Australia 85c South Africa 80c
New Zealand 85c Malaysia $2.25

PRACTICAL ELECTRONICS

JULY 1978

45p

PE TV GAME CENTRE

14 GAMES – COLOUR or BLACK and WHITE

ALSO... OSCILLOSCOPE LOGIC MONITOR

PRACTICAL
ELECTRONICS

VOLUME 14 No. 11 JULY 1978

CONSTRUCTIONAL PROJECTS

GENERAL FEATURES

NEWS AND COMMENT

Our August issue will be on sale Friday, 14 July 1978
(for details of contents see page 849)

GREENWELD

443 Millbrook Road Southampton

SO1 OHX Tel:(0703) 772501

All prices quoted include VAT. Add 25p UK/BFPO Postage. Most orders despatched on day of receipt. SAE with enquiries please. MINIMUM ORDER VALUE £1. Official orders accepted from schools, etc. (Minimum invoice charge £5). Export/Wholesale enquiries welcome. Wholesale list now available for bona-fide traders. Surplus components always wanted.

SEMICONDUCTORS

Diodes; 1N4001/2 **5p**; 4004/5 **7p**; 4006 **8p**; 4007 **9p**; 1250V 1A, **10p**; 1250V 1.5A, **12p**; 50V 3A **10p**; 100V 3A, **12p**; 400V 3A, **15p**; 200V 10A stud, **40p**; 400V 10A stud, **48p**.

Bridge Rectifiers.

50V 1A **26p**; 200V 1A **32p**; 400V 1A **36p**; 100V 2A **48p**; 400V 2A **58p**; 100V 4A **65p**; 400V 4A **80p**; 100V 6A **74p**; 400V 6A **98p**.

400mW Zeners 2V 7 to 36V, **10p** each. 1.3W Zeners 3V3-200V, **20p**.

10 watt zeners from 4V3 to 200V **93p**.

OA81 **5p**; OA91, **8p**; 1N4148, **4p**.

SCR's

0.8A	60V	TO92	**35p**
1A	400V	TO5	**60p**
4A	200V	TO220	**52p**
4A	400V	TO220	**70p**
6A	200V	TO220	**56p**
6A	400V	TO220	**75p**
6A	400V	TO66	**80p**
10A	100V	TO220	**82p**
10A	200V	TO220	**87p**
10A	400V	TO220	**120p**
10A	600V	TO220	**148p**

Triacs

6A	400V	TO220	**98p**
8A	600V	TO220	**135p**
15A	200v	TO220	**135p**
15A	400V	Stud	**220p**

TRANSISTORS

AC127	18p	BC548	10p	BRY56	40p
AC128	18p	BC549	10p	OCP71	120p
AC176	18p	BCY70	15p	TIP41A	56p
AC187	20p	BCY71	15p	TIP42A	66p
AC188	20p	BCY72	14p	TIP2955	86p
AD149	70p	BD131	38p	TIP3055	42p
AD161	40p	BD132	40p	TIS43	35p
AD162	40p	BD133	48p	2N2646	60p
AF279	75p	BD137	40p	2N2905	21p
BC107	12p	BD138	40p	2N2926	12p
BC108	10p	BD139	42p	2N3053	28p
BC108C	12p	BD140	44p	2N3054	52p
BC109	12p	BF173	20p	2N3055	50p
BC109C	15p	BF181	30p	2N3442	130p
BC147	10p	BF194	10p	2N3702	10p
BC148	10p	BF195	10p	2N3703	10p
BC149	10p	BF196	10p	2N3704	10p
BC157	10p	BF197	12p	2N3705	10p
BC158	10p	BF200	28p	2N3706	10p
BC159	10p	BFR39	24p	2N3708	10p
BC182	12p	BFR79	26p	2N3710	10p
BC183	12p	BFX29	22p	2N3819	28p
BC184	12p	BFX48	32p	2N3904	15p
BC212	14p	BFX84	22p	2N3906	15p
BC213	14p	BFX88	22p	2N6027	55p
BC214	14p	BFY50	18p	2N6028	60p
BC441	32p	BFY51	18p	40673	65p
BC461	32p	BFY52	18p		
BC547	10p	BRY39	40p		

