 0) and the flip-flop ½IC5 with $\overline{Q}$ at 0 and Q at 1.

On applying a logic 1 signal to the enable input of the clock generator (IC7c) square wave pulses are applied to the A input of the first decade counter (IC1). The binary output is decoded to a decimal equivalent by the corresponding BCD decoder (IC3) and each 10th pulse passes to a similar counter (IC2) and decoder (IC4).

When the decimal output of IC4=4 and IC3=0 the output of IC6b goes from 0 to 1 (since all three inputs of IC6b are at 0). Any 1 at IC6c produces a corresponding change from 1 to 0 at its output. This produces two simultaneous effects.
(1) After inversion by IC7d the positive pulse resets both IC1 and IC2 to a binary equivalent of zero, and
(2) The negative-going pulse from the output of IC6c, applied to the clock input of IC5 reverses the states of the two outputs such that Q=0 and $\overline{Q}$=1. This has the effect of disabling the action of IC6b and enabling the action of IC6a.

The counting now continues in a similar fashion until the decimal output of IC3 and IC4 correspond to 0 and 6 respectively, when a similar sequence of events occurs except that the reset pulse is now derived from IC6a.

The net effect is that the Q and $\overline{Q}$ outputs of IC5 are alternatively switched on and off with a mark to space ratio of 6:4. Indication may be taken directly from the Q and $\overline{Q}$ outputs of IC5 using l.e.d.s or suitable lamp drivers.

No external reset for the 7490s or the 7473 are provided since the gating period is significantly longer than the clock period, and the states at switch on or at the end of a gating period will have little effect on the output obtained.

Dr M. J. Hacker,
Chirk, Clwyd.

