PRACTICAL

ELECTRONICS

DECEMBER 1977

45p



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FEED THROUGH CAPACITORS 100μF 350V 8p SN76023N SN76033N SN76033N SN76115N SN76227N TAA621AXI TAA621AXI TAA950 TAY-1-1313 TAY-3-8550* TBA1203 TBA550Q TBA650Q TBA650Q TBA651 TBA1208 215 175 228 CMOS ± 4000 15 4001 17 4002 17 4006 105 4007 18 4010 58 4011 58 4011 55 4015 99 4019 60 4020 102 ELECTROLYTIC CAPACITORS: Axial lead type (Values are in µF) 63V: 0.47, 1.0, 1.5, 2.2, 2.5, 3.3, 4.7, 6.8, 8, 10, 15, 22 9p; 47, 32, 50 12p; 63, 100 27p; 50V: 100 7p; 50, 100, 220 25p; 470 50p; 1000, 2200 68p; 40V: 22, 33 pp; 100 12p; 330, 470 32p; 1000 49p; 25V: 10, 22, 47 6p; 80, 100, 160 8p; 220, 250 13p; 470, 640 25p; 1000 27p; 1500 30p; 200 34p; 3300 52p; 4700 54p; 16V: 10, 40, 47, 68 7p; 100, 125, 8p; 470 16p; 1000, 1500 20p; 2200 34p; 10V: 4, 100 6p; 640 10p; 1000 14p. TAG-END TYPE: 70V: 2000 98p; 4700 121p; 50V: 3000 75p; 40V: 4000 70p; 2500 65p; 25V: 4700 48p; 2000 37p; 40V: 2000 + 2000 95p; 325V: 200 + 100 + 50 + 100 190p. 4076 4077 4078 4081 4082 4502 4507 4510 4511 4512 4516 4519 4520 4528 4532 4532 4585 155 353 300 660 750 90 220 355 105 18 58 58 19 18 55 93 52 99 99 60 102 85 176 143 118 75 75 140 82 80 7450 168 LM308 98 LM318 125 LM379 102 LM380 59 LM381 108 LM382 99 LM3900 127 LM3909N 110 M252AA * 74**5**3 250 180 POTENTIOMETERS (A8 or EGEN) Carbon Track, ½W Log & ½W Linear valu 1KΩ & ZKΩ (IIIn only) Single gang 5KΩ-2MΩ single gang D/P switch 5KΩ-2MΩ dual gang stereo OPTO ELECTRONICS * LEDS - clip Tit.209 Red . 125" 13 Tit.211 Gm . 125" 24 Tit.212 Yellow . 125" 27 2" Red 17 TANTALUM 8EAD CAPACITORS 35V: 0.1μF, 0.22, 0.33, 0.47, 0.68 1.0, 2.2μF, 3.3, 4.7, 6.8 25V: 1.5, 10 20V: 1.5 16V: 10μF 13μ each. 10V: 2.2μF, 3.3, 47 6V: 47, 68, 100, 20γ: 68, 100μF 20μ each TBA800 TBA810S TBA820 90 65 TBA9200 70 TDA2020 750 ZN414 795 ZN424 225 116 116 2" Red 2"Amber Green MYLAR FILM CAPACITORS 100V: 0.001, 0.002, 0.005, 0.01μF 5p 0.015, 0.02, 0.04, 0.05, 0.056μF 6p 0.1μF 0.15, 0.2 7p, 50V: 0.47μF 10p SLIDER POTENTIOMETERS Yellow OCP70 ORP12 2N5777 TRANSISTORS 0-25W log and linear value 5K Ω-500K Ω single gang 10K Ω-500K Ω dual gang 70p 80p 20p OC46 ± OC70 ± OC71 ± OC72 ± OC79 ± OC81 ± OC82 ± OC82 ± OC83 ± OC84 ± AC117 AC125 * AC126 * AC127 * AC128 * 12 BF198 14 BF200 BF2200 BF224A 11 BF258* 16 BF258* 16 BF258* 16 BF258* 16 BF258* 10 BF594 10 BF595 10 BF894 11 BF895 10 BF894 11 BF896 12 BF840 11 BF8780 42 BF888* 11 BF8780 43 BF888* 11 BF8780 44 BF888* 11 BF8780 45 BF751* 46 BF751* 47 BF751* 48 BF751* 49 BF751* 49 BF751* 41 BF751* 45 BF752* 45 BF751* 45 BF752* 45 BF751* 45 BF752* 45 BF751* 46 BF752* 47 BF771 48 BF888* 49 BF751* 49 BF751* 40 BF751* 41 BF888* 41 BF752* 45 BF751* 46 BF752* 47 BF771 48 BF752* 48 BF751* 49 BF751* 49 BF751* 40 BF751* 41 BF752* 42 BF751* 43 BF752* 45 BF751* 45 BF751* 46 BF752* 47 BF771 48 BF752* 48 BF752* 49 BF752* 49 BF752* 49 BF752* 49 BF752* 49 BF752* 49 BF752* 40 BF752* 40 BF752* 41 BF752* 42 BF753* 43 BF752* 44 BF752* 45 BF771 46 BF752* 47 BF771 47 BF772* 48 BF772* 49 BF772* 40 BF772* 40 BF772* 40 BF772* 41 BF772* 41 BF772* 42 BF772* 43 BF772* 44 BF772* 45 BF772* 46 BF772* 47 BF772* 47 BF772* 47 BF772* 47 BF772* 48 BF772* 48 BF772* 49 BF772* 49 BF772* 49 BF772* 40 BF7 2 N3702 2 N3703 2 N3704 2 N3705 2 N3706 2 N3707 2 N3709 2 N3711 2 N3711 2 N3715 2 N3772 2 N3773 2 N3819 2 N3820 2 N3823 2 N3824 2 N38266 188 300 18 18 500 29 22 24 400 38 38 28 28 28 28 28 130 24 28 8 130 17 17 17 18 18 18 1400 18 15 55 158 90 120 45 80 35 30 30 76 76 28 45 35 48 25 28 25 58 35 21 39 50 19 50 19 32 27 30 51 18 10 11 10 ZTX531 ZTX550 CERAMIC CAPACITORS: 50V Self Stick Graduated Bezels 7 Seg Displays 71.312 C An 3" 71.313 C Cth 3" 71.321 C An 5" 71.322 C Cth 5" DL.704 C Cth DL707 CA .3" DL747 CA .6" 3p each 4p each 6p ZTX550 2 N526 ± 2 N696 ± 2 N697 ± 2 N698 ± 2 N699 ± 2 N707 ± 2 N708 ± 2 N916 ± 2 N916 ± 2 N920 ± 2 N930 ± 2 N961 ± 2 N91131 ± 0.5pF to 10nF 15nF, 22nF, 33nF, 47nF 0.1µF PRESET POTENTIOMETERS 10 10 11 11 16 12 250 170 288 22 AC128* AC141* AC141K* AC142* AC142K* AC176* AC187* AC188* ACY17 0-1W 50Ω—5MΩ Miniature Vertical & Horizontal 0-25W 100Ω—3-3MΩ Horiz 0-25W 200Ω—4-7MΩ vert POLYSTYRENE CAPACITORS 10pF to 1nF 6p; 1.5nF to 10nF 10p SILVER MICA (Values in pF) 3-3, 4-7, 6-8, 10, 12, 18, 22, 33, 47, 50, 68, 75, 82, 85, 100, 120, 150, 220 9p each 250, 300, 330, 360, 390, 600, 820 16p each FND 357 DRIVERS 75491; 75492 RESISTORS – Erie måke 5% Miniature High Stability, Low CC139... 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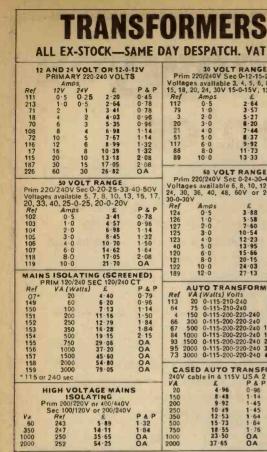
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Our January issue will be on sale Friday, 9 December, 1977 (for contents see page 245)

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		e 3, 4, 5, 6, 8	
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Ref	Amps	£	P&P
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79	1.0	3.57	0-96
3	2.0	5.27	0.96
20	3.0	6-20	1-14
21	4.0	7-44	1-14
51	5.0	8-37	1.32
117	6.0	9.92	1.45
88	8.0	11.73	1-64
89	10.0	13-33	1.84

89	10.0	13-33	1.84
	60 VO	LT RANGE	
Prim		ec 0-24-30-40	-48-60V
		e 6, 8, 10, 12,	
		3. 60V or 24	
30-0-30			
Ref	Amps	£	PAP
124	0.5	3.88	0.96
126	1.0	5 - 58	0.96
127	2.0	7.60	1-14
125	3.0	10-54	1 - 32
123	4.0	12-23	1.84
40	5.0	13.95	1 - 64
120	6.0	15-66	1.84
121	8.0	20-15	OA
122	10-0	24.03	OA
189	12-0	27-13	OA
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4	20	4.96	0-96	113W
4	150	8 - 48	1-14	4 W
ł	200	9.92	1-45	65W
ł	250	10.49	1 · 45	69W
Ť	350	12-53	1-64	53 VV
н	500	15-73	1.64	67W
н	750	18 - 55	1.76	83W
1	1000	23-50	OA	84 VV
1	2000	37-65	OA	95W

SCREENED MINIATURES

MA Volts
200 3-0-3 1 99
1A, 1A 0-6, 0-6 2-5
100 9-0-9 2 14
330, 330 -99, 0-9 2-9
500, 500 0-8-9-, 0-8-9 2-59
200, 200 0-15, 0-15
200, 200 0-15, 0-15
200, 200 0-15-20-0-12-20
1A, 1A 0-15-20-0-15-27
300, 300 0-15-20-0-15-27
300, 300 0-15-20-0-15-27
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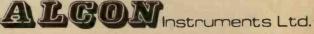
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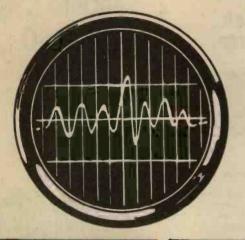
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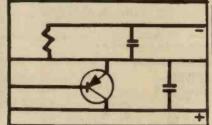


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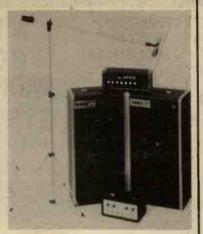
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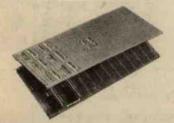
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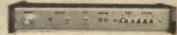
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15-24

Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier

FEATURES: complete pre-amplifier in single pack; multi-function equalisation; low noise; low distortion; high overload; two simply combined for stereo.

APPLICATIONS: hi-fi; mixers: disco; guitar and organ; public address.

SPECIFICATION: Inputs-magnetic pick-up 3mV; ceramic pick-up 30mV; tuner 100mV; microphone 10mV; auxiliary 3-100mV; input impedance 47kΩ at 1kHz. Outputs—tape 100mV; main output 500mV R.M.S. Active Tone Controls—treble ±12dB at 10kHz; bass ±12dB at 100Hz. Distortion—0.1% at 1kHz; signal/noise ratio 68dB. Overload-38dB on magnetic pick-up. Supply Voltage- ± 16-50V. Price £5.22 + 65p VAT. P. & P. free

HY5 mounting board B.1. 48p + 6p VAT. P. & P. free

HY30 15W into 8Ω

The HY30 is an exciting New kit from I.L.P. It features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of: I.C., heatsink, P.C. board. 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up to date technology available.

FEATURES: complete kit: low distortion: short, open and thermal protection: easy to build APPLICATIONS: updating audio equipment: guitar practice amplifier: test amplifier: audio oscillator. SPCEIFICATION: Output Power—15W R.M.S. into 8Ω. Oistortion—0:1% at 15W. Input Sensitivity—500mV. Frequency Response—10H2-16H4z –3dB.

Price £5-22 + 65p VAT. P. & P. free

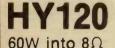
HY50 25W into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World. FEATURES: low distortion: integral heatsink; only five connections: 7 amp output transistors; no

external components.

APPLICATIONS: medium power hi-fl systems: low power disco; guitar amplifler SPECIFICATION: Input Sensitivity—500mV. Output Power—25W R.M.S. Into 8Ω. Load Impedance—4-16Ω. Distortion—0.04% at 25W at 1kHz. Signal/Noise Ratio—75dB. Frequency Response—10Hz-45kHz - 3dB. Supply Voltage—±25V. Size—105 × 50 × 25mm.

Price £6.82 + 85p VAT. P. & P. free



The HY120 is the baby of I.L.P.'s new high power range, designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: very low distortion: integral heatsink; load line protection: thermal protection: five

connections on external components.

APPLICATIONS: hi-fl; high quality disco: public address: monitor amplifier: guitar and organ.

SPECIFICATIONS: hi-fl; high quality disco: public address: monitor amplifier: guitar and organ.

SPECIFICATION: input Sensitivity—S00mV. Output Power—60W R.M.S. Into 8ft. Load Impedance—4-16ft. Distortion—0-04% at 60W at 1kHz. Signal/Noise Ratio—90dB. Frequency Response—10Hz-45kHz -3dB. Supply Voltage—±35V. Size—114 x 50 x 85mm.

Price £15-84 + £1-27 VAT. P. & P. free

HY200 120W into 8Ω The HY200 (now improved to give an output of 120 watts) has been designed to stand the most rugged conditions such as disco or group while still retaining true FEATURES: thermal shutdown; very low distortion; load line protection; integral heatsink; no external

components.
APPLICATIONS: hi-fi; disco: monitor; power slave; industrial; public address.
SPECIFICATION: Input Sensitivity—500mV. Output Power—120W R.M.S. Into 8Ω. Load Impedance—4–16Ω. Distortion—0-05% at 100W at 1kHz. Signal/Noise Ratio—96dB. Frequency Response—10Hz–45kHz – 3dB. Supply Voltage—±45V. Size—114 x 50 x 85mm.

Price £23 - 32 + £1 - 87 VAT. P. & P. free

HY400 240W into 4Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco or public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: thermal shutdown: very low distortion: load line protection: no external components. APPLICATIONS: public address: disco: power slave: Industrial. SPECIFICATION: Output Power—240W R.M.S. into 4Ω. Load Impedance—4-16Ω. Distortion—0-1% at 240W at 1kHz. Signal/Noise Ratio—94dB. Frequency Response—10Hz-45kHz—3dB. Supply Voltage —±45V. Input Sensitivity—500mV. Size—114 x 100 x 85mm.

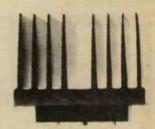
Price £32-17 + £2-75 VAT. P. & P. free

POWER SUPPLIES: PSU36—suitable for two HY30s £5-22 + 65p VAT. P. & P. free. PSU50—suitable for two HY50s £6-82 + 85p VAT. P. & P. free. PSU30—suitable for two HY120s £13-75 + 1-10 VAT. P. & P. free. PSU30—suitable for one HY200 £12-65 + £1-01 VAT. P. & P. free. PSU30—suitable for two HY200s or one HY400 £23-10 + £1-85 VAT. P. & P. free.

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0-1mA	1305	£5.75
0-50V	1306	€5.75

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Size 21 x	1} × 1} in	
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0-500µA	1309	£4.50
0-1mA	1310	€4.50
0-50V	1311	£4.50

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0-1mA	1315	€4.95

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No.	Price
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Vu METER

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No.	Price
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AU110 C1 00 BC2440 C0 30 BFX29 C0 25 TIP32A C0 49 2N3615 C0 90 40347 C0 65 1 AU113 C1 00 BC441 C0 30 BFX30 C0 30 TIP328 CD 51 2N3616 C0 90 40347 C0 65 BC107A C0 08 BC461 C0 30 BFX84 C0 23 TIP328 CD 53 2N3646 C0 09 40360 C0 36 BC107B C0 08 BC461 C0 30 BFX85 C0 24 TIP328 CD 53 2N3646 C0 09 40360 C0 36 BC107B C0 08 BC477 C0 20 BFX86 C0 25 TIP41A C0 51 2N3703 C0 08 40362 C0 38 BC107B C0 08 BC478 C0 20 BFX87 C0 22 TIP41B C0 51 2N3703 C0 08 40362 C0 38 BC108B C0 08 BC478 C0 20 BFX87 C0 22 TIP41B C0 51 2N3703 C0 08 BC478 C0 20 BFX87 C0 22 TIP42B C0 53 2N3705 C0 07 40407 C0 35 BC108B C0 08 BC457 C0 20 BFX87 C0 25 TIP42B C0 53 2N3705 C0 07 40407 C0 35 BC108C C0 08 BC547 C0 21 BFX89 C0 25 TIP42B C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 08 BC547 C0 21 BFX89 C0 55 5 TIP42B C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 08 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC547 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 C0 07 40407 C0 35 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 21 BFX89 C0 55 2N3705 BC108C C0 8 BC47 C0 8 BC47 BC108C C0		DC33/ 10-15				
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GUITAR EFFECTS PEDAL (P.E. July 75)
Modulates the attack, decay and filter characteristics of an audio signal not only from a guitar but from any audio source, producing 8 different switchable effects that can be further modified by manual controls. Possibly the most interesting of all the low-priced sound effects units in our range. Circuit does not duplicate effects from the Guitar Overdrije Lint.

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A multi-purpose sound controller, the functions of which include envelope shaper, tremolo, voice-operated fader, automatic fader and frequency-doubler.

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PHASING CONTROL UNIT (P.E. Oct. 74)
For use with the above Phasing Unit to automatically control the rate of phasing.
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14-48

SOPHISTICATED PHASING AND VIBRATO UNIT
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automatic control over the rate of phasing and vibrato. Printed circuit board

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The Wah-Wah effect produced by this unit can be controlled manually or by the integral automatic controller.
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AUTOMART UNIT (P.E. Mar. //)
Automatically produces Wah-pedal and Swell-pedal sounds
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C4-83

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A modified and extended version of the circuit published.
Details in list.

SEE OTHER PAGE FOR KEYBOARDS, AND OUR LISTS FOR OTHER COMPONENTS AND ACCESSORIES STOCKED

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A manually controlled unit for producing the above-named Component set (incl. PCB)

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Component set (incl. PCB)

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Based upon P.E. "Sound Design" circuit.
Component set (incl. PCB)

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The depth of boost is manually adjustable.
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This unit has its own voltage controlled amplifier and has full manual control over attack, decay, sustain and release functions.

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Printed Circuit board

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LIST—Send stamped addressed envelope with all U.K. requests for free list giving fuller details of PCBs, kits and other components.

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13p 12p 12p 25p 14p 14p

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BC149 BC157 BC158 BC159

BC159 BC182L BC184 BC187 BC204 BC209C BC212L BC213 BC478 BCY71 BD131

BD132 BFY50

BFY51 BFY52 BSY95A MD8001

MD8001 OC28 OC71 OC72 OC84 ORP12 ZTX107 ZTX108 ZTX501 ZTX503 ZTX503

KEYBOARDS AND CONTACTS

KEYBOARDS AND CONTACTS
Kimber-Allen Keyboards as fequired 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 sluminium frame.

3 Octave (37 notes) £25-50. 4 Oct (49 notes) £32-25. 5 Oct (61 notes) £39-75.
Contact Assemblies for use with above keyboards: Single-pole change-over (type SP) 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. See our list for other contacts.

Contact	Each	3 Octave Set	4 Octave Set	5 Octave Set
SP	24p	88-83	£11.76	£14-64
2P	27p	£ 9-99	£13·23	£16-47
4PS	53p	£19·61	£25.97	£32 · 33

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

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ardiophone etc.