74 Series TTL

7400	12p	7447	84p	7410.	37p
7401	14p	7450	15p	74121	36p
7402	14p	7451	14p	74122	51p
7404	17p	7453	14p	74123	64p
7405	23p	7454	14p	74132	56p
7406	28p	7460	14p	74141	63p
7408	14p	7472	29p	74150	173p
7410	14p	7473	29p	74151	79p
7413	28p	7474	29p	74154	144p
7414	62p	7475	51p	74155	73p
7420	14p	7476	29p	74157	66p
7427	36p	7483	91p	74159	200p
7430	14p	7485	132p	74164	126p
7432	28p	7486	40p	74174	110p
7437	36p	7490	46p	74179	120p
7438	36p	7491	75p	74180	120p
7440	15p	7492	52p	74190	188p
7442	65p	7493	52p	74191	158p
7445	88p	7495	73p	74192	120p
7446	88p	7496	85p	74193	120p
				74367	120p

C-MOS

4000	18p	4018	84p	4054	100p
4001	18p	4022	90p	4055	110p
4002	18p	4023	18p	4060	96p
4007	18p	4024	64p	4071	18p
4011	18p	4027	48p	4081	18p
4012	48p	4028	78p	4510	132p
4013	48p	4040	110p	4511	212p
4016	48p	4047	78p	4528	124p
4017.	84p	4049	48p	4588	256p

LINEAR & MISC IC's

741 **25p**. *MC3302 Quad comp **120p**. 555 **40p**. *710 diff comp (TO99) **40p**. 556 **100p**. *7105 LED digit driver 8 for **£1**. LM380 **100p**. *ZN1034E Precision timer **£2.25**. LM301 **30p**. *SLD2128 Dual 128 bit static shift register **£1.50**.

*Supplied with data. If requested.

1977/8 CATALOGUE

48 BIG pages packed with over 4,000 items, many of them illustrated. Discount vouchers worth 50p. PRICE **30p + 15p** post. (Overseas send **60p** surface or **£1** airmail.) Also included is our current Bargain List. Send SAE for bargain list alone.

BUY A COMPLETE RANGE OF COMPONENTS AND THESE PACKS WILL HELP YOU

★ *SAVE ON TIME—No delays in waiting for parts to come or shops to open!*

★ *SAVE ON MONEY—Bulk buying means lowest prices—just compare with others!*

★ *HAVE THE RIGHT PART—No guesswork or substitution necessary!*

ALL PACKS CONTAIN FULL SPEC, BRAND NEW, MARKED DEVICES— SENT BY RETURN OF POST. VAT INCLUSIVE PRICES.

K001 50V ceramic plate capacitors, 5%, 10 of each value 22pF to 1000pF. Total 210. **£3·35**

K002 Extended range, 22pF to 0·1µF. 330 values **£4·90**

K003 Polyester capacitors, 10 each of these values: 0·01, 0·015, 0·022, 0·033, 0·047, 0·068, 0·1, 0·15, 0·22, 0·33, 0·47µF. 110 altogether for **£4·75**

K004 Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for **£3·75**

K005 Polystyrene capacitors, 10 each value from 10pF to 10,000pF, E12 series 5% 160V. Total 370 for **£12·30**

K006 Tantalum bead capacitors. 10 each of the following: 0·1, 0·15, 0·22, 0·33, 0·47, 0·68, 1, 2·2, 3·3, 4·7, 6·8, all 35V; 10/25 15/16 22/16 33/10 47/6 100/3. Total 170 tants for **£14·20**

K007 Electrolytic capacitors 25V working, small physical size. 10 each of these popular values: 1, 2·2, 4·7, 10, 22, 47, 100µF. Total 70 for **£3·50**

K008 Extended range, as above, also including 220, 470 and 1000µF. Total 100 for **£5·90**

K021 Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M, E12 series. Total 610 resistors, **£6·00**

K022 Extended range, total 850 resistors from 1R to 10M **£8·30**

K041 Zener diodes, 400mW 5% BZY88, etc. 10 of each value from 27V to 36V. E24 series. Total 280 for **£15·30**

K042 As above but 5 of each value **£8·70**

PC ETCHING KIT MK III

Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. £3·90

CALCULATOR CHIP

Type C500 by G1, 4 function + constant. 8 digit. Multiplexed output for simple keyboard interfacing. 24 pin DIL. With comprehensive data + socket **£1·50**

DARLINGTON COMP PAIR

BD696A and BD696A—45V 8A 70W plastic power!! gain 750 @ 4A. PNP-NPN pair **£1·50**

VERO OFFCUTS

Pack A, All 0·1" Pack B, All 0·15"
Pack C, Mixed Pack D, all 0·1" Plain

Each pack contains 7 or 8 pieces with a total area of 100 sq. in. Each pack is **£1·30**. Also available by weight. 1lb **£4·20**, 10lb **£32·50**.