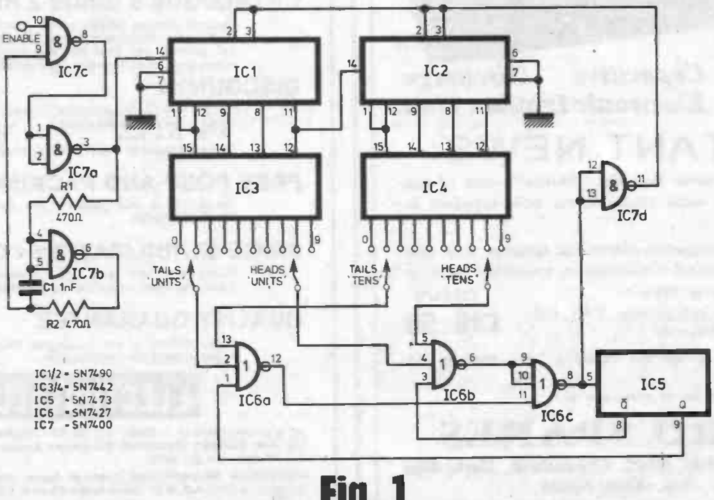


Fig. 1

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OAZ205	0·45
OAZ206	0·45
OAZ207	0·45
OAZ208	0·40
OAZ209	0·40
OAZ210	0·40
OAZ211	0·40
OAZ222	0·45
OAZ223	0·45
OAZ224	0·45
OAZ241	0·25
OAZ242	0·15
OAZ244	0·25
OAZ246	0·15
OAZ290	0·38
OC16	1·00
OC16T	1·00
OC22	1·00
OC23	1·25
OC24	1·10
OC25	0·40
OC26	0·40
OC28	0·75
OC29	0·65
OC30	0·40
OC35	0·75
OC36	0·60
OC41	0·35
OC42	0·40
OC43	0·70
OC44	0·20
OC44M	0·17
OC45	0·20
OC45M	0·18
OC46	0·27
OC57	0·60
OC58	0·60
OC59	0·60
OC66	0·50
OC70	0·18
OC71	0·25
OC72	0·28
OC73	0·50
OC74	0·30
OC75	0·30
OC76	0·30
OC77	0·54
OC78	0·25
OC79	0·30
OC81	0·29
OC81M	0·20
OC81DM	0·18
OC81Z	0·45
OC82	0·28
OC82D	0·25
OC83	0·60
OC84	0·30
OC114	0·38
OC122	1·00
OC123	1·10
OC139	1·00
OC140	1·14
OC141	0·80
OC169	0·20
OC170	0·30
OC171	0·30
OC200	1·00
OC201	1·50
OC202	1·50
OC203	1·25
OC204	1·50
OC205	1·75
OC206	1·10
OC207	1·00
OC460	0·20
OC470	0·30
OCP71	1·20
ORP12	0·60
ORP60	0·55
ORP61	0·48
SX68	0·20
SX631	0·45
SX635	0·55
SX640	0·75
SX641	0·75
SX642	0·60
SX644	0·85
SX645	0·85
TIC44	0·29
V15/30P	0·75
V30/201P	0·75
V60/201	0·50
V60/201P	0·75
XA101	0·10
XA102	0·18
XA151	0·15
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ZT43	0·25
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ZTX108	0·10
ZTX300	0·13
ZTX304	0·24
ZTX500	0·13
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INTEGRATED CIRCUITS	
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7403	0·16
7404	0·26
7405	0·22
7406	0·42
7407	0·42
7408	0·28
7409	0·28
7410	0·16
7411	0·25
7412	0·30
7413	0·36
7416	0·36
7417	0·36
7420	0·16
7422	0·25
7423	0·37
7425	0·87
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7428	0·40
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7442	0·79
7450	0·16
7451	0·16
7453	0·16
7454	0·16
7460	0·16
7470	0·36
7472	0·38
7473	0·41
7474	0·42
7475	0·59
7476	0·45
7480	0·60
7482	0·87
7483	1·10
7484	1·00
7486	0·47
7490	0·55
7491AN	1·00
7492	0·70
7493	0·70
7494	0·80
7495	0·80
7496	0·95
7497	3·87
74100	1·89
74107	0·45
74110	0·58
74111	0·86
74118	0·90
74119	1·68
74121	0·50
74122	0·70
74123	1·00
74141	0·90
74145	1·26
74150	1·75
74151	1·00
74154	2·00
74155	1·00
74156	1·00
74157	0·95
74170	2·52
74174	1·57
74175	1·10
74176	1·26
74190	2·00
74191	2·00
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SQUARE WAVE CONVERTER

THE circuit shown has been designed to add extra versatility to the Minisonic synthesiser by way of providing another waveform from the v.c.o.s.

This circuit converts the sawtooth waveform of the integrator to a pulse waveform by means of a differential comparator. The pulse waveform can be varied from very short, through square to a rectangular form; either by manual control or by voltage control. The switching between manual and voltage control proved beneficial when the synthesiser was being used for live performance work.

ICI is functioning as a differential comparator, the reference voltage level decides the wave shape. In normal operation the comparator is swinging between positive and negative saturation levels; diode D1 serves to clip off the negative cycle and D2 is present in order to attenuate the positive swing to around 0·6V. Capacitor C3 blocks any d.c. which might be present at the output of ICI.

C1 and C2 are necessary in order to prevent any ripple spreading to the v.c.o.s. Voltage control is provided by using an *n* channel f.e.t. as a voltage controlled resistor. IC2 is a simple buffer/summing amplifier with unity gain. Its function is similar to that of the control nodes in the v.c.o.s.

The circuit is simple to set up. With a high impedance voltmeter across VR2, VR1 is adjusted so that the potential is 350mV. The voltage control may be set up by applying a slow positive-going ramp from a v.c.o. and adjusting VR3 until the best effect is heard. The setting of VR4 will alter the minimum pulse length available.