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709
705
709, 8-pin DIL
723
TO5
741
8-pin DIL
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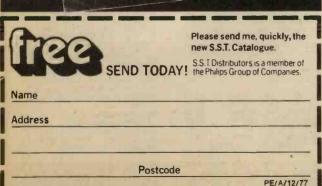
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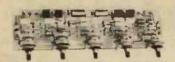
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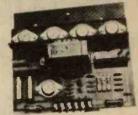
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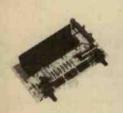
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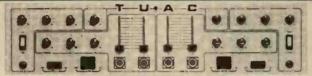
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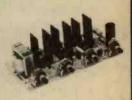
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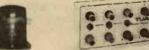
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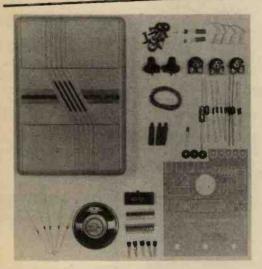
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Not only visitors to the front-door will be amazed, if you like you can connect an additional push button for a back door which plays a different tune!

This kit has been carefully prepared so that practically anyone capable of neat soldering will have complete success in building it. The kit manual contains step by step constructional details together with a fault finding guide, circuit description, installation details and operational instructions all well illustrated with numerous figures and diagrams.

The CHROMA-CHIME is exclusively designed by



THE WAY THINGS GO

As the year approaches its end a little ruminating may not be amiss. Around 1967 PRACTICAL ELECTRONICS was but a few years old and we were all still busily engaged in exploring the uses of the transistor, when the integrated circuit became generally available and started to alter the pattern of circuit design. Today we find ourselves in a somewhat parallel situation to the late 1960s, with the microprocessor now marking the latest revolution in the far from placid history of electronics.

As would be expected, microprocessors have made their initial impact in the industrial and the Service areas, and only just now are these devices beginning to appear in consumer products. Amongst the very first of this kind is a 24-tune door chime. (The designer is in fact a past contributor to this magazine.) To follow, we are promised intelligent toys and combination door locks, according to one speaker at a recent Texas Instruments Seminar. Hurrah for technology! Yes, we will not be surprised if some eyebrow-raising greets these disclosures.

We can also make a disclosure. Amateur-inspired combination lock circuits have been an editor's embarrassment ever since TTL chips became cheap and abundant. Like several other popular circuit ideas, they had more worth as design than in any real-life use.

Looking back, it is amusing to recall that P.E. has in the past been accused by a few individuals of encouraging the alleged "frivolous" use of electronics. Evidently, if this is done on a large enough scale and turns into profitable business, the frivolity can be overlooked! The real truth is that, paradoxically, the more advanced the technology the easier it becomes to apply it to what some might consider trivial or frivolous purposes. Thus does electronics perform as a major conditioner of all our affairs.

At this particular moment one certainly gets the impression that microprocessor makers are still groping around for ways to use their latest wonder devices. Large and potentially valuable areas have indeed been marked out for attention. One such is the motor car industry, but to fully implement the use of the latest in electronics in a non-electronic industry is bound to take time.

Various smaller-scale developments are happening of course, often on a modest budget, perhaps in rather unpretentious laboratories. Some examples came to light during the SERT Symposium last September. It became clear that cash constraints and the inability to purchase the very latest in MPUs are no deterrent to enthusiasm among dedicated workers, especially if the goal is something really worthwhile and of likely benefit to mankind, as for example in the medical field.

Serious amateur experimenters are kindred spirits to these professional "loners" and will also have their contributions to make in this latest area of our technology. Here it might be pertinent to say that the biggest memory and the fastest MPU are not necessarily the best for every purpose. The Mini has not been rendered obsolescent by the TR7.

NON-CRYSTAL BALL

From the present, a peep into the future. What will be the next milestone in electronics?

The award of the Nobel Prize for Physics to Sir Nevill Mott (shared with two American physicists) for work on amorphous materials at Cambridge naturally reawakens interest in the use of non-crystalline materials, particularly glass, as the basis for a new generation of semiconductor devices. Low cost is the chief virtue of glass as a semiconductor and one possible application relates to solar cells. It is being suggested that amorphous solar cells could change the whole situation making direct generation of electricity from solar radiation a perfectly economic operation.

SWITCHING OFF

At this point our crystal gazing must stop: quite finally unfortunately, so far as the present writer is concerned. To explain this a change to the first person now seems in order.

After guiding the destiny of PE since its inception I now have reluctantly to relinquish my editorship. This is due to the relocation of our editorial offices to Poole, Dorset. It is especially sad to part at this very time since PE has now become number one in its field in the UK.

These thirteen years have been exciting, stimulating and rewarding. A great number of contacts have been made with members of all sections of the industry, with advertisers, and with contributors. I have been fortunate in that many of these have become more than just business associations; friendships have been made which I greatly value.

There is of course that far larger band of readers with whom I have always felt a strong rapport despite no direct personal contact. To these unseen tens of thousands who have supported PRACTICAL ELECTRONICS throughout the years (including the critics) I am conscious of my indebtedness. For it is in the end the readers who make a magazine. Our task is to try and meet their needs. I can only hope that in the aggregate we have succeeded

Also leaving PRACTICAL ELECTRONICS will be colleague David Barrington who has worked with me continuously since the pre-launch period in early 1964. He has been a key figure in the compilation of every issue, and his varied feature writing responsibilities included Market Place. Dave will join our associate publication EVERYDAY ELECTRONICS which I will continue to edit from our London Offices.

So now, cheerio. FRED BENNETT.

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Editorial Offices: Westover House, West Quay Road, Poole, Dorset BH15 1JG Phone: Editorial Poole 71191 Tetex: 915748 MAGDIV-G Advertising Offices: King's Reach Tower, King's Reach, Stamford Street, SE1 9LS Phone: Advertisements 01-261 5000 Telex: 915748 MAGDIV-G of town, and you are only too aware of how little opposition the average car lock presents to a thief, then you probably will have promised yourself a burglar alarm one day. It's not just a question of your car being stolen, but you could come back to find your "in-car" music centre missing, and even a simple system is a good deterrent while there are still other vehicles around without protection.

This automobile burglar alarm is triggered by the door operated courtesy light switches, causing pulsation of the horn and headlights, and features exit and entry time delays with the ON/OFF switch hidden somewhere to hand inside the car. The alarm unit itself is fixed in a convenient location somewhere under the bonnet.

CIRCUIT OPERATION

The circuit diagram of the alarm is shown in Fig. 1. With the latch (TR1 and TR2) in the "off" state (TR2 collector low), Timer A is disabled via D2, and the relay is not energised so that the car headlights and horn are off. When the latch is in the "on" state, Timer A is allowed to oscillate, thereby repetitively energising and de-energising the relay, and thus the horn and headlights.

The latch toggles from the "off' to the "on" state when triggered by any of the door switches, except for a short interval after power is applied to the circuit via the hidden switch, when Timer B holds the latch off while the driver vacates the vehicle.

When S1 is closed, C1 begins to charge through R6, at which time the output of Timer B is high, biasing TR2 on, irrespective of the state of all door switches. While TR2 is on, C4 is prevented from charging, and the output

of Timer A is high, de-energising the relay. During this interval, the warning light mounted on the dashboard is illuminated to indicate that it is safe to open the car door.

After about 17 seconds ($1.1 \times C1 \times R6$), the voltage across C1 reaches the threshold level of Timer B, and the output goes low, releasing the latch and turning off the warning light to indicate that opening the car door will now trigger the alarm.

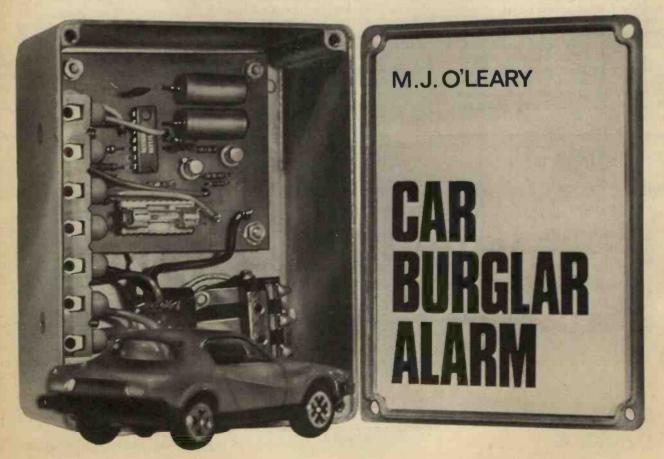
When one of the door switches is operated (closed) by opening the door, even momentarily, the latch toggles from "off" to "on", so that TR2 collector is high. This allows C4 to charge through R7 and R8. After about 18 seconds (1·1C4 [R7 + R8]), the voltage across C4 reaches the threshold level of Timer A and the output goes low, energising the relay.

At the same time, C4 begins to discharge through R8 and the timer pin 13. The discharge period lasts for about 11 seconds $(0.7 \times C4 \times R8)$, until the voltage across C4 falls to the trigger level of Timer A. At this point the timer output goes high, de-energising the relay. Also, the timer discharge pin (pin 13) is now disabled, so that C4 begins to charge once more through R7 and R8.

The charging period this time lasts for about 12 seconds (0.7C4 [R7 + R8]) before discharging proceeds as before, so that from now on, the relay is repeatedly energised and de-energised for periods of 11 and 12 seconds respectively.

During the 18 second interval, between the latch being triggered by the door switch and the relay first being energised, the circuit can be de-activated by opening \$1. This allows the car owner to enter the vehicle and turn off the power before the horn and headlights operate.

The capacitors C1 and C4 must be low leakage types, otherwise the threshold levels of the timers will not be reached. The remaining components are not critical.



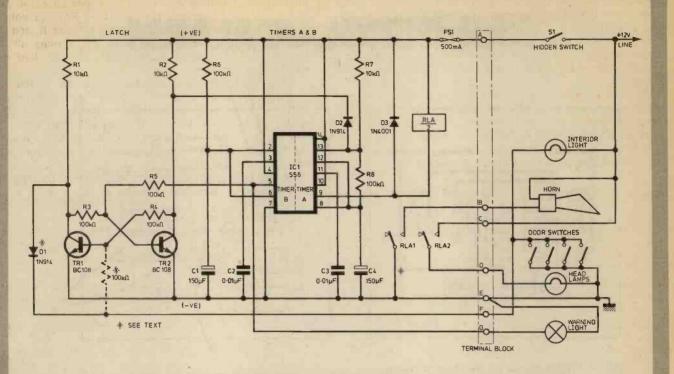


Fig. 1. Burglar Alarm circuit diagram. For positive earth vehicles, D1 is replaced by a 100k Ω resistor which goes to the base of TR1

COMPONENTS ...

Resistors

10kΩ (3 off) 100kΩ (5 off)

Capacitors

C1, C4 150μF/15V solid tantalum (2 off) C2, C3 0.01μF ceramic (2 off) The tant' capacitors must be low leakage $(<0.01 \mu A/\mu FV)$

Transistors TR1, TR2 BC108 (2 off)

Integrated Circuits IC1 556 Timer

Diodes

D1, D2 D3 1N914 (2 off) 1N4001

Miscellaneous

Single sided p.c.b. 58 × 66mm Single sided p.c.b. $58 \times 66 mm$ P.c.b. pins S1 on/off toggle switch FS1 500mA fuse and 20mm holder Relay, $12V/110\Omega$, 2 pole c/o, 10A contacts (Doram) Diecast box $114 \times 55 \times 89 mm$ Terminal block, 7-way Grommet, $6 mm \left(\frac{1}{4} in\right)$ P-clin. size N2 P-clip, size N2 Warning lamp, 12V/2.2W. (An i.e.d. could be used in series with a $680\,\Omega$ resistor)

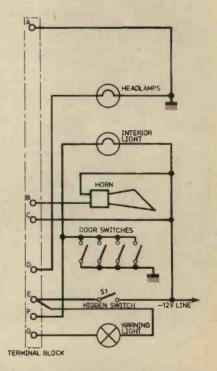


Fig. 2. External wiring arrangement for positive earth vehicles

CAR BURGLAR ALARIM

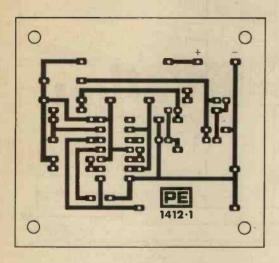


Fig. 3. Printed circuit for Car Burglar Alarm

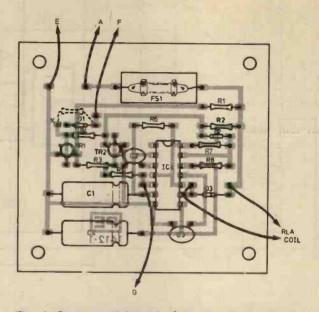
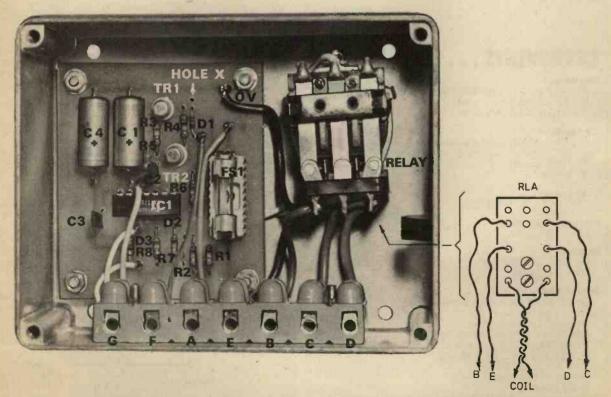


Fig. 4. Component layout of Burglar Alarm board. The spare pad (marked X) is for the "positive earth" modification



The details shown for wiring up RLA are only correct for the Doram type 72-722-0 relay

CONSTRUCTION

The unit comprises a small p.c.b. (which is shown in Fig. 3), a suitable relay, and a seven way terminal block, all housed in a diecast aluminium box which is mounted under the car bonnet. Firstly the p.c.b. should be assembled following the diagram of Fig. 4, and then the metalwork should be carried out.

Four holes are drilled through the base of the box to accommodate the p.c.b. mounting screws. These screws will be independently fastened with nuts to form studs over which the p.c.b. can be placed. They will also act as spacers to separate the board from the base of the box. Fixing holes for the relay should be drilled, and also for the terminal block, and one further hole for the grommet through which the interconnecting leads will enter.

A final four holes are necessary for the self tapping screws which will secure the whole unit to the car. This means that the unit has to be screwed down with the lid off, and the lid subsequently replaced. Make sure that these drillings are situated where there will be plenty of room to introduce a screwdriver once the "bits and pieces" are installed inside the box.

A robust case with tight fitting lid was chosen in preference to a plastics type because the environment inside an engine compartment is pretty hostile. The box will have to stand up to vibration, corrosive elements, and severe heat variations. The unit should be screwed together tightly, using shakeproof washers wherever possible. Good soldering is also necessary.

CONVERSION TO POSITIVE EARTH

The unit as shown in Fig. 1 is designed for negative earth cars, but it can readily be adapted for positive earth vehicles. See Fig. 2.

In this case the positive terminal of the unit (A) is connected directly to earth, instead of S1, and the negative terminal of the unit (E) is now connected to S1, which continues on to -12 volts.

The same p.c.b. and components are used, with the exception that D1 is replaced by a $100k\Omega$ resistor, and an extended pad (marked X in Fig. 4) is provided for this larger component, which goes to the base of TR1 instead of its collector. This is so that the latch can still be triggered by the door switches which are generally connected to earth, and which will give a positive voltage in this case.

The horn and headlight relay contact connections are similar to those for a negative earth system, except that now the horn connection inside the unit (RLAI pole) is connected to the positive rail instead of the negative one, and the headlights (terminal block C) are connected to negative supply instead of the original +12 volts.

The warning light will still be connected between terminal block points G and E, but since point E is no longer earth, all wiring relating to this lamp will need to be insulated from the car chassis.

POINTS TO CHECK

The wiring details given in this article are based on certain assumptions, but the following points should be verified before wiring up the unit: That the headlamp bulbs, and door switches return directly to the car chassis, irrespective of the polarity of the system; and that the horn returns to "Line" and not chassis, i.e. +ve for a negative earth vehicle, or -ve for a positive earth vehicle.

These checks can be made with a simple multimeter, or even a small 12 volt bulb, and the internal relay can be rewired to compensate for any variations encountered.

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FLECTRONICS

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N this second and final part describing the 128 note sequencer, details will be given for constructing the three sub-assemblies making up the unit together with testing procedures and patching examples for use with a synthesiser.

POWER SUPPLY

The power requirements for the sequencer are positive five volts at about 200mA and five volts negative at a very low current for the 741 op amp. The circuit for this is given in Fig. 7 and provides both regulation and stabilisation for the two lines.

Constructional details for realising this are given in Fig. 8 which shows the majority of components mounted on a 76 × 54mm printed circuit board. When assembled both this and the transformer are mounted on a simple angled aluminium sub-frame. The p.s.u., main and counter display boards should be mounted on the baseboard adjacent to the control panel.

MAIN BOARD

The p.c.b. and component layout for the circuit of Fig. 2 is given in Fig. 8. Here i.c. sockets are used throughout to obviate the possibility of chip damage in assembly. They also facilitate the replacement of i.c.s.

When this board is assembled all i.c.s apart from the RAM should be inserted. This will enable the clock oscillator, counter and D-A converter to be checked for correct functioning.

First the control panel is made up from a piece of 135 × 235mm aluminium. This should be drilled and cleared to suit the components shown annotated in the photograph.

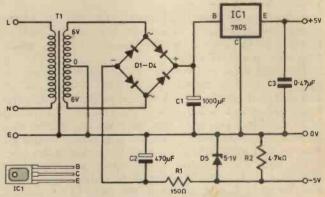


Fig. 7. Circuit of power unit

The Letraset legends were layed on a black paint background and then secured with a clear polyurethane spray.

After this preparation and finishing the control components should be fitted and wired according to Fig. 10 to the main board.

DIGITAL READOUT OF COUNTER

It was found when operating the prototype sequencer that it was often helpful to know what position in the memory had been reached when writing in a tune. It was considered that a full numerical display of the counter state was not necessary, and should greatly increase the cost of the unit. Fig. 9 shows an alternative arrangement which was used in the prototype. In this the binary number at the memory address inputs of IC3 is displayed on seven l.e.d.s, driven via buffer transistors.

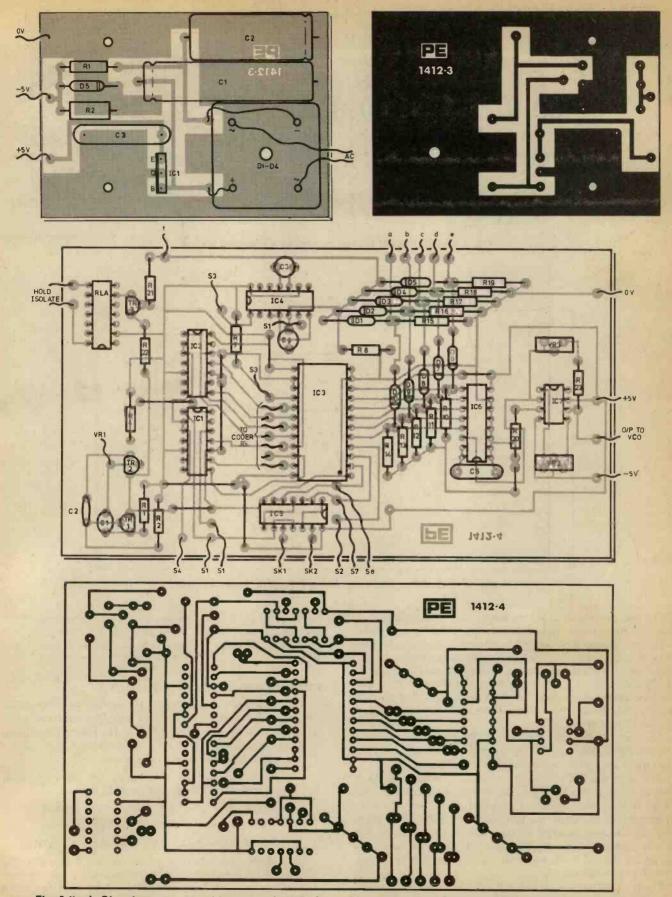


Fig. 8 (top). Showing component layout and p.c.b. for main components of power unit and (below) component board and etching details for the main circuit (Fig. 2)

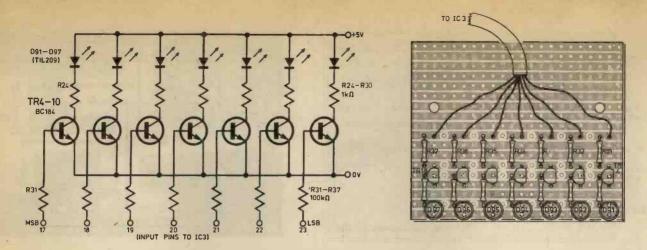


Fig. 9. Circuit of counter and prototype Veroboard layout

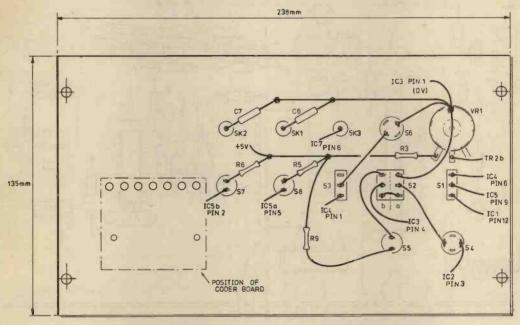


Fig. 10. Interwiring and component layout for control panel

On the prototype unit this circuit was assembled on a 45 × 55mm 0-lin matrix Veroboard (Fig. 9) and fixed with two screws and bushes to the control panel so that all the l.e.d.s are visible via cut-outs from the front.