17 x 3¾" Strips: 0·1" **£2·20**; 10 for **£15**
0·15" **£1·96**
0·1" Plain **£1·83**

EDGE CONNECTORS

Special purchase of these 0·1" pitch double-sided gold-plated connectors enables us to offer them at less than one-third of their original list price!

18 way **41p**; 21 way **47p**; 32 way **72p**; 40 way **90p**; 49 way **111p**.

DIGITAL VOLTMETER/THERMOMETER KIT

Based on the 7106 single IC 3½ digit D.V.M. the Kit contains a PCB, resistors, capacitors, presets, I.C. and 0.5" liquid crystal display. Components are also included to enable the basic D.V.M. kit to be modified to a Digital Thermometer using a single transistor as the sensor.

ONLY £23.75

TRIAC BARGAINS

400V Plastic Case

3A	68p
6.5A with trigger	86p
8A	85p
12A	90p
16A	113p
20A	178p
25A	205p
SCR (C106D) 5A/400v	54p
Diac	23p

* SPECIALS *

4 x 555	£1.08
4 x 2N3055	£1.19
5 x 741	£1.08
LM3911	97p

OPTO ELECTRONICS

0.2" L.E.D.s

Red 11p (86p/10)
Green 23p
Yellow 27p
DL727 0.5" display £1.62

TIMER I.C.s

555	31p
ZN1034E	£1.94
AY–5–1230	£5.24
AY–5–1224	£3.51

MINI MAINS TRANSFORMERS

Standard 240V mains primary 100mA secondary

6–0–6V	92p
9–0–9v	97p
12–0–12v	102p

24HR CLOCK/APPLIANCE TIMER KIT

Switches any appliance of up to 1KW on and off at preset times once a day. KIT contains: AY–5–1230 Clock/Appliance Timer IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triac, complete with PCBs and full instructions. £14.85

White box (56 x 131 x 71mm) – drilled £2.70
– undrilled £2.38

TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring. Insulated Touch Plates. Easy to follow instructions.

TSD300K – TOUCHSWITCH & DIMMER combined. One touch plate for on/off. Small knob controls brightness.	£5.62
TS300K – TOUCHSWITCH. TWO touch plates. ON and OFF.	£4.32
TSA300K – AUTOMATIC. ONE touch plate. Preset time delay OFF.	£4.32
LD300K – 300W LIGHT DIMMER KIT.	£3.02

ABOVE PRICES INCLUDE V.A.T.

Quantity discounts on request. Add 25p postage and packing. Mail order only to:

T.K. ELECTRONICS (PE) 106 Studley Grange Road, London, W7 2LX.

46p 1·5µH

AND OTHER PROJECTS

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

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

OVERSEAS enquiries for list: Europe—send 20p: other countries—send 50p.

KIMBER-ALLEN KEYBOARDS AND CONTACTS

Kimber-Allen Keyboards as required for many published circuits. The manufacturers claim that these are the finest moulded plastic keyboards available. All octaves are C to C, the keys are plastic, spring-loaded, fitted with actuators, and mounted on a robust aluminium frame.

3 Octave (37 notes)	£25·50
4 Octave (49 notes)	£32·25
5 Octave (61 notes)	£39·75

Contact Assemblies (gold-clad wire) for use with the above keyboards (1 required for each note):

Type GJ: Single-pole change-over	each 24p
Type GB: 2 pairs of contacts, each pair normally open	each 27p
Type GC: 3 pairs of contacts, each pair normally open	each 36p
Type GE: 4 pairs of contacts, each pair normally open	each 45p
Type GH: 5 pairs of contacts, each pair normally open	each 57p
Type 4PS: 3 pairs of contacts plus single-pole changeover	each 53p

Printed Circuit Boards for use with GJ, GB and 4PS contacts (thus eliminating much interwiring) are available. Details in our lists.