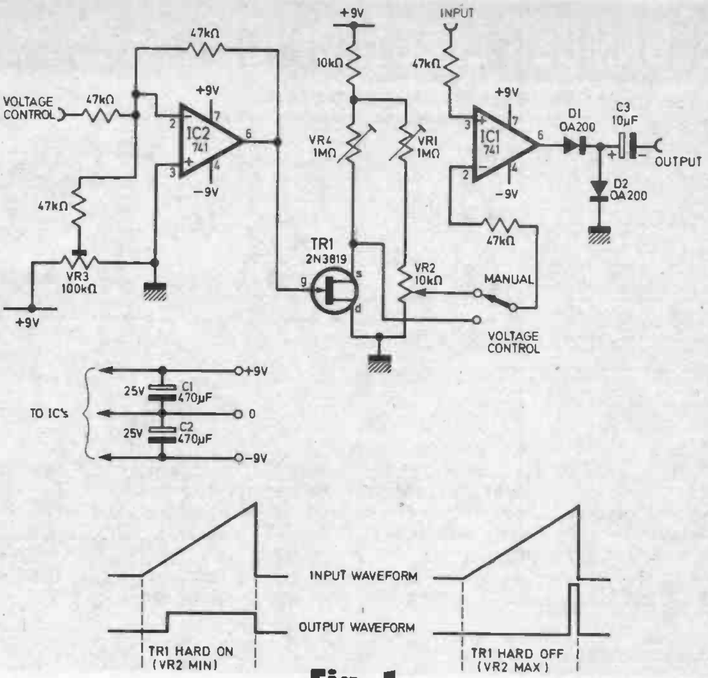


Fig. 1

By careful adjustment of these two presets, the waveform shapes that are shown may be obtained.

P. R. Symons,
East Acton,
London W.12.

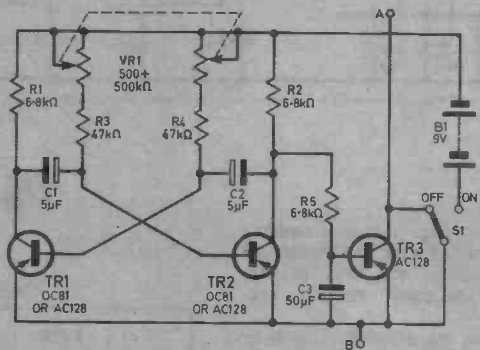
LIGHT PIPE CONTROLLER

THIS unit can be inserted into the circuitry of the Light Pipe. *Practical Electronics*, January 1975, with connection A attached to the collector of TR3 and connection B attached to pin 1 if IC1. The line connecting these two points must, of course, be broken.

With the unit OFF the Pipe runs normally, but with the unit ON the Pipe runs then freezes, runs then freezes, and so on. The speed control in the original design still controls the running speed of the Pipe, whilst this unit's VR1 controls the number of times that the Pipe starts and stops per minute.

Some experimenting may be necessary with R3 and R4 to get the correct start-stop speeds, as the gain of TR1 and TR2 will obviously vary from transistor to transistor.

Fig. 1



When the unit is OFF, S1 shorts out TR3 and also removes power from the unit.

S. J. Baxendale,
South Shields.

IMPROVED PHASER CONTROL

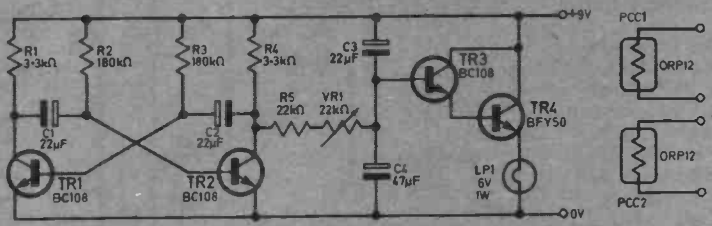


Fig. 1

HERE is an updated design prompted by the Phasing Control (Oct. 1974). This has several advantages over the original circuit. First of all it uses a 9V rail, also it uses fewer, but more-common components.

With the values shown, the circuit has a fixed frequency of 1 cycle per 8 secs. The capacitor C3 enables a fast start at switch on. To set up, adjust VR1 for a reasonable maximum minimum brightness. Since the impedance through VR1 is relatively high, this has no effect on the timing of the multivibrator.

Two things worth noting: TR4 gets hot, and since the unit uses 150mA of current it would be ludicrous to use a battery. A suitable mains unit would suffice as these can be bought for around £2.