To check circuit functioning set the "Stop/Run" switch to "Run" and apply power. With a voltmeter or oscilloscope examine whether the clock oscillator is producing pulses and the correct binary count appears at the l.e.d. "Count" display.

Set the "Stop/Run" switch to "Stop" and check that depressing a key causes the counter to step, and also that it causes a pulse to appear at pin 1 of IC4.

Still with the MCM6810 out of circuit, connect the D-A output to a synthesiser v.c.o. Adjust the offset control VR2 (Fig. 2) until the sequencer output is zero with no keys depressed. Now adjust the gain control VR3 so that playing consecutive octaves on the keyboard produces the correct pitch change in the v.c.o. (It may be necessary to adjust the value of the feedback resistor R23 to obtain the correct pitch span.)

If all is correct so far, switch off the power and insert the MCM6810.

On reapplying power, a random series of notes should

be sounded by the v.c.o. when the clock is running. Pressing the "Erase" switch while running the clock at a fast speed will clear the memory. The sequencer is now ready for use.

PROGRAMMING THE SEQUENCER

A certain amount of practice is needed to programme the sequencer correctly, the user should familiarise himself fully with the working of the device before attempting to write complicated tunes into the memory.

The operating procedure is as follows:

- (1) Clear the memory by running the clock at a fast speed with the "Erase" button held down.
- (2) Select "Stop" with the "Stop/Run" switch.
- (3) Press the counter "Reset" button.
- (4) Set the "Reset Read/Write" switch to "Write".
- (5) Write the required notes in by depressing the appropriate keys (go fairly slowly to avoid mistriggering the circuit). If a note is to be held for more than one beat, the key should be pressed more than once.

If the envelope trigger outputs are being used, the trigger button (1 or 2) should be pressed at the same time as a key whenever a trigger pulse is required.

- (6) When the last note of the tune has been written in, hold the "Reset Write" button, and press the last key again.
- (7) The tune is now ready to be played. Reset the counter, put the "Reset Read/Write" switch to "Read" and select "Run". The tune should now be played through the synthesiser v.c.o.

USING THE SEQUENCER

Even when used with fairly simple synthesisers, the sequencer is capable of producing quite startling results.

Some typical patching arrangements are shown in Fig. 11. The sounds produced by Fig. 11(d), are extremely entertaining if the two v.c.o.s are tuned to a musically related interval.





Fig. 12. Demonstrating a simple tune for the sequencer

COMPONENTS . . .

P.S.U.

Resist			Capaci	tore
Kesis	LUIS	180	Vapaci	LUI 3
D4	4500	LVAZ	C4	4 000

R1 150 Ω $\frac{1}{4}$ W C1 1,000 μF 25 V elect R2 4·7k Ω $\frac{1}{2}$ W C2 470 μF 25 V elect C3 0·47 μF

Semiconductors

D1-D4 Bridge rectifier (2A, 200V) (R.S. Components)

D5 BZX85-5:1 5:1V, 1:3W Zener (R.S. Components)

IC1 7805 5V, 1A regulator (R.S. Components)

Transformer

T1 6-0-6V 250mA mains transformer

L.E.D. COUNTER

(Optional to main board)

 Resistors
 Semiconductors

 R24-R30
 1kΩ (7 off)
 TR4-TR10
 BC184 (7 off)

 R31-R37
 100kΩ (7 off)
 D91-D97
 TIL209 (7 off)

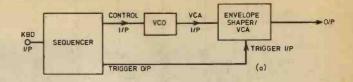
KEYBOARD

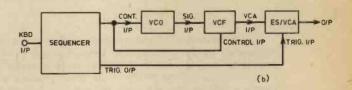
49 note keyboard C to C

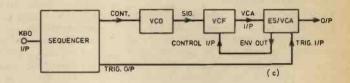
4 s.r.b.p. strips 169 × 51mm for mounting contact blocks

Contact blocks type GB2 (49 off)

(All keyboard items available from Maplin Supplies)







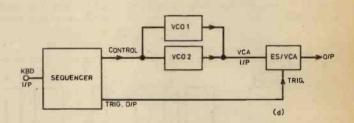


Fig. 11. Some typical patching arrangements with a synthesiser

Fig. 12 demonstrates how a simple tune can be played. Here each bar is divided into 12 beats, a close approximation of the dotted notes is given by using the 1st, 3rd, 4th, 6th, 7th, 9th, 10th and 12th beats only. By writing trigger pulses only on the accented beats the impression is given of a separate bass and melody line being produced by only one oscillator!

It is interesting to note that this tune only uses 25 positions in the memory, less than a fifth of the unit's capacity!

It must be realised that this is a very simple example; the full capabilities of the sequencer are really only limited by the imagination of the user.

EXPANSION

More ambitious constructors should have no difficulty expanding the unit in a number of ways, for example, two or more memories could be connected in series to give longer sequences. Alternatively, two memories could be paralleled to provide more outputs (two tunes could be played at once!).

Even in its basic form, the 128 note sequencer is a very useful addition to a synthesiser, making possible effects and sounds that are very difficult to produce manually.

MICRO-EUS

Compiled by DJD

This is the second of a new regular feature covering all aspects of microprocessors and minicomputers. Appearing every two months, Micro-Bus will present ideas, applications, and programs for the most popular microprocessors; ones that you are unlikely to find in the manufacturers' data books. The most original ideas will probably come from readers working on their own microcomputer systems, and payment will be made for any contribution featured here. This is also the place to air your views, in general, on this new technology, so let's be hearing from you!

TIME-CODE CLOCK

In the past the only type of clock which did not need to be set to the correct time was the sundial; other clocks are at best only as accurate as the last time they were set. However since 1974 when the National Physical Laboratory started transmitting a high-accuracy time code, it has been possible to design an electronic clock which automatically sets itself to the correct time within a minute of switching it on!

amplifier which brings the signal up to the 25mV needed to drive the PLL. The aerial should be placed at least 2ft away from the receiver to minimise pick up from the PLL, and the wire connecting them should be screened.

In the prototype the front-end was built from a kit supplied by D. W. R. Higginson Limited, Bristol Road, Sherborne, Dorset, DT9 4EF, for £14.08 (inc. VAT), and this included a pre-aligned aerial (available separately).

The output from the PLL drives an l.e.d. which should flash at 1Hz when a signal is being received, and the two inputs to the MC6820 Peripheral Interface Adapter (PIA) in the microprocessor system. One input is a conventional input and the other is a latched control unit.

The clock was tested on a Motorola D2 kit, which uses a 6800 MPU, and the complete program is shown in Fig. 3. This could easily be modified for use

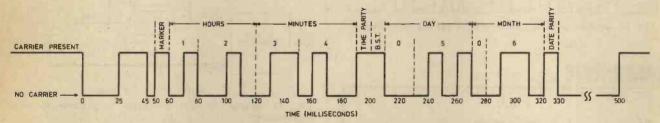


Fig. 1. Format of the encoded time and date information transmitted at the start of each minute

The signal is transmitted from Rugby on M.S.F. 60kHz. A 100-millisecond break in the carrier occurs every second (and on some half-seconds), and each minute the time and date are transmitted in a binary coded decimal format, see Fig. 1. Designs have appeared which used logic gates to read and decode the information but these needed a large number of integrated circuits and much wiring.

An alternative approach presented here is to do all the decoding by software using a circuit based on a microprocessor; in this case the only parts needed, apart from the microprocessor system, are the receiver section and interface as in Fig. 2. This would therefore make an ideal system clock for a microcomputer.

The receiver is built around an NE567 phase-locked loop (PLL) tone decoder whose frequency is set to 60kHz by VR1. When a frequency within about 14 per cent of this is present at its input, it drives the output low. A ferrite-rod aerial tuned to 60kHz feeds a two-stage

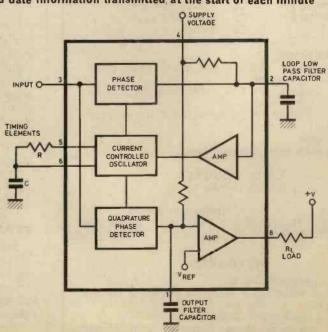
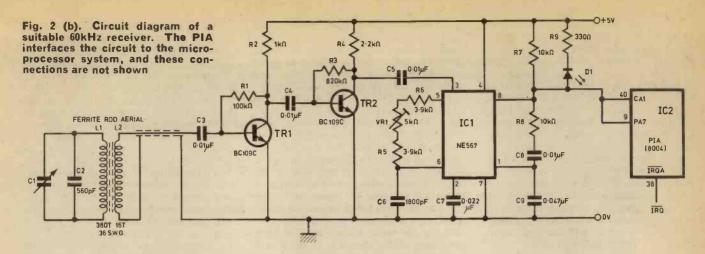


Fig. 2. (a) Block diagram of the NE567 phase locked loop tone-decoder integrated circuit used in the receiver



		NAM	CLOCK	
	*** RU	GBY TIN	E CLOCK	***
	*			
8004	PIA	EGU	\$8004	
EØFE	OUTDS	EQU	SERFE	IN JEUG
A000	IRG	EQU	\$A000	
	1			
0000 0002	XTEMP	RMB	2	
0002 0001	DATA	RME	i	HOURS
0003 0001		RMB	1	MINUTES
0004 0001		RMB	1	TIME PARITY BIT
0005 0001		RMB	1	B.S.T. BIT
0006 0001		RME	1	DAY
0007 0001		RMB	1	MONTH
0008 0001		RMB	1 .	DATE PARITY BIT
0009 06	BITS	FCB	6,7,1,	. 6, 5, 1
000A 07				
999B 91				
999C 91				11 32 11
099D 06				
000E 05				
ARAF A1				

	# MAIN PK	DORMM BEE	
9010 B6 07	BEGIN LDA		
0012 B7 8005	STA	A PIA+1	CONTROL WORD
0015 CE 0022	LDX	£ISR	
0018 FF A000	STX	IRG	INTERRUPT VECTOR
001B B6 8004	LDA	A PIA	CLEAR INTERRUPTS
001E 0E	CLI		
001F 7E EOFE	JMP	OUTDS	OR MAIN PROGRAM

			*** IN	ERRU	JPT.	SERVICE ROUTINE ***	
			*				
0022	CE	0903	ISR	LDX		£30000/13 (30 MSEC.)	
0025				BSR		DELAY	
0027				LDA		PIA	
002A				BMI		RETURN NOT MINUTE PUL	SE
			MINUTE			£35000/13 (35 MSEC.)	
002F				BSR		DELAY	
0031				LDX		£DATA	
0034			NDIGIT			XTEMP	
8036				LDA	В	7.X	
0038				CLR		9, X	
		8004	NEXTIN			PIA	
003D				COM			
003E	49			ROL	A		
003F				ROL		0, X	
		0301		LOX		£10000/13 (10 MSEC.)	
0044				BSR		DELAY	
9946				LDX		XTEMP	
9949				DEC	8		
0849		EF		BNE		NEXTIN	
994B				INX			
		0009		CPX			
094F	26	E3		BNE			
			** SUM			CORRECTION **	
0051				LDA			
0053		85		ADD	A	DATA+3 B.S.T.	
0055		1.		DAA			
0056				CMF	A	£\$24	
9958		01		BNE		FINE SHAPE OF TO S	
805A		0.0		CLR		CHANGE 24 TO 0	8
005B	47	67	FINE	STA		DATA	
			** DIS		DA		
005D		R2	-	BSR		UPDATE	
005F	3B		RETURN	KII			

		**** DEL	AY APP	ROX. X*13 USEC. *	***
9969	09	DELAY D	EX		
9961	26 FD	. E	BNE	DELAY	
8863	39	F	RTS		
				SPLAY BUFFER ***	
				KIT ONLY)	
	EØC4				
	E31C				
	E327	DIS23 E	EGU	\$E327	
		*			
0064	BD EOC	4 UPDATE 3	JSR	CLRDS	
0067	96 02	ı	DA A	DATA	
0069	BD E31	c :	JSR	DIS01	
996C	96 03	ι	DA A	DATA+1	
996E	BD E32	7	ISR	DIS23	
0071	39	F	RTS		

Fig. 3 Program for the 6800 which reads and decodes the time and date information from the receiver section, and displays the time on the displays in the D2 kit

with other micros. As it stands the program uses the display routine in the D2 kit JBUG monitor to display the time; when executed the program first causes an arbitrary number to be displayed (and this flickers at one-second intervals due to the time taken by the interrupt service routine), and then each minute the display is updated to the new correct time as the time code is received.

The program is entered at BEGIN, and this first section initialises the PIA, making CAI an interrupt input, and puts the address of the interrupt-service routine ISR into the pseudo interrupt vector at A000; on interrupts this is picked up by the monitor and used as a jump address.

The interrupt mask is then cleared, and control transferred to the main program; in this case OUTDS, the display routine which refreshes the 7-segment displays in the D2 kit.

On the rising edge of every pulse from the receiver an interrupt is generated and the routine ISR is called. This routine is only concerned with minute pulses, so it reads the input line after 30 milliseconds and returns to the main program if it is still high. Otherwise the ISR updates the seven locations at DATA with the decoded information, and it does this as follows:

The program delays a further 35 milliseconds to the centre of the first data bit and then reads bits at 10 millisecond intervals into the correct location at DATA. The number of bits to be shifted into each location is different (see Fig. 1) and is given by the number in the corresponding element of the array BITS. All the delays are generated by the subroutine DELAY which counts down the index register X, and in systems with different clock rates the delay parameters will have to be altered accordingly.

To convert from G.M.T. to the more familiar B.S.T. the program adds the summertime bit to the number of hours. Finally, for testing purposes, the routine UPDATE uses subroutines in JBUG to

clear the displays and load the new hour and minute counts into the display buffer. Note that although the date and parity information are not displayed they are available in the array.

DATA

As well as making an ideal source of the time and date in an existing microcomputer system, a time-code clock could be constructed using a dedicated microprocessor with the program stored in ROM. It would be a simple matter to extend the program to give date display, error-checking (using the parity bits), seconds, an alarm, and time-controlled switching of circuits. All things considered, the sundial does not have much going for it any longer!

MICRO PLAYS CHESS

The "Chess Challenger" pictured below is a new microprocessor-based game that is being imported from the States, and it is currently on sale here for about £150. It is a remarkable example of how micros have crept up on us, and most people who have played against it are amazed that such a serene-looking wooden case contains a machine that can produce strong opposition to their moves.

The Chess Challenger microprocessorbased chess playing game



The player enters his move at a keyboard to the right of the chess-board, and the machine gives its reply on a four-digit seven-segment display. The moves are entered as the co-ordinates of the two squares involved (in what is unfortunately the opposite of standard algebraic notation): e.g. FROM 4b TO 4d. The "EN" key then enters the move and the machine replies in about two seconds.

It is worth noting that the machine performs no move checking, so any piece may be moved to any square that is either unoccupied or else occupied by an enemy piece; it is up to you not to cheat! This has the side-effect of making it possible to set up mid-game positions, albeit in a rather tedious way.

AN EXCELLENT PARTNER

The special moves of castling and en-passant captures are dealt with by means of the "DM" double-move key. This prevents the machine from replying to the next move entered, so it enables you to move more than one piece in one turn. The machine will castle at the first opportunity and it sometimes castles through check; in this event it is necessary to move its king and rook back and ask it to move again, and it will not attempt another castling. It does not capture en-passant. If a player's pawn reaches the back line it is promoted into a queen and you cannot ask for an under-promotion. However, it neglects to promote its own pawns, and in one game played against it where it could have forced a victory it left its pawn unpromoted on the last line.

The machine announces "check" by an l.e.d., and when mated says "I lose" with an other. A useful additional feature is the possibility of interrogating for the current board position piece by piece to verify that the pieces are set up correctly.

At first sight the machine plays a good game, and it certainly never misses a trick if one is immediately possible. However, it only performs a static evaluation of the current position and does not look ahead at all. In other words it will fail to spot a mate in two, unless it happens to choose the key move for other reasons. Despite this the algorithm it uses to choose what it considers to be the best move is well designed so that nine times out of ten it actually does come up with one of the better moves. When for some reason it gives a bad move its opponent usually remarks that "it failed to see what was going on"; it cannot spot long-term plans and, by the same token, does not form long-term plans. This is a common failing of all but the most sophisticated of chess programs.

Out of a number of games played against it by players of ordinary to club standard it won about one-third. The shortest mates are spectacular if unrepresentative, but they illustrate the machine's blind spots and two are given below:

Pete Christian	Chess Challenger
White	Black
1. 5b-5d	5g-5e
2. 4a-8e	7g-7e
3. 7a-6c	8g-8f
4. 6cN5e (xP)	7h–6f
5. 8e-6g (xP)	LOSE
Geoff Walker	Chess Challenger
White	Black
White 1. 5b-5d	
	Black 5g-5e 2g-2f
1. 5b-5d	5g-5e
1. 5b-5d 2. 2a-3c	5g-5e 2g-2f
1. 5b-5d 2. 2a-3c 3. 6b-6d	5g-5e 2g-2f 5e-6d (xP)
1. 5b-5d 2. 2a-3c 3. 6b-6d 4. 4b-4d	5g-5e 2g-2f 5e-6d (xP) 3h-2g
1. 5b-5d 2. 2a-3c 3. 6b-6d 4. 4b-4d 5. 4b-4d	5g-5e 2g-2f 5e-6d (xP) 3h-2g 7g-7e
1. 5b-5d 2. 2a-3c 3. 6b-6d 4. 4b-4d 5. 4b-4d 6. 6a-3d	5g-5e 2g-2f 5e-6d (xP) 3h-2g 7g-7e 6h-5g

I LOSE

9. 8e-6g

The game is based on the 8080A micro, the Intel-designed 8-bit device descended from their 8008 and currently the most widely used microprocessor. The program and keyboard/display interface routines are stored in a 2K byte ROM, and for the board position and other variables there are ½K bytes of RAM. As the photograph shows, it forms a very compact unit, this being made possible by supplying the transformer as a separate unit.

This machine is an excellent partner for average players who want some rapid and accurate opposition to help them improve their game, and it will certainly get one past the stage of leaving pieces unprotected. Unfortunately, while you are improving, the machine stays at the same level making the same mistakes. Perhaps with this in mind the makers offer to upgrade the game for an additional £50 by replacing the program chip. The upgraded game can be set to play at one of three strengths, and at level 3 it searches to a greater depth and takes up to 30 seconds per move. For those who do not play chess the makers say that a "Backgammon Challenger" is in the pipeline, and who can guess what else may be on the way?