RHYTHM GENERATOR

15-Rhythm Tempo, Timing and Logic control unit (excl. sw's but incl. PCB)	£12·90
10-Instrument Effects circuits	£13·56
PCB for Effects circuits	£4·25
Power Supply incl. PCB	£12·00

128-NOTE TUNE-PROGRAMMABLE SEQUENCER

(P.E. Nov/Dec 77)

Enables a voltage controlled synthesiser to automatically play pre-programmed tunes of up to 32 pitches and 128 notes long. Programs are keyboard initiated and note length and rhythmic pattern are externally variable. (Please use order codes quoted in brackets.)

Main Circuit (Nov) excl. sw's (KIT 76-1)	£20·60
Power Supply (KIT 76-3)	£6·05
Trigger Inverter and Alt. Output (KIT 76-2)	£1·35
LED Counter (KIT 76-4)	£2·45
PCB (as published) for KITS 76-1 & 3 (PCB 76A)	£2·61
PCB for KITS 76-2 & 4 (PCB 76B)	£2·54

P.E. STRING-ENSEMBLE (P.E. commencing Mar 78)

The new keyboard string-instrument synthesiser.

Power Supply Basic component set	£9·22
Tone Generators (incl. Test components)	£14·93
PCB for PSU and Tone Generator	£3·40

Details of further kits and PCBs in our list.

FORMANT SYNTHESISER (Elektor 1977/78)

Very sophisticated music synthesiser for the advanced constructor who puts performance before price. Details in our lists.

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

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

Component set (incl. PCB)	£11·95

DISCOSTROBE (P.E. Nov. 76)

4-channel light-show controller giving a choice of sequential, random, or full strobe mode of operation.

Basic component set	£18·19
Printed circuit board	£3·45

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

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

Pre-Amp Module Components set (incl. PCB)	£4·22
Basic Output Circuits—combined component set with PCBs, for alphaphone, cardiophone, frequency meter and visual feed-back lampdriver circuits.	£6·59
Audio Amplifier Module Type PC7	£7·75

10% DISCOUNT VOUCHER (PE67)

TERMS: Correctly costed, C.W.O., U.K. orders over £40 goods value. Valid until end of month on cover of P.E. This voucher must accompany order.

TRANSISTORS

AC128	26p
AC176	26p
BC107	14p
BC108	14p
BC109	14p
BC109C	15p
BC177	14p
BC184	12p
BC187	25p
BC204	14p
BC209C	14p
BC213	15p
BC214	15p
BC262	25p
BC415	16p
BC478	29p
BD131	44p
BD132	54p
BF244A	24p
BF245A	24p
BSY95A	22p
MD8001	172p
OC71	20p
OC72	30p
RPY58A	48p
TIS43	50p
ZTX108	9p
ZTX301	13p
ZTX384	16p
ZTX501	13p
2N2219	27p
2N2646	50p
2N2905	35p
2N2905A	36p
2N2906	22p
2N2907	22p
2N3054	66p
2N3055	60p
2N3702	12p
2N3704	12p
2N3819	35p
2N3820	64p
2N3823E	39p
2N5459	45p

INTEGRATED CIRCUITS

301 8-pin DIL	48p
318 8-pin DIL	230p
320-15	58p
324 14-pin DIL	87p
341-15	195p
709 8-pin DIL	48p
723 TO5	105p
723 14-pin DIL	56p
726 TO5	980p
741 8-pin DIL	32p
748 8-pin DIL	63p
4024 14-pin DIL	46p
4069 14-pin DIL	18p
4136 14-pin DIL	126p
7805 TO220	205p
7806 TO220	205p
7808 TO220	205p
7812 TO220	205p
7815 TO220	205p
7818 TO220	205p
AY10212 16-pin DIL	650p
AY16721/6	195p
CA3046 14-pin DIL	90p
CA3080 8-pin DIL	82p
CA3084 14-pin DIL	209p
M252 16-pin DIL	680p
MC3340 8-pin DIL	150p
MCM6810 24-pin DIL	670p
SG3402N 14-pin DIL	262p
STK025	595p
TDA1022 16-pin DIL	672p
XR2207 14-pin DIL	420p
ZN425E 16-pin DIL	375p

PRICES ARE CORRECT AT TIME OF PRESS.
E. & O. E. DELIVERY SUBJECT TO AVAILABILITY.

PHONOSONICS

WIRE WRAPPING CENTRE

HOBBY WRAP Model BW 630

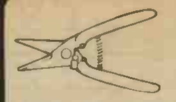
Battery Wire-Wrapping Tool Complete with Bit and Sl Line

NEW

WIRE-WRAPPING TOOL
For .025" (0,63mm) sq post "MODIFIED" wrap, positive indexing, anti-overwrapping device.