Q. A. Rice,
Mitcham, Surrey.

3-CHANNEL SOUND-TO-LIGHT CONVERTER

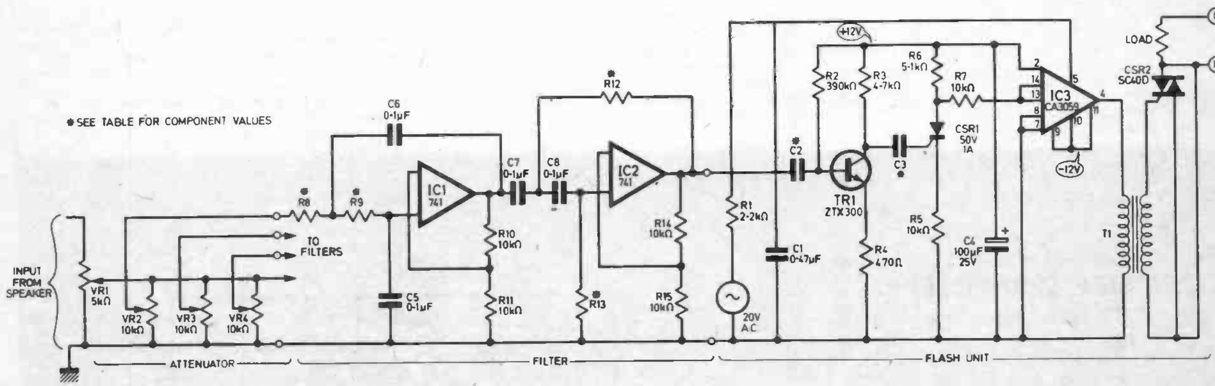


Fig. 1

THE circuit in Fig. 1 is a sound-to-light converter with 3 independent channels handling the low, middle and high frequency ranges respectively.

Signal from an amplifier speaker output is first passed through an attenuator (to allow accommodation of a wide range of input levels). Filters then divide the input into the three separate frequency ranges.

The filter outputs are then fed via an amplifying stage to the gate of CSR1 which is acting as a switch.

Table 1

	Low	Middle	High
R8, 9	12kΩ	3·3kΩ	820Ω
R12, 13	56kΩ	12kΩ	3·3kΩ
C2, 3	10µF	10µF	1µF

The CA 3059 provides an output pulse at the next zero crossing point of the mains after the thyristor is fired. No RFI supression is therefore required, as all switching is performed at the zero-crossing point.

The output pulse from the CA 3059 then fires the triac via the 1:1 pulse transformer T1.

Component values for the three filters are given in Table 1, the actual circuitry being the same for all three.

D. G. J. Kingsbury,
Soulby.

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Celestion MH1000 8 or 15 ohm	£13·50
Celestion C03K	£4·46
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EMI 13 × 8in 20W bass 8 ohm	£9·00
EMI 14 × 9in bass 8 ohms, 14A770	£11·92
EMI 8 × 5in, 10W, d/cone, roll surr.	£3·56
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EMI 8in roll surr. bass	£5·73
EMI 5in mid range	£3·50
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Goodmans 8P 8 or 15 ohm	£5·95
Goodmans 10P 8 or 15 ohm	£6·25
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Goodmans 12PG 8 or 15 ohm	£16·50
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Goodmans 15AX 8 or 15 ohm	£45·00
Goodmans 15P 8 or 15 ohm	£22·50
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Jordan Watts Module, 4, 8 or 15 ohm	£15·36
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Kef B110	£6·75
Kef B200	£7·85
Kef B139	£15·08
Kef DN8	£2·08
Kef DN12	£5·39
Kef DN13 SP1015 or SP1017	£4·05
Lowther PM6	£30·60
Lowther PM6 Mk 1	£32·85
Lowther PM7	£48·60
Peerless KO10DT 4 or 8 ohm	£7·25
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Peerless 2050	*pair*	39·50
Peerless 2060	*pair*	£53·00
Richard Allan Twin assembly	*each*	£13·46
Richard Allan Triple 8	*each*	£20·25
Richard Allan Triple 12	*each*	£25·16
Richard Allan Super Triple	*each*	£29·25
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Richard Allan RA82 Kit	*pair*	£59·40
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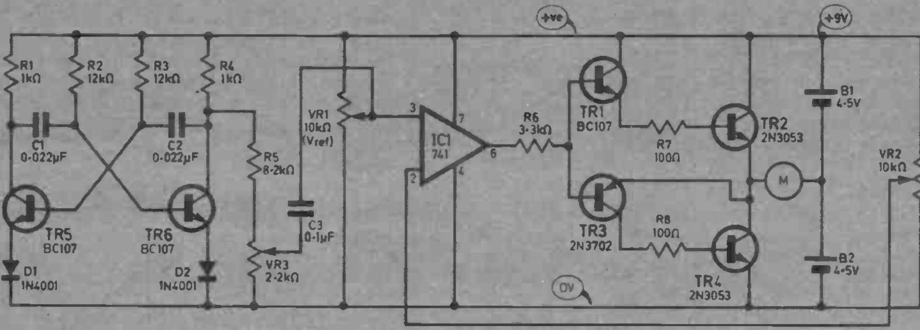

Fig. 1

THE circuit in Fig. 1 was originally constructed to control the X and Y axial travel of an X–Y recorder and has since found use as a servo unit for a radio-controlled car.