FERRANTI D/A CONVERTER

The ZN425E is the cheapest monolithic 8-bit D/A converter currently available despite its excellent specifications, and as an added bonus it contains an 8-bit binary counter so that it can be used as the basis of a simple A/D converter. It was specified for the digital waveform generator in the previous Micro-Bus, and can be obtained from S.D.S. Components Ltd., Hilsea Industrial Estate, Gunstore Road, Portsmouth for £3.78 (inc. VAT) plus 65p postage.

A few tapes of the program for a "Bulls and Cows" game are still available from P.E. (see October issue).

NEWS BRIEFS

Program Cassettes for Home TV Terminal

GENERAL Instrument Microelectronics Ltd and EMI Tape Ltd have jointly developed an inexpensive method of storing computer data for home use, using conventional audio cassette tapes and a standard audio cassette mechanism or deck.

The technique, for which patents have been obtained, permits the storage of 1.6 million bits of data on each side of a conventional C-60, 30-minute per side cassette and offers one hundredfold increase in storage capacity in comparison with ROM microcircuit cartridges, at one quarter of the price. Moreover the technique allows voice and digital data to be stored on the same cassette.

The widespread availability of inexpensive hardware for the storage and playback of computer programs is seen as a key requirement in the development of the domestic television receiver into a computer system for use by all the family as a TV games centre and programmed learning and information terminal.

The possible range of programs is unlimited. By plugging a suitable cassette program into the cassette deck contained in the TV Game, the linked television could be transformed into a scientific or business calculator display in which every stage of calculation is displayed on the TV screen. Alternatively, language tapes could be made available combining on-screen text with the spoken word.

General Instrument Microelectronics have in an advanced state of development a set of compatible MOS microcircuits for interfacing the television to its CP1600 microprocessor family. Modular in concept, these interface circuits can be used by the manufacturer to offer a wide range of optional extras on the standard TV, culminating in a complete home computer system. These interface circuits allow the reception of the Viewdata and Teletext services



FRANK W. HYDE

SAILS IN THE SUNSET

The now rejected system of photon propulsion for the spacecraft which will be used to rendezvous with Halley's comet has caused some people difficulty. In fact the same principles apply to this system, which uses photon wind for the propulsive medium, as to the normal sailing dinghy. The incident radiation would be reflected by the sail and the resultant energy would urge the vehicle in the same manner as the wind on Earth. It is, of course, necessary to take into account the action of gravitational and centrifugal forces.

However, it could be intriguing to plot a course with its necessary tacking when moving towards the sun. It might not be so facetious if it was suggested that the variations in the medium and the strength of the radiation might lead to the use of the planets as buoys.

SPACE SHUTTLE

Now that the space shuttle has entered both the vocabulary of the public at large and the world as a whole, it is to be hoped that a new look will appear on the space scene. Since there will be much that other countries can aim for at a much lower budget, it is foreseeable that many more missions will be required than envisaged in the first plans.

The rate at which mission time has already been taken up, it would seem that the second and third shuttles are already justified. Indeed, the natural reaction to the September disaster for the second Voyager may accelerate this.

It must be very apparent now that the way to economic stability in the space

programmes is via a maximum use of these new methods. The horizons are so wide that the accusation of "money wasted on wrong things" can be easily disposed

The implications for industry and further employment is very considerable particularly in light metal raw materials. These are to be thought of in terms of millions of tons. So much indeed is required that every country in the world can benefit where process industries are working.

CHEAP SOLAR CELLS

One of the greatest needs of solar development is the requirement of cheap solar cells. It would not require any more money spent on development to increase efficiency for the quantities needed would be so great that a very rapid towering of price would result.

While the last little fraction of efficiency is required for space missions, this does not apply to earth based equipment. The difference in cost for a low grade cell is very great and other alternatives of basic materials could now be investigated.

The same reasoning applies to space projects where the shuttle is used. The weight that can be raised to orbit is so great in comparison to a single launch, that larger quantities of solar cells can be used. Here again the economic law applies. It is better and cheaper to use a large number of less efficient units which will in the end exceed the installed equivalent power.

THERMOELECTRIC DEVICES

So far as earth based units are concerned, attention might also be given to thermoelectric devices. Used in cylindrical reflectors the area of activity is of sufficient extent for continuous lines of such devices to be used without overheating.

For example, a two metre by one metre sheet of aluminium will give a very high concentration of heat over a plane of 500 centimetres. For the "do it yourself' enthusiast it may be extended cheaply using simple angles instead of a parabola-cum-cylinder arrangement. A simple corner reflector will serve very well if slightly modified. Two sheets of aluminium, two metres by one metre, set longways will provide one square metre of concentration with a gain of four to one. In fact a complete unit such as this, with preheating from the distributed "lost heat", can make a very efficient garden unit to supplement the household heating.

The last few sentences may be thought to be far removed from space, but is it really so? Does not the new space age offer such spin-off facilities? The same techniques can be moved from one discipline to another to make the maximum use of resources. Many years ago it was suggested that a large reflector arranged in orbit could not only supplement the heating of the Earth but that also it could be arranged to act as a second moon. Such a project is well within the compass of present technology.

The moving of the large gravity pulled structures and the associated equipment into space would reduce many costs and enable many devices on Earth to be reduced considerably in dimensions. Is it so fanciful to see the Earth controlled from its outer environs?

Certainly, if all nations took part in such a future programme there would be automatic control of attitudes. There would be so much for everyone to do that common interest could lead to common citizenship. Such a situation would indeed make horizons boundless. Not least of the benefits would be a wrist telephone which put everyone in touch with everyone else. Perhaps it is better to leave the subject there for the moment.

JUPITER

There seems to be a number of people who have been somewhat dismayed by the interpretation of Prof. McNally's report about the Jovian planet. Within the last several weeks there have been many questions as to whether Jupiter is to be a second Sun. It is unfortunate that when these ideas take hold of public imagination a whole crop of pseudo science appears.

It has been known for a very long time that Jupiter gives out more heat than it receives. This in no way justifies a statement that it will grow hotter and hotter to reach a state of concentrated gravity condition to raise temperatures to fission level. Indeed, application of the inverse square law will settle any fears of a new "Sun" within the lifetime of the one already sustaining the Earth and its people.

At the distance of Jupiter from the Sun, nearly 500 million miles, a much smaller fraction of the Sun's heat per square mile of the planet is received than that received on the Earth.

The Pioneer results, in any case, have established the reigning temperature very definitely. A great deal of heating up would be required to bring it to a hospitable level. The projected mission into the atmosphere of the planet will bring forward much needed data to enable assessments to be made in these matters.

That Jupiter is a remnant of the original nova is gaining ground now. This would seem to be a logical explanation of Jupiter's size and effect in the solar system. Its effect on the Sun is considerable because the centre of rotation of the Sun and Jupiter is some 30,000 miles outside the photosphere. The inevitable result is a disturbance of the atmosphere of the Sun.

MARKET PLACE

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

POCKET MULTIMETER

A new, high accuracy, personal digital multimeter from Sinclair Radionics is now available in the UK at £29.95 plus VAT.

Claimed to be less than one-third the price of existing $3\frac{1}{2}$ digit meters, the PDM35 fits easily into a coat pocket, brief case or tool kit.

Using an adaption of the old Oxford calculator cases (to save cost), the PDM35 will measure a.c. and d.c. voltage to an accuracy of I per cent of reading. Also d.c. current can be measured to the same accuracy. The resistance range is up to 20 megohms. Range selection is by a slide switch as against the usual rotary type.

There is no provision for a.c. current measurement as Sinclair claim their investigations show little demand for this facility.

A brief technical specification is as follows: D.C. Volts (4 ranges) 1mV to 1,000V at 1 per cent ±1 count, 10MΩ input impedance; A.C. Volts (40Hz-5kHz) 1V to 500V at 1 per cent ±2 count, mean reading r.m.s. (calibrated); D.C. Current (6 ranges) 1nA to 200mA at 1 per cent ±1 count, maximum resolution 0·1nA; Resistance (5 ranges) 1Ω to 20MΩ at 1·5 per cent ±1 count, also provides 5 iunction-test ranges.

Additional extras include an a.c. adaptor for 117V 60Hz or 220/240V 50Hz, carry case and a 30kV probe.

For addresses of nearest stockists of the PDM35 digital multimeter readers should write to Sinclair Radionics Ltd., Dept P.E., London Road, St. Ives, Huntingdon, Cambs, PE17 4HJ, although most good component shops and some stores will have stocks.

MUSICAL DOORBELL

No doubt most readers will have already heard of the Chroma-Chime, claimed to be the world's first microprocessor controlled electronic doorbell manufactured by Chromatronics.

This product is now available in kit form for the enthusiasts who want to build their own units. The kit comes complete with all parts including the



Chroma-Chime kit from Chromatronics

microprocessor chip, printed circuit board and a comprehensive assembly manual.

At £18 inclusive of VAT and postage the Chroma-Chime will certainly make a novel gift to add to the Christmas shopping list. Further details and kits can be obtained from Chromatronics, Dept P.E., Coachworks House, River Way, Harlow, Essex.

We hope to give a more in-depth report on the Chroma-Chime kit in the near future.

TAPE/RECORD CARE

With the price of tapes and records on the increase each month, it would seem that BASF have taken the ideal opportunity to launch their Checkpoint record and tape care accessories.

Being their first venture into record accessories, they have produced special gift packs containing such items as cleaning fluid, record cleaning arm and strobe speed check discs. For the cassette recorder there's a cassette tape head cleaner and even an inspection mirror.

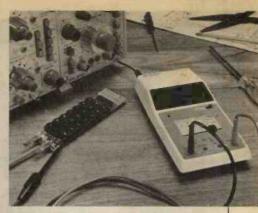
Apart from complete record and tape care kits all Checkpoint accessories are available separately in special bubble packs.

Prices of the BASF Checkpoint accessories vary from £7.94 for a complete record and cassette case kit to 30p for a record cleaning cloth. All units are available from most audio shops and some big stores.

DIFFICULT COMPONENTS

Readers who are experiencing difficulty in obtaining the Radiospares switches for the "Digital Multimeter", published in our October issue, will be pleased to know that Sparks Developments are able to meet their requirements.

They are also able to offer a low cost alternative to the 1 per cent high stability resistors required for the input divider chain. By using two resistors for each of R20-R26 allows the use of preferred resistance values from the E12 range.



Sinclair PDM35 digital multimeter

Also, by utilising the spread in values of a sample of components, a pair of resistors can be selected by measurement to obtain a final value very close to the ideal value.

They are prepared to supply a complete set of resistors R20-R27 to make up the input divider chain to an accuracy of 1 per cent. In addition they will supply printed circuit boards for the project with the necessary modifications to accommodate the extra resistors.

All enquiries should be addressed to Sparks Developments, Dept P.E., 53 North Street, Melbourne, Derbys, DE7 1FZ. A stamped addressed envelope should be enclosed with any enquiry.

GOOD-BYE

This is a very sad occasion for me to have to say goodbye to all readers of P.E., having been responsible for "Market Place" since the first issue.

This is due to a management decision that the magazine would benefit by a move to Poole, Dorset. Even though the Editor and myself, who first started Practical Electronics way back in 1964, feel that this is a bad move for the magazine.

Not being able to make this move West the Editor, Fred Bennett, and myself are having to relinquish our positions on Practical Electronics at a time when the efforts of all the P.E. Team have now made it No. 1 in its field in the U.K.

For myself it is particularly sad as I am the sole Editorial staff member of the Practical Group of magazines who worked with and was trained by the late F. J. Camm, the originator of the "Practicals".

I should like to take this opportunity to thank all my friends at our Printers, my colleagues on P.E. (particularly Dave Tilleard and Peter Mew of Advertising), our Advertisers and my close friend Gordon Godbold for an exciting and rewarding 13 years.

Finally, I hope that all readers of P.E.

Finally, I hope that all readers of P.E. will continue to give the magazine the support it deserves.

Dave Barrington

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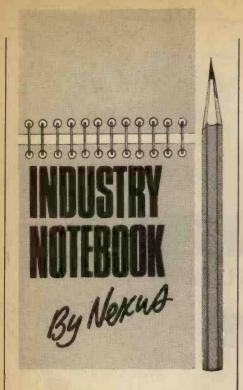
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The proceedings will be opened by Professor C. Turner, King's College, London.

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MAIL BAG

The most distressing feature of being a columnist in 1977 is the occasional mail which arrives from young people seeking an entry into the electronics industry. The writers are generally out of work or in some deadend job. Can I help? Would I please supply names and addresses of firms who have vacancies, give introductions. They are sad letters to receive, reflecting the high level of unemployment in our society, especially among school leavers.

Regretfully, I have to point out that while sympathising with the plight of my correspondents, it is no function of PE to act as an employment agency although, of course, we are always glad to receive letters from readers and give what advice we can.

It seems to me that career expectations are much higher today than they used to be. Young people are encouraged to believe that jobs will be found for them, whereas, we of an older generation were brought up to help ourselves and be far more self-reliant. We had to be prepared to work long hours for very little pay if this meant getting experience and a foothold on the bottom rung of the ladder.

Any sort of job would do to get a start and provide a chance to prove yourself. But if you fell down on the job, then it was a week's notice and out you went. My first job in electronics was as a junior service engineer at a local radio dealer for which I got £1.25 for a 48-hour week and no extra pay for overtime. It was a start on the road to becoming a qualified engineer.

Those were the bad old days of hire and fire, long hours and low wages,

but those days offered the opportunity of getting a start, however humble. To-day there are so many rules and regulations that employers are much more reluctant to take on any but the obviously best youngsters. Greater job security would seem to have limited the job opportunities.

The other great change is in the electronics industry itself. It is still a great growth industry but not in the numbers of people employed. If we look back to the first generation of electronic computers we find that the original ENIAC computer developed in the United States and completed just over 30 years ago used 18,000 valves and consumed 100kW of power.

It seems laughable today but just think of the employment it provided. All those valves, valveholders, resistors, capacitors, the millions of interconnections all wired by hand and laboriously soldered, joint by joint. Even when they got it going it needed an army of trouble-shooters to keep it on stream.

The fact is that today an unskilled operator pushes an I.s.i. module in to a printed circuit board and passes it to a flow-soldering machine and in less than a minute has wired up as many as 5,000 components and the board works first time and keeps on working. And today, the chances are that even the testing of the board after assembly will be done on automatic test equipment by a semi-skilled operator.

This hard fact was brought home forcibly to me when I was looking over the last set of GEC accounts. This year's record profits and turnover were achieved with less people employed. The UK work-force in 1976 was 166,000 people. Today it is 10,000 less.

By no means is this reduction entirely due to things like l.s.i. but it does show the trend resulting from mechanisation and automation and modernisation.

If we look at Racal Electronics Group we find turnover in 1975 of £50 million generated by 4,187 people. 1976 saw a huge leap forward to £79 million generated by 5,028 people. This year's turnover was £122 million with 5,373 people. Note that turnover has more than doubled with only a 25 per cent increase in employment in the past two years. In the past year alone, turnover was up 53 per cent and yet the Group employed only just over 300 more people.

All is not lost however for the bright young person. Technology-based companies are hungry for talent. Last year GEC spent £150 million on R and D. So my advice to keen youngsters is to get qualifications as quickly as they can. An ONC or HNC won't guarantee a job but it will impress an employer that the applicant is career-minded and not just a job-hunter.

PRICE BREAKTHROUGH

After the National Enterprise Board took a big stake in Sinclair Radionics everything seemed to go quiet, unusual for such a publicity-conscious concern. Then there was that sudden spate of press advertising for Sinclair calculators and now the big breakthrough in instruments.

To market a digital multimeter with a price tag of under £30 was a bold move. But such a price is only possible if the instrument can be produced in great volume. The DM2 had done well with over 25,000 units sold but the new smaller and cheaper PDM35 will do even better as it started off with firm orders for 20,000 from the USA alone.

Among the cost-cutting economies to get price down without sacrificing performance were the use of an adaptation of the Oxford calculator case as a housing, thus saving on tooling costs, and a precision resistor network on a single thick film circuit.

The designer of the DM2, John T. Nicholls, has also designed the PDM35. As head of Sinclair's Instrument Division he is already looking ahead to a range of instruments to be introduced to the international market in 1978. I understand that an up-market model will be an auto-ranging 4½ digit instrument but it is also hinted that there will be some down-market instruments as well. Sinclair Radionics is aiming to be the world's largest manufacturer of digital multimeters, at least in volume of instruments, by mid-1978.

Meantime, I can reveal that production of Sinclair's tiny t.v. set is rapidly expanding and although the bulk of production is ear-marked for the United States market it is expected to be available in the UK by Christmas.

SIGNS OF THE TIMES

Selling information can be just as profitable and far less risky than selling products. But while some people talk, others get out and sell. Oil-rich Libya has just glven Marconi Communcations Systems Ltd its biggest ever single order, worth £9 million, for updating the radio facilities at Benghazi and Tripoli airports.

The capacitor manufacturers, Advance Filmcap, has changed its name to Gould Components Ltd., reflecting its change of ownership to the US Gould Corporation. I think it unlikely that the Advance name will be dropped from instruments but one never knows.

The Co-op has signed up for another £4 million worth of ICL mainframe computers. This is the biggest single commercial order that ICL has ever taken and raises Co-op purchases from ICL in the past 18 months to £6 million.

Logic Probe LP-1

LOGIC PROBELS



It enables you to trace logic levels, pulses and logic sequences through complex

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digital circuits.
It detects pulses as short as 50 nsec and stretches them to 1/3 sec for easy observation.

Try the LP-1 and you won't know how you ever managed without it!

How it works

You just clip the probe leads to the circuit power supply, setting the 'Logic Family' switch to DTL, TTL or CMOS. (CMOS position also covers HTL.).

Touch the probe's tip on the node you're investigating and the LP-1 lights up to show you exactly what you've got. The LED marked 'HI' comes on for logic state 1 (High) and 'LO' comes on for logic state 0 (Low).

The third LED, marked 'PULSE', shows the dynamic signal activity at the node under test. Set the switch to 'PULSE' and pulses as narrow as 50 nanoseconds are stretched to 1/3 second. Single-shot and low rep. rate pulses are clearly shown—you can't do that even with a fast CRO! High frequency pulses up to 10MHz will make the 'PULSE' LED blink continuously at 3Hz; and with assymetric signals the 'LO' LED will come on for duty cycles under 30%, and 'HI' for those over 70%.

Another useful feature is 'Pulse Memory'.

Put the probe tip on to a node, switch to 'MEM' and the next logic change-positive or negative—or the next pulse edge, will cause the 'PULSE' LED to come on and stay on, until reset. Meanwhile, 'HI' and 'LO' LEDS continue to function as usual. No other probe or logic checking device gives you all that!

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Or, write your order, enclosing cheque, postal order, or stating credit card number and expiry date. (Don't post the card!)

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Brief Specification:

HTL/CMOS Threshold logic 1, 1,70% Vcc logic 0, 0,30% Vcc Min. detectable pulse:

50 nanoseconds

Max. input signal frequency:

Power requirements: 5 Volt Vcc, 30mA 15 Volt Vcc, 40mA

36 Volts max. Size: 6.1 x 1.0 x 0.7 inches (155 x 25 x 18 mm) Weight: 3 oz (85g)

Power leads: 24 inches (610 mm), colour coded.