A	For AWG 30	BW-630
B	For AWG 26-28	BW 2628
C	Bit for AWG 30	BT-30
D	Bit for AWG 26-28	BT-2628

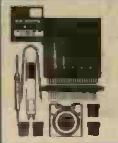
A £24·77 B £29·58 C £2·61 D £6·89



OK PLIERS AND CUTTERS
UNIVERSAL CUTTER
Cuts everything. Leather, wire, plastic, tin-plate, cardboard. Stainless steel blades.
Just one of the range of high quality pliers, cutters, tweezers and screwdrivers.

3136 £3·20

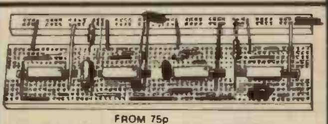
3 IN 1 WIRE DISPENSER
New wire dispenser cuts and strips three different colours of wire. Quick and easy to use pocket size.
£3.77



WIRE WRAPPING KIT
Contains: Hobby Wrap Tool WSU-30 M, Wire Dispenser WD-30-B, (2) 14 DIP's, (2) 16 DIP's, Hobby Board H-PCB-1, DIP/IC Insertion Tool INS-1416 and DIP/IC Extractor Tool EX-1.

Wire-Wrapping Kit	WK-4B (Blue)

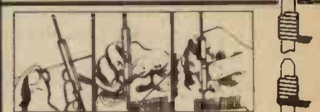
£17·80



FROM 75p

TERMINAL AND DISTRIBUTION STRIPS
Bread boarding building blocks with universal matrices of solderless plug-in tiepoints.

- Facilitate quick, solderless circuit build-up and check-out on universal .1" x .1" matrix.
- Are offered in ten configurations.
- Accept all components with leads up to .032" diameter.
- Require no special patch cords.
- Includes integral non-shorting instant mounting backing.

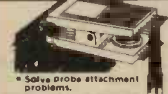


HOBBY WRAP TOOL
Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0,63mm) Square Post.

Regular Wrap	WSU-30	£4·39
Modified Wrap	WSU-30M	£4·69

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER

14-16 Pin Dip IC Inserter	INS-1416	£2·58



IC TEST CLIPS

FOR DUAL-IN-LINE PACKAGES

- Provide full access to integrated circuit DIP leads.
- Remove DIP's damage free.
- Available in sizes to accommodate all DIP's; TC-14 fits 14-pin DIP's etc.
- Solve probe attachment problems.
- Simplify prototype and production testing, field service work, and quality control.

£2·75

DIP SOCKET
Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, gold plated pins, .025 (0.63mm) sq., .100 (2,54mm) centre spacing.

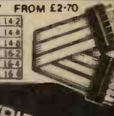
14 Pin Dip Socket	14 Dip
16 Pin Dip Socket	16 Dip

FROM 14p

DIP/IC EXTRACTOR TOOL
The EX-1 Extractor is ideally suited for hobby enthusiast or lab engineer. Featuring one piece spring steel construction. It will extract all LSI, MSI and SSI devices of from 8 to 24 pins.
Extractor Tool EX-1 £1·10

RIBBON CABLE ASSEMBLY FROM £2·70

With 14 Pin Dip Plug 2" Long	DE 14 2
With 14 Pin Dip Plug 4" Long	DE 14 4
With 14 Pin Dip Plug 8" Long	DE 14 8
With 16 Pin Dip Plug 2" Long	DE 16 2
With 16 Pin Dip Plug 4" Long	DE 16 4
With 16 Pin Dip Plug 8" Long	DE 16 8



DISTRIBUTORS WANTED * * *

OK Machine & Tool U.K. Limited
48a The Avenue Southampton SO1 2SY
Telephone Southampton (0703) 38966 7 Telex 477222 Cablegram OKMAC

DISTRIBUTORS WANTED * * *

ASTRA-PAK

92 GODSTONE ROAD
WHYTELEAFE SURREY CR3 0EB

All prices include V.A.T. Add 25p for P&P (Extra for overseas). Discounts over £10 less 5%, over £20 less 10%, over £50 less 15%, over £100 less 20%.
Send SAE for complete list of components.