A voltage at pin 3 of IC1 between 0 and 10V will drive the motor via TR1 and TR2, or TR3 and TR4 and hence adjust the feedback pot VR2 until the slider voltage is identical to that on pin 3.

The purpose of TR5, TR6 and their associated components is to modulate the reference voltage at pin 3 with a 3kHz square wave, its amplitude being adjustable from zero to a few volts with VR3. This modulation effectively creates a "dead-band" region at the operating point of the servo; VR1 being adjusted for maximum positional resolution consistent with good damping.

A side effect of the modulation is that the motor tends to vibrate at the modulation frequency. This reduces hysteresis or stickiness that may be present.

The components as shown will drive any small motor up to a maximum current of about 1A.

J. D. Jardine,
Dewsbury.

CAR SIDELIGHT ALARM

How often have readers parked their cars and forgotten to turn off the sidelights, only to return to find the battery flat? This simple circuit can be used to sound a buzzer or to drive a multivibrator connected to a loudspeaker, to give an audible alarm when the ignition is switched off with the lights still on. A push button is provided to override the alarm should it be necessary to park the car with the sidelights on.

The alarm is driven from the sidelight circuit via relay contacts RLA1 and RLB1. When the ignition is on, relay RLA is operated disabling the alarm. Switching off the ignition releases RLA and contact RLA1 closes to sound the alarm. RLA2 makes which allows the override circuit to operate. If the sidelights must be left on, then, pushing S1 will operate relay RLB. RLB1 opening breaks the alarm circuit and RLB2 holds RLB operated.

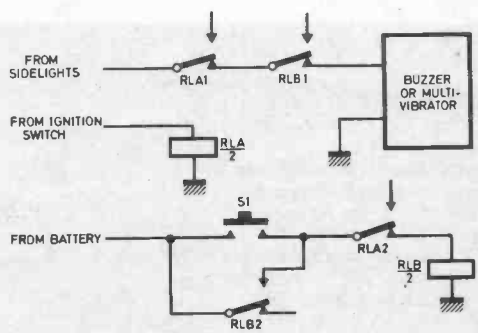

Fig. 1

The next time the ignition is turned on RLA operates, thus releasing RLB. This gives the driver the protection of not leaving the alarm overriden by mistake.

The type of relay used is not critical, except that both relays RLA and RLB should be 2 pole changeover types.

M. Spendley,
Arnos Grove.

REAR WINDSCREEN WIPER CONTROLLER

This circuit makes use of the well known NE 555V timer chip in an astable mode of operation.

Potentiometer VR1 is linked to S1a and S1b and provides on/off and varies the delay between sweeps (between continuous operation and up to two minutes is available with values shown). VR2 controls the time the relay is closed and therefore the length of the wiper sweep. Careful adjustment of VR2 gives a uniform sweep and a self-parking facility.

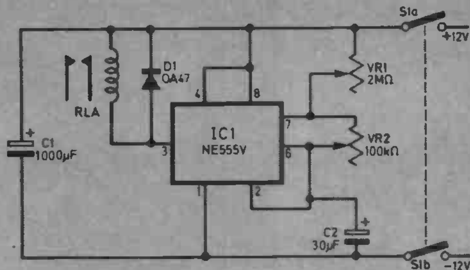

Fig. 1

The circuit is contained in a small box approx. 4in wide 2½in high and 1½in deep, and can be used in negative or positive earthed cars according to relay contact connection.

G. T. McDermid,
Ramsbottom.

CAR SEAT-BELT ALARM

Now that it is almost law that you and your front seat passenger wear seat-belts, this circuit was devised to provide a reminder to "Clunk, click every trip". It is loud and shrill in operation so it cannot be ignored, is cheap to build and consumes only 100mA when ON and only 300μA when OFF (at 15V).

The circuit consists of a two transistor oscillator (multi-vibrator) TR1 and TR2, a one transistor amplifier TR3 and a switch TR4. The reed switch is of the normally open type and the speaker is an ex-t.v. 3Ω type. The unit will run on a flat car battery with reduced volume. The reed switch is taped or glued to the buckle unit and a small but powerful magnet is similarly secured to the belt tongue. A seat switch is useful to stop the alarm sounding when working on the car with the ignition on.