LOGIC "1"

LOGIC "1"

LOGIC "0"

LO LED ON

LO LED ON

LO LED ON

LO LED ON

DURING PULSE LED BLINKS

AT 3Hz RATE

LOGIC "1"

LOGIC "0"

DURING PULSE TRANSITIONS PULSE LED BLINKS

AT 3Hz RATE

LOGIC "1"

LOGIC "0"

LO LED ON TO NARROW PULSES

LOGIC "1"

LOGIC "0"

LO LED ON HI LED DOES NOT RESPOND TO NARROW PULSES



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	(TO5)	(STUD)	(C106)	(TO220)	(TO220)	(TO220)	(TO220)	(10
200	0 - 35	0.50	0-45	0 - 40	0.58	0-60	0-68	1-1
400	0-40	0.60	0.50	0 - 45	0-87	0-88	0.88	1-4
600	0-85	0.85	0.70	_	1-09	1-18	1-26	1-1

	11210H2			140		**	10A	16A
PIV	1A	3A	3A	4A	6A	8A		
	(TO5)	(STUD)	(C106)	(TO220)	(TO220)	(TO220)	(TO220)	(TO220)
200	0 - 35	0.50	0-45	0 - 40	0.58	0-60	0.68	1-14
400	0-40	0.60	0.50	0 - 45	0-87	0 - 88	0.89	1-40
600	0-85	0.85	0.70	_	1-09	1-18	1-26	1-80
BT106	E1-00, BT1	07 £1-60,	BT108 £1-64	BT109	£1-00, BT	116 €1-00,	2N3525 €	0 - 50
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	44			-5A		-5A		10A		15A	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	
100V		0-80	0-70	0-70	0.78	0-78	0-83	0-83	1-01	1.01	
200V	0-84	0-64	0-75	0-75	0-97	0-87	0-97	1-01	1-17	1-17	
400V	0.77	0.78	0-80	0-83	0-97	1-01	1-13	1.19	1-70	1-74	
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7413	0.40	7496	0.82	CA3046	0.80*
7414	0.72	74100	1.07	CA3130	0.90
7417	0.43	74107	0.35	MC1304P	1.60*
7420	0.16	74121	0.34	MC1307P	0.85*
7425	0.30	74122	0.47	MC1310P MC1351P	1.60*
7427	0.30	74123	0.65	MC1351P	0.75*
7430	0.16	74141	0.78	MC1353P	0.75
7432	0.28	74145	0.68	MC1458P	0.77
7437	0.30	74154	1.30	MC1496L	0.82*
7441AN	0.76	74164	0.93	SASS60	2 · 25
7442	0.65	74165	0.93	SAS570	2.25
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7470	0.32	74181	2 · 70	TAA861	0.65
7472	0 · 26	74191	1.33	TBA530	1-85*
7473	0 . 30	74192	1.20	TBA530Q	1.90*
7474	0.32	74193	1.35	TBA560	2.80*
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C128	0-16	BC125	0-18*	BC302	0-40	BDY60	1.70	BFY50	0-20	OC84	0-40	2N2906	0-18	4000BE	0.20
C128K	0-25	BC126	0.20*	BC303	0 - 46	BDY61	1.65	BFY51	0-18	OC139	1 - 30	2N2925	0 - 14"	4001BE	0.20
C141	0.22	BC140	0-32	BCY30	0-55	BDY62	1-15	BFY52	0-19	OC140	1 - 30	2N2926O	0.08.	4002BE	0.20
C141K	0.34	BC141	0-28	BCY31	0-55	BDY95	2-14	BFY53	0.25	OC170	0.23	2N2926R	0-10"	4006BE	0.05
C142	0-18	BC142	0.23	BCY32	0.60	BF121	0-50	BFY64	0 - 35	TIP29A	0-44*	2N2926Y	0.08.	4007BE	0 - 20
C142K	0-32	BC143	0.23	BCY33	0.55	BF123	0 - 50	BFY90	0-90	TIP30A	0.52°	2N2926G	0-10"	4008BE	0.93
C176	0-16	BC144	0-30	BCY34	0.55	BF179	0 - 30	BSX19	0-16	TIP31A	0-54	2N3053	0 - 20	4009BE	
C176K	0-32	BC147	0.09°	BCY38	0-50	BF180	0 - 30	BSX20	0-18	TIP32A	0-64	2N3055	0 - 50	40 10BE	0.52
C187	0-18	BC148	0-09°	BCY39	1-15	BF181	0-30	BSX21	0-20	TIP41A	0-66	2N3137	1-10	4011BE	0.50
C187K	0-36	BC149	0.09*	BCY40	0-75	BF182	0-30	BSY52	0 - 28	TIP42A	0.72	2N3440	0 - 56	4012BE	
C188	0-18	BC152	0-25*	BCY42	0 - 30	BF183	0-30	BSY53	0.39	2N404	0 - 40	2N3442	1 - 20	4013BE	
C188K	0 - 32	BC153	0-18"	BCY54	1-60	BF184	0-20	BSY54	0.33	2N696	0 - 20	2N3570	3-60	4014BE	
D149	0 - 80	BC157	0-09-	BCY70	0 - 12	BF185	0-20	BSY55	0-74	2N697	0.20	2N3702	0-10*	4015BE	
D161	0-35	BC158	0-09°	BCY71	0 - 18	BF194	0-10*	BSY65	0.30	2N706	0-15	2N3703	0.10*	4016BE	
D162	0-35	BC159	0.09*	BCY72	0-12	BF196	0.12*	BSY95A	0.16	2N718	0 - 22	2N3704	0-10*	4017BE	
F114	0 - 20	BC160	0 - 32	B0115	0.55	BF197	0.12"	BU105	1-80*	2N929	0 - 16	2N3705	0·10°	4018BE	1.10
F115	0.20	BC161	0-38	BD131	0 - 36	BF224J	0-18*	BU105/02		2N1131	0.15	2N3706	0.10*	4019BE	0.50
F116	0 - 20	BC168	0-09*	BD132	0.40	BF244	0.17*	BU108	3.00°	2N1132	0-16	2N3707	0.10*	4020BE	1-12
F117	0-20	BC169	0.12*	.BD135	0.36.	BF257	0 - 30	BU109	2.50°	2N1302	0-40	2N3708	0.09*	4021BE	1.03
F118	0-50	BC169C	0-14*	BD136	0.39*	BF258	. 0-35	BU126	1.50*	2N1303	0-40	2N3709	0.09°	4022BE	0.95
F124	0-25	BC182	0-11*	BD137	0.40*	BF259	0-48	BU133	1.60*	2N1304	0.45	2N3710	0 - 10°	4023BE	0 - 20
F125	0-25	BC182L	0-12*	BD138	0.48*	BF336	0.35*	BU204	1.60°	2N1305	0.45	2N3711	0·10°	4024BE	0.86
F126	0-25	BC183	0.10*	BD139	0.58"	BF337	0 - 32"	BU205	1.90*	2N1306	0.50	2N3715	1-70	4025BE	0.20
F139	0-35	BC183L	0-10*	BD144	2 - 20	BF338	0-45*	BU206	2-40*	2N1307	0 - 50	2N3716	1-80	4026BE	1.55
F239	0-37	BC184	0.11*	BD157	0-60	BFW30	1-25	BU208	2.60*	2N1308	0-60	2N3771	1-60	4027BE	0.62
L102	1-45	BC184L	0.12"	BD181	0-86	BFW59	0-30	MJ480	0-80	2N1309	0-60	2N3772	1-90	4028BE	0-91
L103	1-30	BC186	0-20*	BD182	0.92	BFW60	0-36	MJ481	1.05	2N1711	D - 24	2N3773	2-10	4029BE	1-10
U107	3-30"	BC187	0 - 24*	BD183	0.97	BFX29	0 - 26	MJ490	0.90	2N2102	0 - 44	2N3819	0.28*	4030BE	0.55
U110	1-75"	BC207B	0-12"	BD184	1-20	BFX30	0 - 30	MJ491	1-15	2N2217	0 - 30	2N4347	1-10	4041BE	0.80
U113	1-60"	BC212	0-11*	BD232	0.60	BFX84	0.23	MJE340	0-40°	2N2369	0-14	2N4348	1-20	4042BE	0.83
C107	0.09	BC212L	0.12*	BD233	0.48	BFX85	0 - 25	MJE520	0-45	2N2369A	0-14	2N4870	0.35*	4043BE	1.00
C107B	0.12	BC213	0-12*	BD237	0.55	BFX86	0.25	MJE521	0-55	2N2483	0 - 20	2N4871	0.35*	4044BE	0-94
C108	0.12	BC213L	0-14"	BD238	0.60	BFX87	0-20	OC43	0-95	2N2484	0 - 16	2N4918	0.60*	4046BE	1-32
C108B	0-12	BC214	0-14"	BD410	0-60	BFX88	0.20	OC44	0 - 32	2N2646	0-50	2N4919	0.70*	4049BE	0-54
C109	0-12	BC214L	0-15*	BDX32	2-30	BFX89	0-90	OC45	0-32	2N2711	0 - 20	2N4920	0.50*	4050BE	0.54
C109B	0-12	BC237	0-16*	BDY10	1-50	BFY11	1-10	OC46	0-20	2N2712	0-15	2N4922	0.58"	4069BE	0.30
C109C	0-15	BC238	0-16"	BDY11	2.00	BFY18	0-50	OC70	0-30	2N2904A	0.20	2N4923	0.46*	4070BE	0.50
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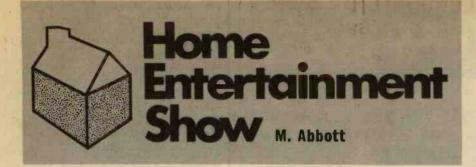
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BC BC BC BC BC



THE balconies remained empty in the Grand Hall of Olympia for what used to be called the Audio Fair, where just under ninety stands barely filled the

main floor

The exhibition ran from September 12 to 18, and giving lectures during that period at the Wireless World stand was John Logie Baird himself! This lifesize model of the inventor, with his blank wax face animated by a sound synchronised movie projector, was chillingly convincing, as he (it?) told of his early experiments in television.

Although numerous big names in hi-fi were present at the exhibition, their interest rating seemed "pushed over" in favour of such things as calculators, alternative uses for television, digital watches and clocks, including an l.e.d. clock radio from SI Electronic (UK) for under £20. The show was of no real interest to organ or synthesiser fans.

INTELLIGENT TURNTABLE

There was a chance to see and operate the new ADC Accutrac +6 Turntable, and this gave a good example of the subservient microprocessor's ability to please, because this deck, which is expected to retail at around £150 inclusive of cordless remote control, can play up to six l.p.s using touch-switch activated "hands off" servo mechanisms which really do treat the records with loving care. There can be no mishaps, and the records are not dropped brutally on to the platter.

What is more, the system can be instructed to play any combination of tracks in any order. The micro-processor stroboscopically controls the turntable speed, and seeks out the selected recordings with an infra-red "eye" mounted in the cartridge, which counts the smooth unmodulated gaps between tracks. ADC are keen to point out that this is a true hi-fi class deck, and not a mere gimmick. The circuit blueprint for the Accutrac +6 measures nearly 5m by 6m, most of which is on a 2.5mm Mos chip!

CORDLESS HEADPHONES

Listening to recordings with headphones is generally accepted as being more satisfying than using loudspeakers.

but nobody likes tripping over wires. For this reason Beyer Dynamic developed their infra-red cordless system. The ISS 76 Stereo Transmitter (there is also a mono version), along with the DT444S headphones incorporating infra-red receiver, will set you back about £190, but if you have your own headphones, you can buy a discrete plug-in type receiver for about £30.

The transmitter can take an audio signal from any source, and the infra-red output is semi-directional, therefore needing some walls around to "bounce" the signal.

INFORMATION BY TV

Much activity was centred on television, providing an opportunity to try out the CEEFAX and ORACLE teletext systems for one's self, but by far the most impressive t.v. data service to use was that of Viewdata, both from simplicity of operation and the potential usefulness point of view.

Unlike other systems, the PO's Viewdata communicates via telephone lines and is completely user interactive. If the required page number is not known, you simply call up the general index, and select a suitable heading by entering its number. A more appropriate index will then appear, and further selection through this "family tree" of pages will bring you to anything from a Which Report on a particular freezer to an airline ticket booking facility. You could find the nearest golf course to your Summer holiday location, complete with fees and opening hours.

The services possible are endless; it simply depends upon which organisations feed their information into the system. For example, a motoring organisation could provide a diagnostic service. If your car will not start on a cold morning, by answering "yes/no" type questions, the most likely fault

would be displayed.

As yet there is only a pilot service, and a full public service is not envisaged until the early 1980s. Because of this, there are no conversion modules which will instantly give your t.v. Viewdata capability, and a set designed for this additional facility would probably cost an extra £80

MARKSMANSHIP BY TV

Anyone expecting to hear the roar of tank battles and dog fights at the t.v. games stands would have been disappointed, for with the odd uninspiring exception, only the "blipping" of the usual ball games could be heard.

Along with these games, Interton Electronic were showing the rifle range option of their Video 3001 multi-games (colour) unit, with which, for an extra £20 on top of a basic £52, you can plug in the V300 Rifle and aim at a spot of light bouncing around the screen, or call for the target to fly past in clay pigeon style. No scores appear on the screen (for obvious reasons) and the plastics "shooting iron" gets flooded by daylight, so the game has to be played in a darkened room.

OTHER INTERESTS

The show was by no means all about hardware, and among the other activities were live music performances at the theatre, with an open invitation to make private recordings, and which included a demonstration by the BBC Radio-phonic Workshop. There were lectures by various hi-fi experts too!

A cinema showed films of all kinds, one of which, produced by the BBC, gave an insight to local radio behind the scenes. The London Broadcasting Company (LBC), local radio, were indeed present, and transmitting live from Olympia throughout the show, whilst a few stands away, the BBC were busily receiving experimental transmissions of Proms concert music for live demonstration in Matrix H Quadrophony.

The new base of this exhibition may not please the hi-fi buff, but will undoubtedly provide greater scope for

imagination in the future.





NEWS BRIEFS

SERT MICROPROCESSOR SYSTEMS and SOFTWARE SYMPOSIUM

More than 140 delegates attended the Society of Electronic and Radio Technicians three-day symposium held at the University of Kent last September. Twenty papers were delivered during the five sessions of this wide ranging programme. Overall the Symposium embraced a broad spectrum of user experience with contributions from active participants in this new technology from universities, technical colleges, semiconductor makers, industry, the Health Service, the Post Office and the National Institute of Agricultural Engineering.

The opening session covered introductory and basic matters. Software is a subject that makes many strong electronics men blanche, whereas the hardware side of the business is reasonably easy to digest. Papers dealing with machine codes and structure and language in software specification and design must have cleared points of doubt or confusion among those

without much experience in program compiling.

SOFTWARE SENSE

A point stressed during the fourth paper was the importance of consulting fully with the user at the initial planning stage and defining precisely the problem to be solved before attempting to construct a flow chart. Subsequent alteration or additions to the software can only be made at considerable expense and trouble. Whereas hardware costs have fallen dramatically, software tends to become more expensive and is the major cost factor in current computer systems. All this indicates a need to organise a method for examining programmes in detail at different steps. Here a leaf could be taken from the hardware engineer's book, for something analogous to circuit fault finding is the obvious answer.

THINGS TO COME

Looking ahead, the same speaker ventured the view that soon microprocessor will speak to microprocessor—and that might spell doom for the human programmer. Software could be available on the shelf in the form of standard modules to

be selected and plugged in just like hardware units.

In the meanwhile, however, the electronics designer has to face reality and get to grips with development systems, programmers, languages, editors, and compilers—subjects which received attention during Session 2 entitled Programming and

System Design.

LOW COST MICROPROCESSOR APPLICATIONS

The Third Session included papers dealing with Low Cost Storage on Audio Cassettes, an MPU System for the Enthusiast or Small Laboratory, and Microprocessors in Education. The presenter of the last paper enthused over US minicomputers, which are available in this country either as complete machines or in kit form, recommending these for students and hobbyists alike.

COMMERCIAL APPLICATIONS

Session 4 was devoted to commercial applications; these included a microprocessor system which has replaced a conventional pneumatic logic control system in a factory air conditioning plant with a claimed 70 per cent energy saving; a system for monitoring and controlling commercial greenhouse environments; and a microprocessor control system for telephone coin boxes. The latter has been developed by Post Office Research to replace existing relay logic systems. The tremendous scaling-down of hardware (and of the circuit diagrams) was demonstrated with illustrations of the existing relay equipment and its probable successor. It is of interest to learn that the Post Office started on this project in 1972 before the first commercial microprocessor had become available.

SOPHISTICATED SYSTEMS

Session 5 was devoted to advanced and unusual uses of microprocessors and included two papers relating to medical applications. Assuredly there is an exciting and socially important role for microprocessors in the Health Services. One example is a microprocessor-based foetal monitoring system devised to overcome the disadvantages of the normal chart recording bedside monitor which has been in use for many years. The system described has been used successfully for monitoring patients in the labour ward of a maternity hospital, and has been well received by medical staff.

The second medical application provided an example of computer assisted learning, a technique which has become well established for education and training in a wide range of subjects. The project described is a training equipment for patients undergoing haemodialysis treatment with artificial kidney machines. The haemodialysis Simulator/Trainer incorporates an Intel 4040 together with an alphanumeric display unit.

SYMPOSIUM PAPERS

Reprints of all the papers presented at this symposium are available in a single volume comprising some 200 pages. publication is available to Practical Electronics readers at the specially reduced price of £7.00 which is inclusive of postage and packing. Orders, with remittance, should be sent to the Secretary, 1977 MPU Symposium (Dept P.E.), S.E.R.T. 8-10 Charing Cross Road, London WC2H 0HP.



ELECTRONIC INVENTIONS 1745-1976 By G. W. A. Dummer Published by Pergamon Press 158 pages, 190 × 275mm. Price £5.50

HIS is an unusual, if not unique, book. A source of reference for serious student work, but also an enticing volume for browsers, perhaps even a bedside book for electronics enthusiasts to dip into.

Brief descriptions of inventions with source reference are given in chronological order. Ample cross reference is provided through separate listings of subjects and inventors, plus an index.

The concept is excellent. The subject is so immense, the task therefore colossal. So the courage of the compiler is to be admired. This kind of reference book courts trouble—since spot the omissions is a game all can play! This reviewer for example was disappointed to find no mention of Messrs. Colpitts, Hartley, Cockcroft or Walton, Foster or Seely, or Wien in the List of Inventors. Truly an unfortunate slight to these gentlemen and their contributions to classic

Under Transistors and Semiconductor Devices we find Esaki and the tunnel diode, also Ovshinsky and the amorphous semiconductor. But absent is Dr. Carl Zener.

What is an electronic invention? The author himself dis-

cusses this tricky definition in the Preface. One could also enquire exactly what is entitled to be referred to as "electronic". Surely not the Phonograph or Gramophone? Yet this invention of Mr. Edison's in 1877 is given a place. There are further examples of equipment or devices which taken on their own have no claim to be considered electronic, yet they are com-monly accepted as so nowadays because in their modern form they are an integral part of some electronic amplifying or control system.

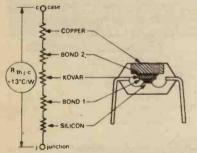
These points of criticism are in fact a kind of compliment to this book, for they demonstrate the fascinating nature of its contents and the thoughts they set going in the reader. The author invites additional data, for possible inclusion in a further edition. It is to be hoped that this work undergoes further research and expansion for it could be the basis of a badly needed central reference source in the field of electronics. But it will require revising and expanding at least once a year!

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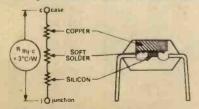
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Supplied with free printed circuit board, heat sink mounting bracket, comprehensive instructions, and suggested applications.

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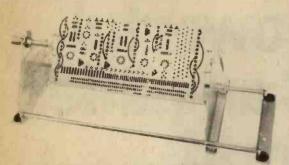
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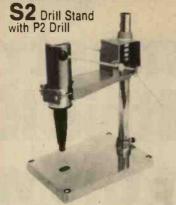
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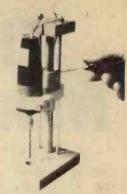
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EDISON THE MAN WHO MADE THE FUTURE

By Ronald W. Clark Published by Macdonald and Jane's 256 pages, 240 × 165mm. Price £6.95

THE Edison story is perhaps the most romantic of all in the realm of invention. From his earliest years Thomas Alva Edison had an enquiring mind that could be satisfied only by intense experimentation. Throughout his life a relentless physical drive coupled to a great creative mind bore a prolific crop of inventions such as no one else has equalled, as evidenced by the vast number of patents in his name.