7400	0.12	7492	0.44	74181	1.92	74LS75	0.45	74LS293	0.90	4052	0.84
7401	0.12	7493	0.40	74182	0.75	74LS76	0.32	74LS298	1.60	4053	0.84
7402	0.12	7494	0.80	74184	1.20	74LS78	0.32	74LS352	0.92	4054	1.10
7403	0.12	7495	0.54	74185A	1.20	74LS83	0.78	74LS353	1.05	4055	1.00
7404	0.13	7496	0.60	74186	7.20	74LS85	0.90	74LS365	0.50	4060	0.98
7405	0.13	7497	2.38	74188	2.70	74LS86	0.35	74LS366	0.50	4066	0.48
7406	0.28	74100	0.94	74190	1.05	74LS93	0.95	74LS367	0.50	4067	3.50
7407	0.28	74104	0.40	74191	0.99	74LS95	1.10	74LS368	0.50	4068	0.24
7408	0.14	74105	0.40	74192	0.99	74LS107	0.36	74LS386	0.37	4069	0.17
7409	0.14	74107	0.28	74193	1.05	74LS109	0.36	74LS670	2.00	4070	0.17
7410	0.13	74109	0.45	74194	0.90	74LS112	0.38			4071	0.17
7411	0.18	74110	0.46	74195	0.84	74LS113	0.36			4072	0.17
7412	0.21	74111	0.70	74196	0.90	74LS114	0.36	4000	0.14	4073	0.17
7413	0.25	74116	1.60	74197	0.90	74LS123	0.82	4001	0.15	4075	0.17
7414	0.54	74118	0.82	74198	1.48	74LS124	2.45	4002	0.16	4076	1.05
7416	0.27	74119	1.30	74199	1.48	74LS125	0.44	4006	0.92	4077	0.46
7417	0.27	74120	0.82	74221	1.50	74LS126	0.44	4007	0.16	4078	0.22
7420	0.13	74121	0.25	74273	2.15	74LS132	0.69	4008	0.92	4081	0.17
7421	0.28	74122	0.40	74279	1.25	74LS136	0.40	4009	0.45	4082	0.20
7422	0.17	74123	0.53	74283	1.70	74LS138	0.53	4010	0.48	4085	0.72
7423	0.25	74125	0.44	74284	6.85	74LS139	0.53	4011	0.15	4086	0.76
7425	0.20	74126	0.45	74293	1.35	74LS151	1.05	4012	0.16	4089	1.55
7426	0.25	74128	0.62	74298	1.92	74LS153	0.50	4013	0.42	4093	0.65
7427	0.25	74132	0.68	74390	1.92	74LS154	1.20	4014	0.80	4094	1.80
7428	0.34	74135	0.68	74393	2.12	74LS155	0.86	4015	0.77	4095	1.10
7430	0.13	74136	0.75			74LS156	0.86	4016	0.42	4096	1.10
7432	0.24	74137	0.94			74LS157	0.47	4017	0.77	4097	3.50
7433	0.32	74141	0.58	74LS00	0.19	74LS158	0.53	4018	0.87	4098	1.12
7437	0.24	74142	2.00	74LS01	0.19	74LS160	1.22	4019	0.42	4099	1.90
7438	0.24	74143	2.00	74LS02	0.19	74LS161	0.69	4020	0.92	4404	1.00
7440	0.13	74144	2.00	74LS03	0.19	74LS162	1.22	4021	0.82	4412	0.30
7441	0.52	74145	0.64	74LS04	0.20	74LS163	0.69	4022	0.82	4428	0.80
7442	0.55	74147	1.30	74LS05	0.20	74LS164	1.20	4023	0.15	4445	1.50
7443	0.90	74148	1.18	74LS08	0.19	74LS168	2.00	4024	0.66	4449	0.30
7444	0.90	74150	0.99	74LS09	0.19	74LS169	2.00	4025	0.15	4501	0.17
7445	0.70	74151	0.60	74LS10	0.19	74LS170	1.76	4026	1.28	4502	0.88
7446	0.70	74153	0.60	74LS11	0.19	74LS173	1.05	4027	0.50	4507	0.50
7447A	0.64	74154	1.05	74LS12	0.19	74LS174	1.12	4028	0.67	4508	2.25
7448	0.60	74155	0.63	74LS13	0.46	74LS175	1.05	4029	0.86	4510	1.05
7450	0.13	74156	0.63	74LS14	1.10	74LS189	2.85	4030	0.48	4511	0.98
7451	0.13	74157	0.63	74LS15	0.19	74LS190	0.81	4031	2.34	4512	0.92
7453	0.13	74159	1.70	74LS20	0.19	74LS191	0.81	4033	1.25	4514	2.85
7454	0.13	74160	0.80	74LS21	0.19	74LS192	1.80	4034	2.00	4515	2.80
7460	0.13	74161	0.80	74LS22	0.19	74LS193	1.80	4035	1.00	4516	1.02
7470	0.28	74162	0.80	74LS26	0.24	74LS195	1.12	4036	2.40	4518	0.99
7472	0.22	74163	0.80	74LS27	0.40	74LS196	1.20	4037	0.99	4519	0.50
7473	0.26	74164	0.89	74LS30	0.19	74LS197	1.20	4038	1.00	4520	1.05
7474	0.26	74165	0.89	74LS32	0.25	74LS221	1.12	4039	2.80	4521	2.00
7475	0.30	75166	0.99	74LS37	0.27	74LS247	0.97	4040	0.88	4522	1.35
7476	0.26	74167	2.70	74LS38	0.27	74LS248	0.97	4041	0.77	4527	1.60
7480	0.45	74170	1.68	74LS40	0.19	74LS249	0.97	4042	0.72	4528	0.92
7481	0.90	74172	4.00	74LS42	0.53	74LS251	1.00	4043	0.82	4529	1.10
7482	0.80	74173	1.18	74LS47	0.97	74LS253	1.05	4044	0.82	4536	3.56
7483	0.72	74174	0.89	74LS48	0.97	74LS257	1.05	4045	1.40	4553	4.20
7484	0.90	74175	0.68	74LS49	0.97	74LS258	1.05	4046	1.32	4555	0.85
7485	0.88	74176	0.88	74LS51	0.19	74LS266	0.39	4047	0.96	4556	0.85
7486	0.26	74177	0.88	74LS54	0.19	74LS273	2.50	4048	0.60	4558	1.25
7489	2.00	74178	1.20	74LS55	0.20	74LS279	0.50	4049	0.42	4566	1.40
7490	0.35	74179	1.10	74LS73	0.30	74LS283	1.00	4050	0.42	4583	0.75
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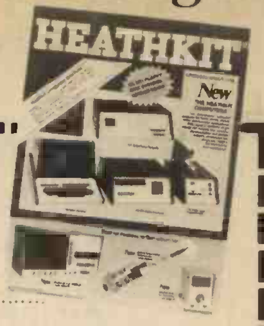