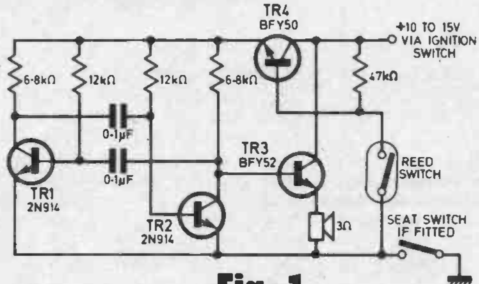

Fig. 1

If both front seats are to be equipped, a seat switch (normally closed) and a reed switch (normally open) should be fitted to the passenger seat. These two switches should be connected in parallel and wired in series with the driver's reed switch.

A. R. Knight,
Blackbird Leys,
Oxford.

CAR-CASSETTE POWER SUPPLY

The unit shown here was designed to run a cassette tape recorder in a car. Diode D1 protects the circuit against wrongly connected supply lines. A reference voltage provided by R1/D2 controls the series transistor TR1. C1 removes any noise that may be generated by D2, while C2 deals with any spurious signals at the output.

Overload protection is provided by means of R2/TR2. Because the load current is flowing through R2 there is potential difference across it. Once this p.d. exceeds 0·6V TR2 will begin to conduct. This will turn off the series transistor TR1 by diverting its base current to the negative line, and the output voltage will fall to zero. Once the overload is removed, the supply will return to normal.

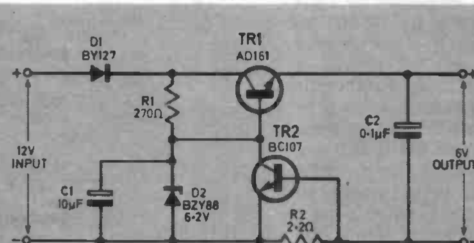

Fig. 1

The voltage rating of D2 can be chosen to suit the voltage of the cassette player. A 6·2V zener will provide an output of six volts.

G. Luck,
Gosport,
Hants.

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4021/14021	0·85	4052/14052	0·80	4096/—	0·90	14516/4516	1·15	14561/—	0·55
4022/14022	0·80	4053/14053	0·80	4097/—	3·10	14517/—	3·35	14562/—	4·65
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4024/14024	0·65	4055/—	1·10	4099/—	1·55	14519/4019	0·45	14568/—	2·60
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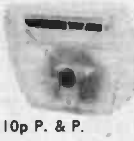

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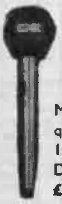

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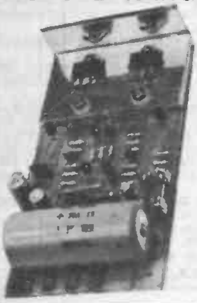

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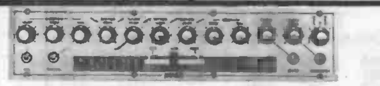

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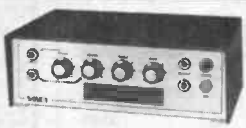

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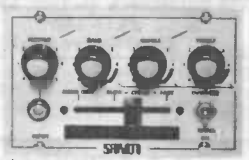

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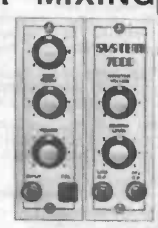

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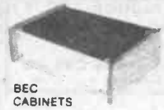

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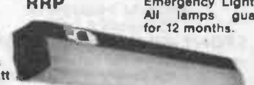

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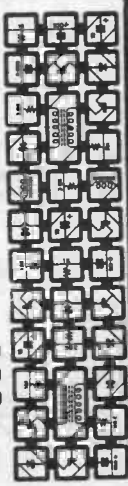

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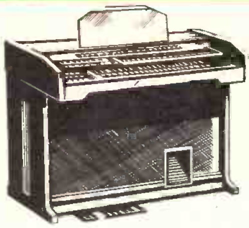

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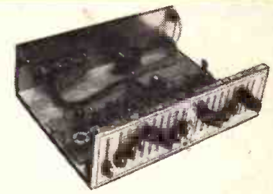

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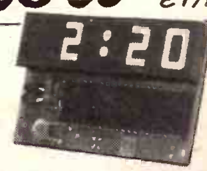

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