The talking machine (phonograph), the electric light bulb, and electricity generation and distribution are his most memorable achievements, but there were many others. Not a scientist, but essentially a practical experimenter and innovator, Edison nevertheless was an instigator of research and development, his Menlo Park "invention factory" being the forerunner of

the modern R and D Department.

Edison, the man who made the future is the latest addition to a long list of published biographies. Published this October no doubt to coincide with the centenary of the gramophone, Ronald Clark's book is a good introduction to the great man. There are obvious difficulties in treating adequately this subject within a mere 250 pages; however Edison's life, his inventions and the (often tempestuous) commercial affairs that formed a large part of the Edison story are described in sufficient detail for this purpose. Another feature that will ensure this book's popularity is the historically interesting photographic record presented in 48 pages of sepia prints. This colour, used also for the text, intensifies the sense of history, and plays its part in making this an attractive volume.

PROBLEMS AND SOLUTIONS IN LOGIC DESIGN

By D. Zissos Published by Oxford University Press 146 pages, 155 × 230mm. Price £1.75 Paperback; £3.50 Hardback

M ost elementary books on logic design show how, using Boolean algebra, a minimal logic circuit can be derived from the truth-table. However in practice theoretically correct circuits may not work, due to race-hazards (spikes caused by gate delays), or may need modification to allow for fan-in restrictions (the maximum number of inputs available on each

gate).

Previously these aspects of the design had to be worked out empirically, but in this book Professor Zissos shows how these factors can be taken into account in the design stages by using some elegant methods derived by him. Furthermore he shows how sequential logic circuits too can be systematically designed, using his sequential equations which give the new states of the circuit in terms of its previous states.

Most of the book is taken up with, as its title suggests, worked problems illustrating the various techniques. These fifty-one problems fall under four headings:

Unclocked sequential circuits; e.g. traffic lights, pump controller, panel game, electronic dice.

Clocked sequential circuits, using flip/flops; e.g. word scanner, paper-tape reader, parity circuit.

Counters; e.g. programmable counter, self-locking counter, 24-hour clock.

Combinational circuits; e.g. seven-segment display, binary-togray converter.

As can be seen from the above examples the problems chosen are practical and entertaining, and where the techniques are not explained in quite enough detail the problems provide the necessary supplement. The book assumes no specialist knowledge and should provide anyone with the necessary tools for designing practical digital circuits.

D.J.D.

AN INTRODUCTION TO MICROCOMPUTERS: VOLUME 1-BASIC CONCEPTS By Adam Osborne

This is an expanded version of the chapters forming the first half of an earlier edition of An Introduction to Microcomputers which sold 30,000 copies in the USA. The book deals with microcomputers on two levels. Firstly it contains a very clear description of the fundamental concepts of computing—binary arithmetic and boolean algebra—and explains how a typical microprocessor operates. It comes into its own, however, in the later chapters which cover such subjects own, nowers, in the later chapters which cover studyed answers as input/output and memory addressing, and provide answers to questions like "what is the difference between cycle stealing and simultaneous DMA?" and "why do few microprocessors provide indirect memory addressing?". In dealing with the internal logic of the microprocessor the chip slice is explained, and the book concludes with the compilation and discussion of a hypothetical instruction set.

The book is well illustrated with diagrams clearly drawn and in a uniform style (not just extracted from manufacturers' data as is unfortunately sometimes seen), and a novel technique of dividing the text into sections of boldface type, for fundamental facts, and lightface, for explanations in greater depth. makes the book useful as a reference source. All in all it provides well written, authoritative, and very readable explana-tions of most aspects of microcomputer design.

D.J.D.

A PRACTICAL INTRODUCTION TO ELECTRONIC CIRCUITS

By M. H. Jones Published by Cambridge University Press 237 pages, 175 × 255mm. Price £9.50 Hardcover £3.95 Paperback

An excellent up-to-date text book practically orientated and using well-known circuit devices as illustrations throughout. Explanations are clear and to the point, uncluttered by unnecessary delving into non-essentials. There is no excessive recourse to mathematics. Component values and pin connections are given in the circuit diagrams so that the readers can college out the authoric recommendation to the true readers can follow out the author's recommendation to prove by practise. For Dr. Jones is, as he tells us in the Preface, a staunch believer in learning by constructing and experimenting.

One chapter is devoted to thermionic valves and the cathode ray tube otherwise the book concentrates on solid state devices. The function of bi-polar, field-effect, power and other discrete devices is explained and such devices are then shown in typical applications. Integrated circuits received full attention. The 741 is the most frequently used linear example. One chapter on logic, counters and timers introduces digital i.c.s-TTL, the

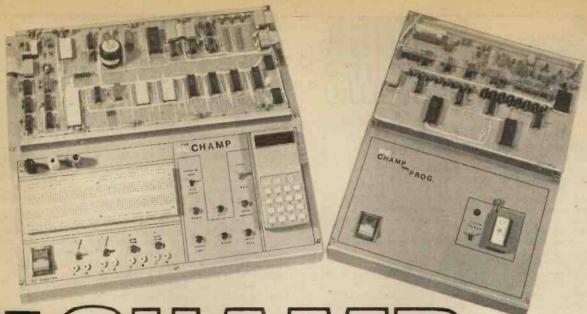
on logic, counters and timers introduces digital 1.c.—111, the 555 timer and alternative forms of logic such as Mos and CMOS.

All the well-known circuit building blocks seem to be covered including one of fairly recent introduction, the bucket brigade. This makes the book a good work of reference apart from its main purpose as a textbook for those who have already some knowledge of simple circuits and who wish to progress with a serious study of the subject. A Practical Introduction in Florencies Circuit and Computer C duction to Electronic Circuits deserves to become a standard work for the hobbyist and student.

STARTING AND RUNNING A SMALL BUSINESS By Alan Sproxton Published by United Writers 130 pages, 210 × 130mm. Price £3.95

THE component retailing business offers plenty of examples of "The Small Business". It is appropriate therefore that a book on this subject should come from the pen of one who has established his own highly successful component business, well-known in the constructor field. Mr. Sproxton's experiences as an entrepreneur have not been limited to electronic components but he has in the past been involved in several different business ventures.

Drawing freely upon all of this wide background the author has written a book that is enjoyable to read and imparts helpful information to the would-be proprietor. The author explains the problems every small owner faces and from personal experience offers sound and valuable advice, interlacing the hard facts of business life with amusing anecdotes and humorous asides. In this free and entertaining approach he has been aided and abetted by Jack Pountney, Art Editor Practical Electronics, who has provided this book with amusing illus-F.E.B.



PE GAMP R.W. COLES B.CULLEN

PART FOUR

Ow that we have examined the circuitry of the CHAMP main board, and the details of its interface with the control panel and keyboard, we are in a position to move into the construction phase. This month we will consider the assembly of the main board, the design and construction of the power supply module, and the assembly of the plinth which supports the main board, and houses the power supply module.

STRIPBOARD LAYOUT

The CHAMP main board consists of a piece of 0 lin matrix Veroboard measuring 304.6 × 165mm (12 × 6.5in). This is an unusually large size for Veroboard, and if you intend to build CHAMP PROG it may be wise to buy two sheets at the same time, because of course CHAMP PROG uses the same type of board.

The board layout and the required track breaks are shown in Fig. 4.1 and Table 4.1. Before working on the board we would recommend chamfering the edges where they slide into the self adhesive card guides, because these guides grip very firmly and this can hamper board removal later.

As far as possible, the Veroboard component geography is similar to the circuit layout of Fig. 2.3, and although there are some differences, constructors should have no difficulty in finding their way around. Notice in particular that the program memory data and address buses, and the four bit m.p.u. bus are each represented by parallel runs of Veroboard copper track. This arrangement is costly in board space, but is more than made up for by the added convenience when wiring up and trouble shooting, and it provides a layout which can be related to the circuit diagram very easily.

SOCKETS

On the prototype board all i.c.s were mounted using Soldercon socket strips. This technique is strongly recommended for three reasons:

- (a) Sockets are essential in Mos systems because of the damage which can occur if an LSI chip ever has to be removed.
- (b) Soldercon pins are the cheapest way of providing sockets.
- (c) Soldercon pins have the advantage that wiring up can take place between the i.c. pins instead of just outside the i.c. pins, as would be necessary with "raft" type sockets. This is a big help when using 0 6in wide chips, and allows maximum use of available board space.

The disadvantage of Soldercon pins is that they are not much good when repeated insertions or withdrawals of the chip is necessary.

This is not a problem with the CHAMP integrated circuits, but the interfacing sockets (SK1-8) certainly will get well used, and consequently conventional low profile 16-way d.i.l. sockets should be used in these positions. It is also possible that constructors of CHAMP PROG will find themselves regularly swopping 4702A chips around on the CHAMP board, and in this case 24-way low profile sockets could be substituted in the IC18 and IC19 positions, although this has not yet been found necessary on the prototype.

You may have noticed that the prototype board sports an extra 28-way Soldercon i.c. socket in the top righthand corner. This was installed in the prototype to allow

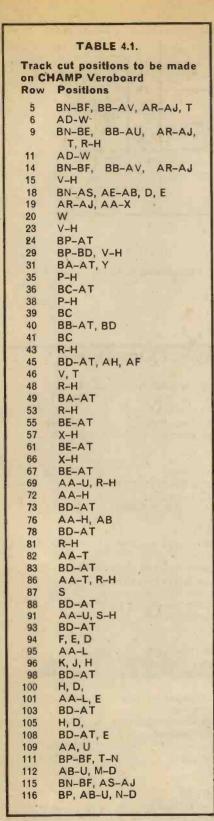
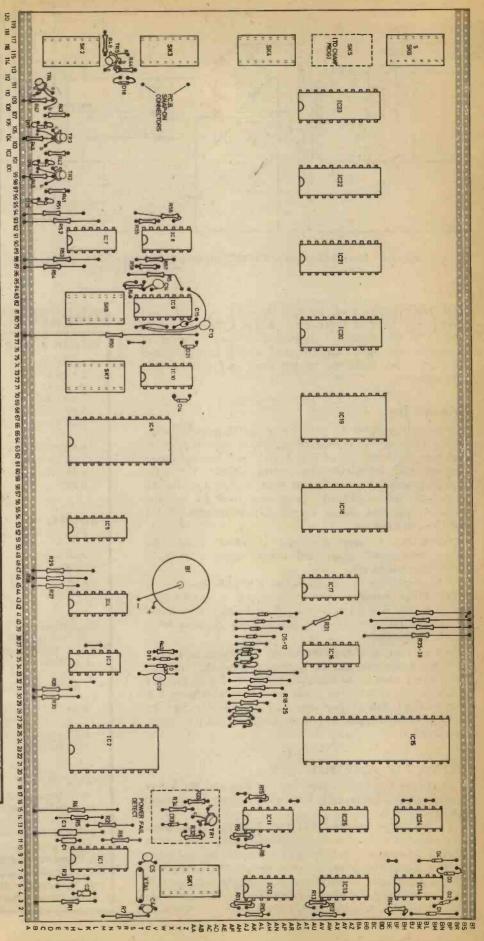


Fig. 4.1. Basic CHAMP board layout. Wiring details of CHAMP complexity cannot be superimposed on this diagram and so for full assembly of this board reference to Fig. 2.3 should be made



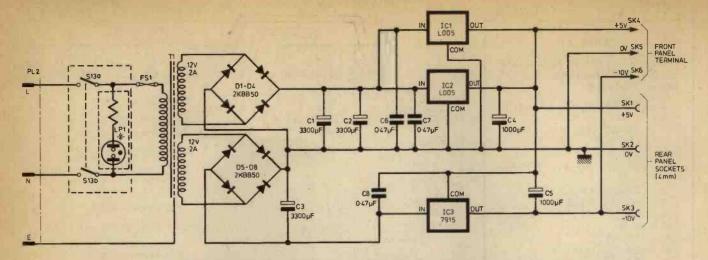


Fig. 4.2. Circuit diagram of CHAMP power supply. Fuse FS1 is only essential if a fused mains plug is not used and should be 2A

the future addition of an 8251 USART or 8253 programmable interval timer chip to the CHAMP board, should it be desirable. With hindsight we consider it unlikely that most constructors would require these facilities, and therefore suggest that this area is left uncommitted.

WIRING UP

It is not possible to produce a comprehensive interwiring diagram for Veroboard circuits of this complexity, but with combined use of Fig. 2.3, Fig. 4.1, and the board photographs, interconnection wiring should be fairly straightforward for the experienced constructor. In the prototype yellow KYNAR wire was used for all the logic wiring, and this is very highly recommended for the following reasons:

- (a) Kynar is very fine and therefore avoids the "Spaghetti" effect which can occur with p.v.c. insulated wire.
- (b) Despite its small diameter, KYNAR has a very tough insulation which is nevertheless easy to strip.
- (c) KYNAR is silver plated which helps you to avoid dry joints and assures you of high integrity interconnections.

The disadvantage of KYNAR is that it seems to be difficult to find in amateur suppliers' catalogues at the moment. It is widely used in the electronics industry for its primary purpose of wire-wrapped joints and is available from R.S. Components, but if you are unable to secure any, be sure to substitute the very finest single strand p.v.c. wire you can find.

GETTING IT TOGETHER

Once the board has been cut to size and the edges chamfered, track breaks can be made, which conform to

The Soldercon pins and d.i.l. sockets should be soldered in position first, to provide a reference framework for the discrete components and the interwiring, but the bandolier strip to which the Soldercon pins are attached should be left in place until construction is complete, as this will help prevent any distortion or loss of pins during soldering. The exact order in which the discrete components

COMPONENTS . . .

A CONTRACTOR OF THE PARTY OF TH		
CHAMP POWE	R SUPPLY & MAINFRA	ME
Capacitors		
2 off 0·1μF	30V ceramic disc	C9, C10
3 off 0.47μF	Ceramic disc	C6, C7, C8
2 off 100μF	35V tant bead	C11, C12
2 off 1,000μF	25V electrolytic	C4, C5
3 off 3,300μF	25V electrolytic	C1, C2, C3
Semiconductor	s	
2 off L005	Regulator	IC1, IC2
1 off 7915	Regulator (Technomatic)	IC3
2 off	Bridge rectifier	THE PLAN
	2 Amp (I.R. 2KBB50)	B1, B2
0.444		
Switches	Doram type sub min	S1, S2, S11,
4 off s.p.d.t.	Doram type sub min	S12
4 off c/o	Doram type min push	S5. S6-S8
2 off n.c.	Doram type min push	S3, S4
2 off n.o.	Doram type min push	S9, S10
1 off d.p.s.t.	Doram type-illuminating	S13
	rocker switch	
Miscellaneous		
	V, 25VA winding	
	assis mounting plug	
3 off 4mm	Socket/terminal post	SK4, SK5,
		SK6
1 off 16-pin	d.i.l. socket (or other connector)	SK7
1 off	Experimenter 300	
	Breadboard	
8 off 2mm	Sockets	SK8-SK15
3 off 4mm	Sockets	SK1, SK2,
		SK3

CONSTRUCTOR'S NOTE

The large sheets of Veroboard can be obtained from A. Marshall (London) Ltd. A suitable transformer for T1 can be obtained from Doram, order code: 66-150-6, or RS Components, order code: 207-251.

Card guides for the CHAMP main board may also be obtained from Doram, order code: 68-337-1.

The breadboard (EXP300) is available from Continental Specialties Corporation (UK) Ltd., Spur Road, North Feltham Trading Estate, TW14 0TJ.

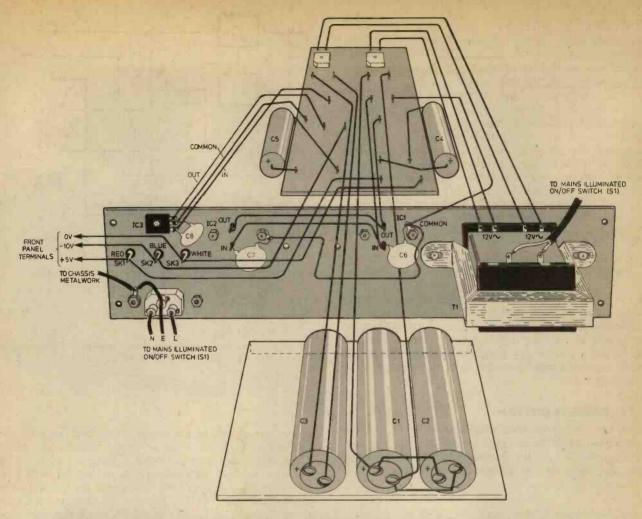


Fig. 4.3. Exploded view and wiring layout of CHAMP power supply. The p.c.b. and the large electrolytic support plate are both mounted on the CHAMP back-plate

and the interwiring are added, is best left to individual preference, but of course, the Mos chips should not be plugged into their places until construction is complete, to prevent accidental damage. The last component to be mounted should be the DEAC stack, and in fact it might be wise to add this only after the circuit has been checked with power applied.

The power connections to the board are made via three wander plug terminated flying leads, and these are made with p.v.c. insulated flexible wire soldered to terminal pins inserted in the CHAMP board power bus tracks. Terminal pins are also used to provide the keyboard power, and two are situated adjacent to SK3 for this purpose, wired to +5V and 0V respectively.

The 16-way interconnection jumpers from SK7 to SK8, and from SK1 to the front panel socket can ideally be made up using ribbon cable, and 16-way plugs of the penetrating "no solder" variety such as those made by T & B Ansley, which was the method used in the prototype. The main problem with these components is availability; putting them together was found to be easy even without the special tools made for the purpose, and much more convenient than making soldered connections. An alternative to the ribbon cable system is to use d.i.l. "header plugs" with soldered multiway cable, a more tedious but perfectly sound solution.

POWER SUPPLY CIRCUIT

The CHAMP power supply is designed to provide sufficient current to power the main board, the CHAMP-PROG board, and any reasonable combination of interface circuitry on the breadboard socket. The specification therefore calls for a +5V supply at 1A, and a -10V supply at 750mA. In practice these current specifications have been comfortably exceeded.

The circuit of the power supply module is shown in Fig. 4.2, and as can be seen, the design is fairly conventional, using fixed voltage regulators to set the output potential and provide the necessary high quality regulation. The positive supply uses two L005 devices in parallel to meet the current requirement, but there is no reason why LM309Ks should not be substituted directly if available. The LM309K will also provide a higher current capability if this should be necessary, although to take full advantage of this, the bridge rectifier would have to be changed to a 4 amp unit to prevent overheating.

A negative regulator from the 79' series i.c.s is used to provide -10V but since -10V units are not available, a 15V device (the 7915), is used with its common terminal referenced not to zero volts, but to the +5V output from the L005s.

This configuration works well with no compromise of the short circuit protection provided in the regulator.

POWER SUPPLY LAYOUT

The power supply is built as a module which can be tested independently of the other CHAMP components, and which can be removed easily from the plinth as and when necessary. The module uses the aluminium back panel of the plinth as its main structural component and also as a heat sink for the regulators and transformer. The large electrolytic smoothing capacitors are supported by an aluminium tray which rests on the bottom panel of the plinth for stability, and for the sake of neatness, some of the circuit interconnections are provided by a printed circuit board which mounts on a bracket also attached to the back panel.

Figure 4.3 shows the overall arrangement and the connections required, and this should be compared with the photograph of the unit assembled in the plinth. The printed circuit board layout is shown in Fig. 4.4, although 0.15 in matrix Veroboard or even pin-board could be used instead if p.c.b. making is not your area of interest.

The only thing to remember when wiring up the unit, is that wire of sufficient diameter to handle the currents involved should be used, and that all terminals conducting mains voltage should be properly insulated. It is of course essential that all exterior metalwork be connected to the mains earth to prevent any danger of electric shock, and CHAMP should always be used with a 13 amp plug fitted with a 2 amp fuse.

PLINTH CONSTRUCTION

The plinth design has been simplified as far as possible so that construction is straightforward, but as you can see, the appearance of the finished unit is very pleasing to the eye. Materials and dimensions are given in Figs. 4.5 and 4.6.

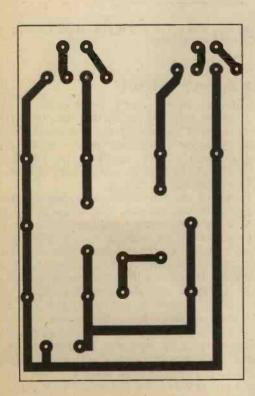
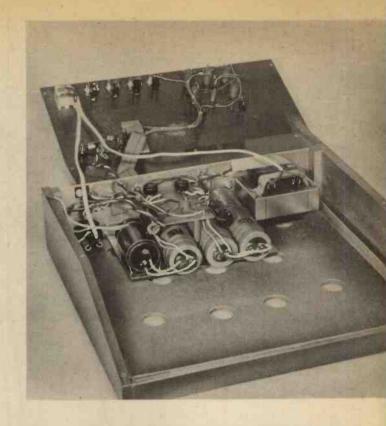


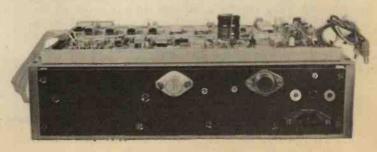
Fig. 4.4. Printed circuit layout of CHAMP power supply, p.c.b.

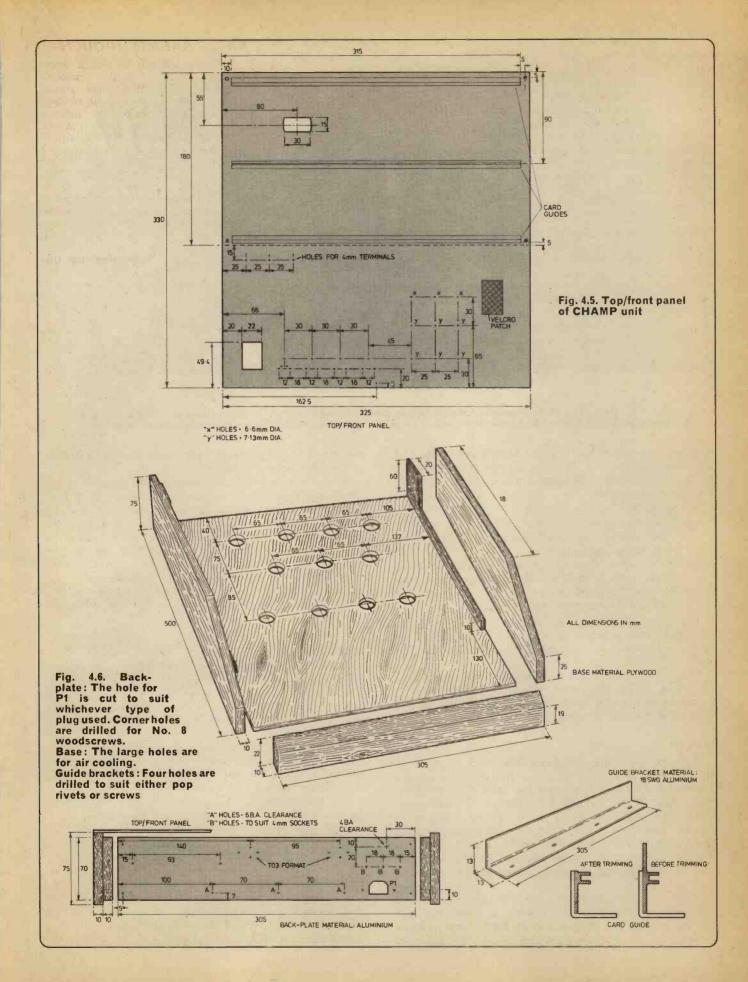


The first step is to cut the plywood parts to size, and it is important at this stage to ensure that the two plinth side members are identical. This is achieved by clamping the sides together with G clamps, or binding with tape before finally trimming both to size. On the inside bottom edge of the sides, mark a line equivalent to the thickness of the bottom panel, and similarly on the inside rear edge, mark a line equivalent to the thickness of the back panel, and finally, on the front edge draw a line equivalent to the thickness of the front edging strip.

The plywood runners should be cut to fit inside these marks, and then pinned and glued in position with a woodworking adhesive such as Evostick Resin W. If a large illuminated mains on/off rocker switch like the one in the prototype is used, it will probably be necessary to truncate the left-hand plywood runner to provide the necessary clearance for the switch body. The bottom panel, when cut to size, should have a number of air holes drilled in it to allow for convection cooling of the power supply module, whereupon it can be primed and glued to the sides and the front edging strip.

It is a good idea to temporarily attach the aluminium back panel at this stage, so that the plinth is properly aligned while the glue hardens. The aluminium top panel or cover should be carefully cut to size, and all the





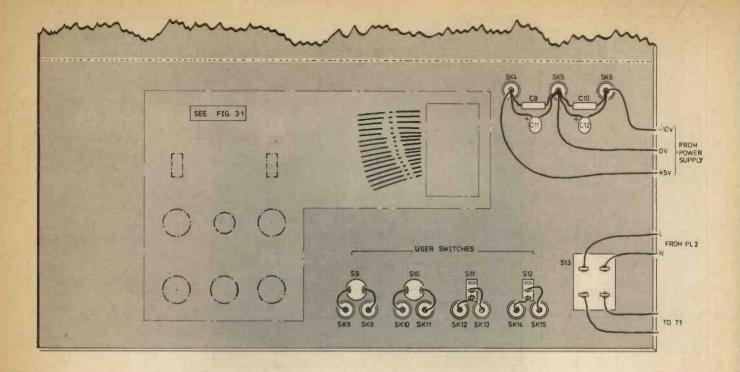


Fig. 4.7. Rear view of front panel wiring. A 16-way connector (d.i.l. socket in the prototype) enables all leads from the CHAMP board to be disconnected at once. Details given match Doram type pushbutton switches

necessary component locating and fixing holes drilled and deburred. The bend in the cover can be produced fairly easily, even without a bending machine, if the following procedure is followed:

- (i) Mark the bend line in pencil.
- (ii) Clamp the panel to a workbench with the aid of a stout straight edge, with the pencil mark aligned with the straight edge.
- (iii) With another stout straight edge press evenly down on the panel, bending it only a few degrees at a time.
- (iv) Remove the panel often and check it against the plinth until the desired angle is obtained.

The cover should now be screwed to the plinth and the edges trimmed before the L shaped brackets and card guides are bolted (or pop-riveted) into position (see Fig. 4.6).

It is a good idea to use the CHAMP main board as a jig while finally positioning the card guides prior to fixing, to ensure that the board is not too loose or too tight when assembly is complete.

FINISH

A lot of care was taken over the finish imparted to the CHAMP prototype, and we feel that the results achieved, justify the small amount of extra effort involved. When the "fit" of the plinth components is satisfactory, the cover should be removed and the plywood base given two or three coats of aerosol primer. Allow the primer to dry and sand down to a fine surface between coats. A top coat of a suitable colour can then be applied; in the case of the prototype, a metallic cellulose paint was used, with attractive results.

The cover should be rubbed down all over with wet and dry paper or fine Emery to provide a good "key" for the primer which is applied, and as before, apply two or three coats. A contrasting metallic finish was chosen as

the top coat, and several light coats should be applied until a good finish is achieved.

Before the outlines and lettering are applied to the cover, the paint should be allowed at least two days to harden off to prevent damage to the finish. The outlines are first pencilled in with the aid of a soft pencil, then inked over with either drawing ink or a spirit based felt tipped pen. (Do not use a water based ink, or the lines will run when varnish is applied.)

All necessary lettering is applied with Letraset, or a similar dry transfer technique, before the application of a coat of clear polyurethane varnish to give a durable protective finish.

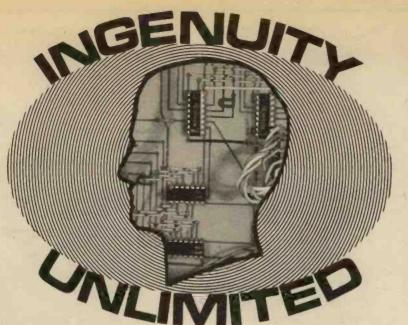
ASSEMBLY

When the plinth is complete, the front panel components can be fitted and wired up as in Fig. 4.7. The use of a 16-pin d.i.l. socket as a termination adds to the modularity of the design, but is not strictly necessary. Terminal pins and soldered connections could be used instead if desired.

The ribbon cable, or loom, from the front panel is taken through the large hole in the cover to appear under the main board, so that it can be unobtrusively mated with the appropriate d.i.l. socket.

The power supply module should be thoroughly tested in isolation before the main board is plugged in, and it is wise to do comprehensive voltage checks on the main board before any chips are plugged in. It will not be possible to get CHAMP to run properly at this stage because the keyboard has not been described, and the CHAMP firmware will not be available, but if desired, the clock chip can be plugged in and the clock and reset waveforms checked with an oscilloscope, as can the SYNC pulses emanating from the 4040 cpu chip.

NEXT MONTH: Keyboard design and construction



A selection of readers' original circuit ideas. It should be emphasised that these designs have not been proven by us. They will at any rate stimulate further thought.

Why not submit your idea? Any idea published will be awarded payment according to its merits.

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.

Each idea submitted must be accompanied by a declaration to the effect that it is the original work of the undersigned, and that it has not been accepted for publication elsewhere.

CAR LIGHTS ALARM TO LIGHTS CIRCUIT +12V LIGHTS SWITCH R2 10kn C2 22µF 16V AWD TO IGNITION CIRCUIT ZS170 R3 10kΩ +12V IGNITION DI SWITCH R4 10k0 BFS59 D2 R1 100k0 TR1 TR2 ZTX 450 ZTX300 ZTX 300 ZS170 22µF 16V

Fig. 1

THE alarm circuit shown in Fig. 1 can save the embarrassment of a flat battery due to forgetting to turn off the side lights. The alarm will sound for about five seconds after the ignition is switched off, so if the lights are needed for parking the alarm is eventually silent. This circuit is designed for negative earth cars. For positive earth vehicles, p.n.p. transistors would have to be used, and the capacitors and ZS170 diodes reversed.

The circuit can be built on a piece of stripboard. It is then connected to the car earth, and to the lighting and ignition switches as indicated in Fig. 1.

If the RS Components type audio alarm is used, which has an average current of 60mA and peaks of IA, then a high current transistor should be used for TR3.

When both lights and ignition are on, TR2 is on, which holds TR3 off. Also TR1 is on because C1 is charged

up. When the ignition is turned off, TR2 turns off, and is temporarily kept off by TR1 being on for five seconds by the charge on C1. When this charge decays, TR1 goes off and TR2 switches back on, thus inhibiting the alarm.

The circuit works very well, and gives a short sharp reminder to turn off the lights.

A. J. Buxton, Stockport, Cheshire. THE circuit in Fig. I was intended as a rear light bulb failure indicator for cars, but could be used for any light source monitoring. Numerous designs for this purpose have appeared over the years, but this is probably the simplest method possible (and should therefore be the most reliable!), having only three components.

The l.d.r. (R2) is mounted in a convenient position within the lamp housing, with the active face directed towards the filament. When the bulb is illuminated, R2 has a low resistance thereby short circuiting the l.e.d. which consequently remains off. If, however, the bulb blows, the resistance of the l.d.r. rises causing the voltage across D1 to increase sufficiently for it to light up.

The circuit as shown, is for a 12V negative earth system. For positive earth vehicles, reverse the l.e.d., and for 6V systems reduce R1 to 470Ω. In any case, the warning circuit should be wired on the correct side

LAMP FAILURE INDICATOR

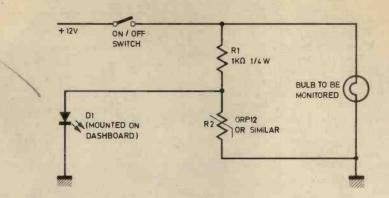


Fig. 1

of the on/off switch to ensure that no current consumption takes place while the lights are turned off.

If there is insufficient room within the lamp housing for the l.d.r., a small hole can be drilled through the reflector, angled towards the filament, and the i.d.r. mounted behind it.

G. H. Lucas, Leicester.

A LTHOUGH this circuit was designed for the six digit common anode display of a CT7001 digital clock i.c. it could be modified for use with other types of seven segment display.

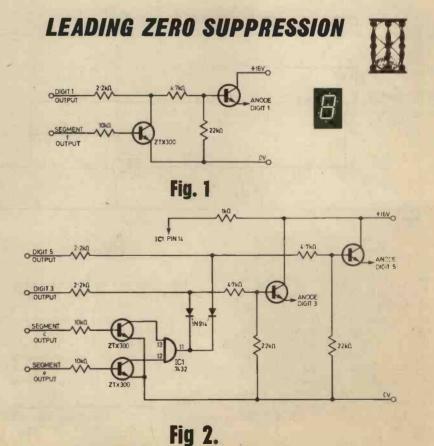
Zero blanking in the tens-of-hours digit is normally achieved by using the circuit shown in Fig. 1. The count here is either 1 or 2, depending upon whether a 12 or 24 hour display is used. At segment f it is possible to detect the presence of a zero, and suppress the display.

However, to blank the zeros in tens-of-minutes and tens-of-seconds where the count climbs to 5, two segments have to be used, and segments c and e are selected, as it is only in a zero format that both of these segments are active at the same time.

In Fig. 2, a 7432 or gate is used to detect a zero. The output of the gate connected to the digit driver will only be low when the inputs connected to segments c and e are both low. As this only happens when a zero is present, all other figures from 1 to 5 will be displayed, while a zero which requires both segments, will be inhibited.

Only one gate is required, as the output is fed via diodes to the tens-of-minutes and tens-of-seconds digit drivers.

G. Ballantyne, Clydebank, Dunbartonshire.





POLARITY PROTECTOR

THE home experimenter can all too easily destroy expensive components at the anxious moment of trying out a circuit, by hastily applying reversed polarity to the supply input.

Time and money can be saved by simply fitting a bridge rectifier to the circuit, as shown in Fig. 1. Polarity of the applied power is now unimportant. The sacrifice made for the benefit of this precaution is that a volt or more will be lost across the rectifying diodes, but more often than not, this voltage loss will be inconsequential.

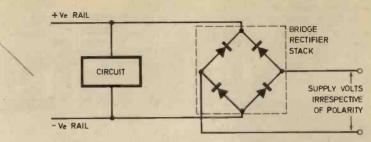


Fig. 1

This idea is particularly suitable for car radios and cassette players. where the vehicle may have a positive or negative earth electrical system. P. M. Freeman. Nottingham.

LOGIC PROBE

Having seen many different types of TTL logic probes advertised in magazines varying in price from £5-£25, I was prompted to design this circuit which has many of the features of a probe in the £9-£12 range, yet it only costs about £1 to build.

The circuit (Fig. 1) was built onto an old "fat" ball point pen tube, which had flying leads for +5V and OV connections.

When A is at 0 the output of IC1a is at 1, so l.e.d. D3 is on, indicating the "low" state.

When A is at 1, because of the inverter, IC1 pin 5 is at 0, so the

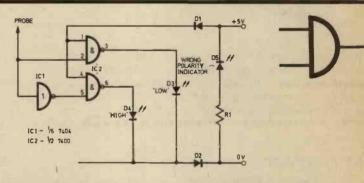


Fig. 1

output of IC1b is at 1 and D4 is on, indicating a "high" state.
D1 and D2 are included to protect

the circuit against wrong polarity

R1 is chosen to give correct operating current for D5.

J. Scott Patterson. East Lothian.

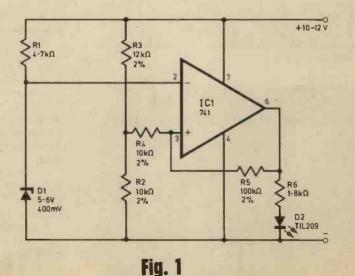
HIS circuit was built to replace an expensive meter in a radio control transmitter.

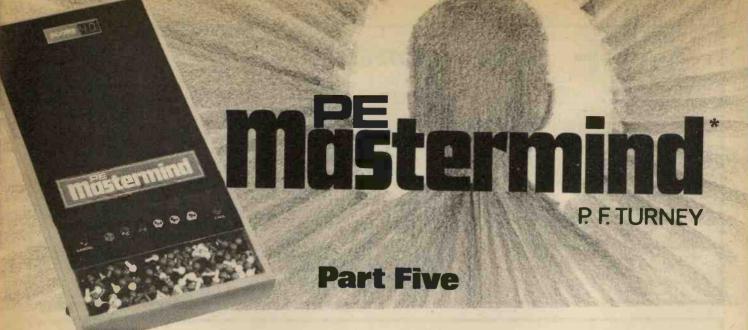
The NiCad battery used is nominally 12 volts, with a maximum of nearly 14V when fully charged. When discharged, the cell voltage should not fall below 1 volt; that is, 10 volts for the battery.

The circuit of Fig. 1 is a Schmitt trigger operating an l.e.d. indicator. The reference voltage is provided by the 5.6V Zener diode, and hysteresis is set by the ratio of R4 and R5 to about 1 volt. The trip voltage is set by the ratio of the potential divider resistors, R2 and R3. For accurate setting, R3 could be replaced by a variable resistor. When the battery falls to 10 volts the output of IC1 goes low and turns off the l.e.d., which remains off until the battery rises to at least 12 volts again. The total cost is very much less than the cheapest meter.

A. Langton, Aberdeen.

BATTERY CONDITION INDICATOR





Last month it was seen how the position indicator signal handled the situation of repeated internal colours with both "P" and "I" correct entries. The final section of the scoring logic, dealing with the cases where there are repeated internal colours with only "I" correct entries, is to be considered this month, together with the display logic.

THE RESET LOGIC

The existence of this logic was mentioned last month and rather than to now undertake a full operational description the approach will be to illustrate its action with a series of actual examples.

The basic function of this logic is highlighted by the example shown in Fig. 5.1. Below is shown a sequence of events executed by the machine in response to the colours of this example.

(2)-(4) no further change of status (except for clearing of "S"s).

Fig. 5.1. Example showing the need for the reset logic X CODE R R 0 П -1 0 0 0 ENTRIES 0 0 0 0 0 0 0 .0

Table 5.1

TRUTH TABLE FOR THE RESET LOGIC

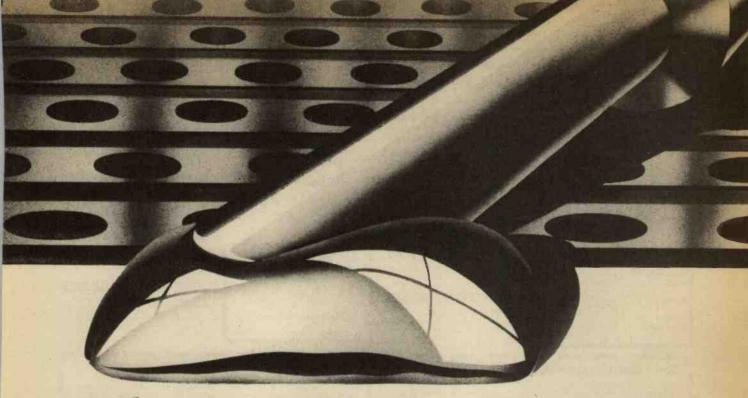
s	lave \$	Status		Re	set fu	nction	is A	A Flip	Flop P's
Sı	S ₂	S ₃	S ₄	R ₁	R ₂	Ra	R ₄	JA3	JA4
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	1
0	1	0	0	0	0	0	0	0	0
0	1	0	1	0	0	0	1	0	K
0	1	- 1	0	0	0	1	0	K	0
0	1	1	1	0	0	1	1	1	0
1	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	1	0	0
1	0	1	0	0	0	1	0	0	0
1	0	- 1	1	0	0	1	1	0	0
1	1	0	0	0	1	0	0	0	0
1	1	0	1	0	1	0	1	0	0
1	1	1	0	0	1_	1	0	0	0
1	1	1	1	Do	n't care	cond	ition		

It is seen that I₂, I₃ and I₄ are all set, giving an incorrect score of three white key pegs. It is the function of the reset logic to reset two of these flip flops and produce the correct score of one white key peg. By convention I₃ and I₄ are reset with I₂ retained. The truth table for this and all other examples of reset logic operation is shown in Table 5.1. The final two columns of this table will be discussed a little later.

In the example just considered "S" flip flops S_2 , S_3 and S_4 were all set by a single entry, corresponding to a slave status of 0.111 in the truth table, which shows that I_3 and I_4 are to be reset to logical zero ($R_3 = R_4 = 1$).

These resets are enabled by clock pulse $C_5\overline{C}$ from the comparison counter, and there are two reasons why this must be so. Firstly, by the time $C_5\overline{C}$ appears all flip flops will have been clocked and given time to set, and secondly,

^{*} Mastermind is the registered trade mark of Invicta Plastics Ltd



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had a "P" correct entry been made the PI signal would have gated clears to any "I" and "S" flip flops also set by the entry, prior to the appearance of $C_5\overline{C}$. If more than one "S" flip flop has remained set by the time $C_5\overline{C}$ appears, it is known that only "I" correct entries have been made and the reset logic can therefore be enabled.

The slave status 1111 can never occur, since in this situation one entry would be "P" correct (1111 means that the entry is correct for colour with all internal colours and so must be correct for position with one of them), and all slaves would be cleared prior to $C_5\overline{C}$.

IC48 and 49, shown in Fig. 5.2, are used to implement these reset functions.

THE "A" FLIP FLOPS

The example of Fig. 5.3 will be used to demonstrate the requirement for two more flip flops. The sequence of events is summarised below.

Only P_2 remains set and an incorrect score would be indicated. What has happened is that P_2 in (2) clears I_2 which was retained in (1) by the reset logic, reducing the score by one white key peg. Had the reset logic been organised to clear I_2 and I_3 and retain I_4 instead there would still be input combinations that would be wrongly scored.

The solution to this dilemma is to use conditional deletions or clears, and the "A" filp flops are used to indicate whether or not a clear is conditional. No detailed description of these flip flops is to be given and their operation is illustrated by way of example, see Fig. 5.3 and the sequence of events below.

(1) Enter Red $C_2\overline{C} - C_4\overline{C}$ $C_5\overline{C}$	K high S ₂ , I ₂ ; S ₃ , I ₃ and S ₄ , I ₄ set I ₃ and I ₄ reset by reset logic. A ₃ set to indicate that I ₃ was conditionally reset
(2) Enter Red	L high Slaves cleared
C ₀ C	P ₂ sets and clears and inhibits I ₂ and S ₂ . PI high
C₃¯C	S_3 , I_3 set. PI line Is inhibited from clearing S_3 and I_3 by $\overline{A}_3 = 0$ at input to gate 3 of reset level 2
0.5	(see Fig 4.1)
C₄Ĉ	I ₄ , S ₄ set and promptly cleared by
C₅Ē	No action (only S ₃ set)
400 440 ML	

(3)-(4) No change

The score is now the correct score of one black and one white key peg. Flip flop A_4 serves for I_4 in a similar fashion, no example is to be given for this case.

The set conditions for the "A" flip flops are shown in the last two columns of Table 5.1. The entries of K (from

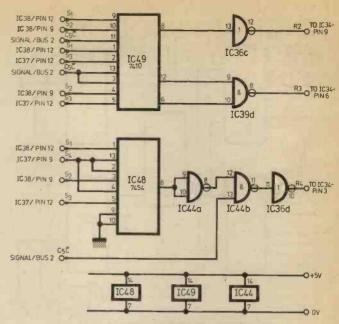


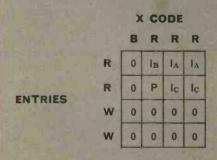
Fig. 5.2. The reset logic circuitry

the entry counter) in these columns indicate that only if the corresponding slave status arises in response to a first entry is a conditional reset necessary. Note that the status 0101, for example, can arise only if an entry is made in position 1 or in position 3 (otherwise it would be "P" correct), and only In position 1 is the retained "!" flip flop I₂ subject to a possible reset by the occurrence of a "P" correct entry in position two.

0111 GATE

This is a two input NAND gate (IC39c) that acts to inhibit the PI line from resetting I_4 when the 0111 status arises, which can only be in response to a first entry. A full discussion of its role is somewhat involved and is for this reason not included here.

Fig. 5.3. Example illustrating three reset modes of the scoring logic



The reset modes are as follows:—(a) I_A—cleared by "reset logic"; (b) I_B—cleared by P₂ (clear and inhibit function); (c) I_C—cleared by PI enabling "Reset Level 2".

As explained in the text, the score given here is incorrect, and so necessitating the use of the "A" flip flops.

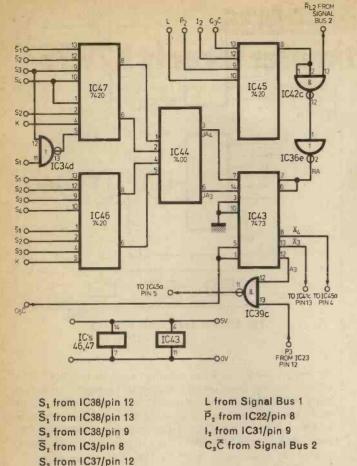


Fig. 5.4. The "A" flip flop and associated logic. Locations for i.c. pin outs are also listed

CLEARING THE "A" FLIP FLOPS

S, from IC37/pin 9

C₈C̄ from Signal Bus 2 K from Signal Bus 1

Both these flip flops are cleared by the reset signal R_{L2}, but A₃ is additionally cleared via IC45. The reason for this is that unless A₃ is cleared as soon as it has served its purpose it can in certain circumstances incorrectly inhibit the PI line from clearing I₃.

A type SN7473N dual JK flip flop is used for A_3 and A_4 , shown in Fig. 5.4 together with the set and reset logic, ICs 43; 44, 46 and 47; and 45b respectively.

DISPLAY LOGIC

Conventional display logic is employed using two SN7447N seven segment decoder drivers coupled to a type DL727 dual seven segment I.e.d. display (see Fig. 5.5). This display must only be enabled when the final results are available from the scoring logic. For this reason signal N from IC20, the entry counter, is taken to the BI/RBO (Blanking input/Ripple blanking output) of both drivers, so that these are only enabled following the fourth entry made, and until such time as a subsequent deduction is commenced. Signal N is buffered by IC19 and 27 before being taken from board one to board two.

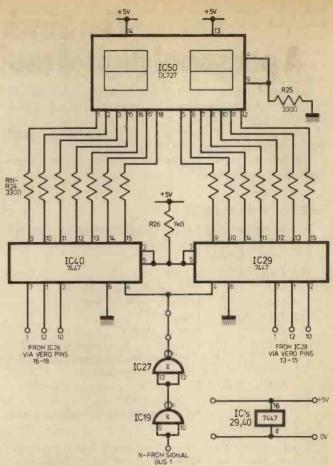


Fig. 5.5. Circuitry for the display logic

Strictly the BI/RBO should be used in conjunction with an open collector gate, but in this application the internal output is disabled by ensuring that the RBI never assumes the value of logical zero.

Limiter resistors are necessary between the decoder and the displays. Do not use values of resistance below approximately 180 ohms in an effort to achieve greater brightness from the displays. (A value of 330 ohms, as given in the list of components, was used for these resistors in the prototype).

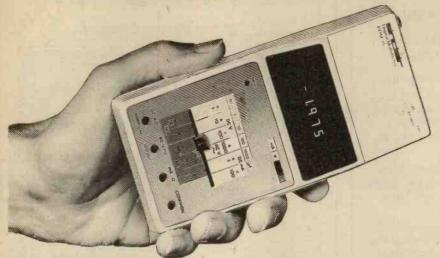
CONSTRUCTION

The remaining section of the scoring logic is wired on the main board (Board 1), with i.c. positions as shown in Fig. 5.6. As usual, all wiring is carried out using single cored wire on the top side of the board, reference being made to the circuit diagrams of Fig. 5.2 and 5.4 as appropriate.

Remember that an i.c. should be carefully positioned and orientated on the board before any of the copper tracks are broken and any connections made.

The display circuits are wired onto Board 2. The details of this board are given in Fig. 5.6. One important point to remember here is that the DL727 display is viewed through the cut-out on the peg board. It is therefore a very wise precaution to check that the final position of this display on Board 2 lines up exactly with this cut-out when the board is mounted in the casing. The display itself should be mounted using, for example, solder-con pins.

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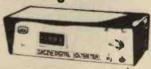


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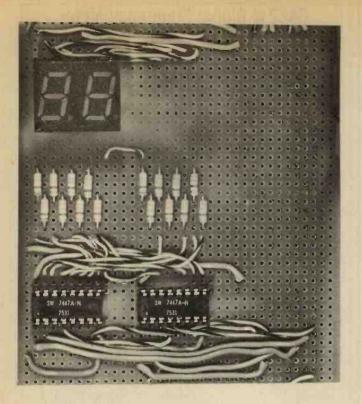
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In the test schedule last month it was suggested that temporary connections be made between pins 9, 6 and 3 of IC34 and 0V in order to perform worthwhile testing. Do remember to remove any such connections before proceeding with this month's construction!

FINAL TESTING

The ultimate test of any piece of equipment is to connect it up and try it! The scoring may be checked by monitoring the internal X codes and comparing the achieved scores with those expected from appropriately chosen combinations of inputs. Advantage may be taken of any occurrences of repeated X codes to verify that the reset logic and "A" flip flops are performing correctly.

Remember that fault tracing may be expedited by slowing down the internal clock as described in part three. To help those who do meet with problems a list of likely oversights is given below.

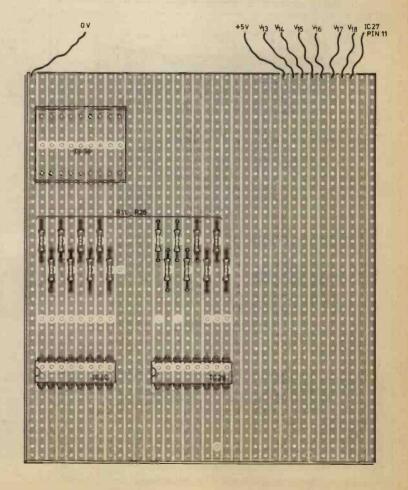
- (a) Check i.c. power connections—these are easily missed!
- (b) Make sure that you have not forgotten to solder in any i.c. pins.
- (c) Check for shorting Veroboard tracks.
- (d) Forgotten any Veroboard breaks?

Finally, it may be mentioned that there is a golden rule with non-operative TTL built systems: Always suspect your wiring first and the IC last!

Fig. 5.6. Component layout for the display logic. A photo of the prototype is shown above. For assembly details Fig. 5.3 should be referred to

COMPONENTS ...

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ADDRESS(Block cap	os please)

NEWS BRIEFS

Sound Transmission by Infra-red Light

NEW multi-channel infra-red sound transmission system A has recently been demonstrated in this country. The Sennheiser Intraport System designed and manufactured in West Germany by Sennheiser is a large-scale development from the cordless headphones system for domestic hi-fi equipment first introduced at the Berlin Audio Fair 1975. Equipment

is available for up to nine channel operation.

The demonstration was arranged by Hayden Laboratories Limited, of Chalfont St. Peter, Bucks, the U.K. distributors, and took place at Shepperton Film Studios. The whole of one stage area was saturated at high intensity from a number of strategically placed i.r. radiators (aerials). Each infra-red power radiator contains a bank of diodes and the power stage electronics. An automatic level setting amplifier ensures a low distortion radiation at maximum power.

The transmitter contains the exciter circuits of the multi-channel unit and the power supply for up to eight power radiators. A high frequency carrier is frequency-modulated by the audio signal. The transmitter output feeds the active radiators, where the emitted infra-red light is amplitude-modulated by the carrier. A special connection cable contains a coaxial lead for the r.f. signal and two d.c. supply leads for the power

The receiver is incorporated in the headset. This is fitted with a channel selector switch and houses standard batteries. Mounted on the headset, facing forward, is the infra-red

receiving diode.

Reception is not entirely dependent upon direct line-of-sight with the radiators, since the i.r. radiation is reflected from light-coloured walls and objects, and so a strong field can be built-up within the room or hall. The number of radiators nature of the surrounding surfaces. The system's only limitation is that it cannot function in bright environments (over 300ft candles). required depends upon the area to be covered and the reflection

Using the standard headset PE's representative found that excellent reception was obtainable anywhere within the stage area, a fall-off in signal and increase in background noise being experienced when the wearer closely approached the dull-coloured distant walls, but a sheet of polystyrene of about

The system is stated to be ideal for conference halls, factories and other large, moderately well-lit areas. Since solid surfaces are opaque to infra-red no radiation "leaks" out of the enclosed area, thus the infra-red system has great possibilities for "security sensitive" applications.

No licence is required for this type of wire-less communica-

tion.

POINTS ARISING

DIGITAL REACTION TIMER (November 1977)

The p.c.b. conductor layout in Fig. 2 does not show the necessary copper cladding extension around the fixing holes, which allow the stiff copper wire p.c.b. anchors to be soldered. This omission should be catered for. Also, the fixing holes themselves need not be as large as indicated in Fig. 3.

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Complete kit of parts including construction plans

Total building costs £9.00 P.P. and Ins. £1.10

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Build this converter kit and receive the aircraft band by placing it by the side of a radio tuned to medium wave

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

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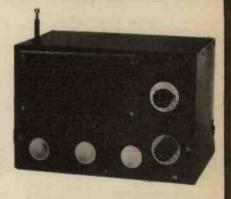
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All parts including Case and Plans.

Total Building costs £4.95 P. & P. + Ins. 90p

E.V.7. Case and looks as above, 7 Transistors and 3 diodes. Six wavebands, MW/LW, Trawler Band SW1, SW2, SW3, powered by 9V battery. Push pull output. Telescopic aerial for short waves. 3in. Loudspeaker. All parts including Case and Plans.

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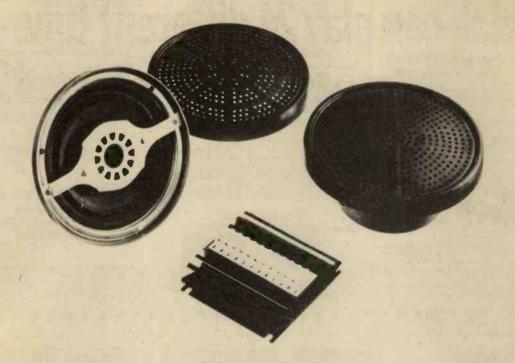
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A novel feature is that the amplifier is automatically switched on or off by sensing the power line of the radio/tape unit hence alleviating the need for an on/off switch.

The amplifier is sealed into an integral heatsink and is terminated by screw connectors making installation a very easy process.

The S15 has been specially designed for car use and produces performance equal to domestic speakers yet retaining high power handling and compact size.

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15 watts per channel into 4Ω Distortion 0-2% at 1kHz at 15 watts
Frequency response $50\text{Hz}{-}30\text{kHz}$ Input Impedance 8Ω nominal
Input sensitivity 2V R.M.S. for 15 watts output
Power line $10{-}18\text{V}$ Open and Short circuit protection
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Size $4 \times 4 \times 1$ inches

C15/15 Price £17.74 + £2.21 VAT. P. & P. free

Data on S15
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O/P Powers available. 25W-40W-75W-150W-300W-400W-500W-1kW-1-5kW, Various battery I/P voltages available.

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P.E. ORION STEREO AMPLIFIER & TUNER

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20 + 20 Watts r.m.s. into 8 ohm load. Distortion less than 0-1% 100Hz-10kHz. Frequency response ± 162 DNz to 20kHz. Hum levely virtually nil with volume full on. This is a power amplifier of superb quality incorporating the very latest design features. Professional hi-fl enthusiasts have classed it as fantastic and real value for money. The CCT incorporates a low flux transformer and inputs for disc, tape, tuner, etc.

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8 inch system

This system is designed for use with above amplifiers rated up to 25W r.m.s. per channel at 8 Ω . May be incorporated in an enclosure 295 x 490 x 295mm (11-5 x 19-3 x 11-5in) approx. external, constructional details of which are given with each bass unit, to provide an overall frequency response of 50Hz to 22Hz. Four-element cross-over, ready constructed on p.c.b. Output leads have push-on receptacles to suit speaker tags. Cross-over frequency is $2\cdot8$ kHz approx.

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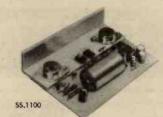
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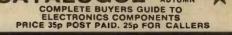
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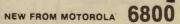
CD4000 0.24 CD4018 1.15 CD4041 CD4001 0.24 CD4019 0.70 CD4042

800	1.10	CD4023	0-24	CD4046	1.52
009	0.64	CD4024	0-84	CD4047	1-15
010	0.64	CD4025	0.24	CD4049	0.64
011	0.24	CD4027	0.64	CD4050	0-64
012	0.24	CD4028	1.02	CD4051	1.06
013	0.60	CD4029	1.30	CD4052	1.06
014	1-15	CD4030	0 - 64	CD4053	1.06
015	1 - 15	CD4031	2.53	CD4054	1.32
016	0.64	CO4035	1-34	CD4055	1.50
017	1.15	CDAD27	4.40	CD4056	1.50

	CD4025 0	.24	CD4049	0.64	CD4070	0.66	(
	CD4027 0	-64	CD4050	0-64	CD4071		1
	CD4028 1	-02	CD4051	1.06	CD4072	0 - 25	(
	CD4029 1	- 30	CD4052	1.06	CD4073	0 - 25	K
	CD4030 0	-64	CD4053	1.06	CD4075	0 - 25	K
	CD4031 2	-53	CD4054	1 - 32	CD4076	1-17	1
	CD4035 1	1-34	CD4055	1.50	CD4077	0.66	1
į	CD4037 1	1 - 10	CD4056	1.50	CD4078	0.25	E

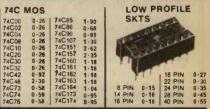


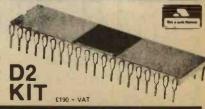
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Practical Electronics December 1977

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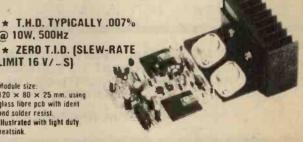
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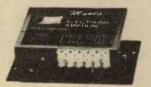
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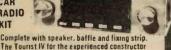
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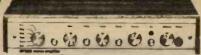
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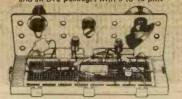
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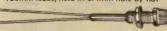
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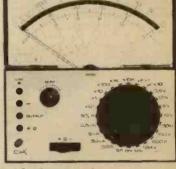
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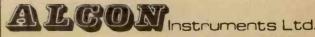


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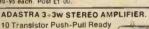
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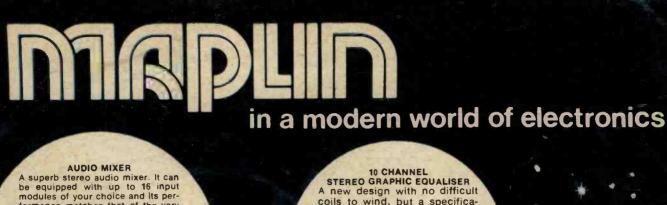
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