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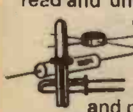

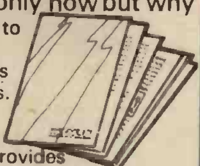

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HY5
Preamplifier

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 appropiate 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.
SPECIFICATION: Output Power—15W R.M.S. into 8Ω. Distortion—0·1% at 15W. Input Sensitivity—500mV. Frequency Response—10Hz–16kHz –3dB.

Price £5·22 + 65p VAT. P. & P. free

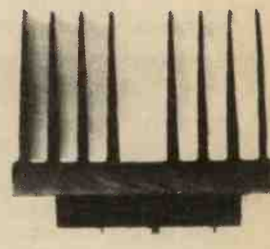
HY50
25W into 8Ω

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-fi systems; low power disco; guitar amplifier.
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

HY120
60W into 8Ω



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; no external components.
APPLICATIONS: hi-fi; high quality disco; public address; monitor amplifier; guitar and organ.
SPECIFICATION: Input Sensitivity—500mV. Output Power—60W R.M.S. into 8Ω. Load Impedance—4–16Ω. Distortion—0·04% at 60W at 1kHz. Signal Noise Ratio—90dB. Frequency Response—10Hz–45kHz –3dB. Supply Voltage—±35V. Size—114 × 50 × 85mm.

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

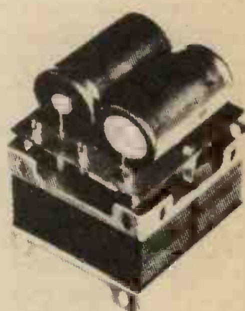
HY200
120W into 8Ω

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 hi-fi performance.

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 × 50 × 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 × 100 × 85mm.

Price £32·17 + £2·57 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. PSU70—suitable for two HY120s £13·75 + 1·10 VAT. P. & P. free. PSU90—suitable for one HY200 £12·65 + £1·01 VAT. P. & P. free. PSU180—suitable for two HY200s or one HY400 £23·10 + £1·85 VAT. P. & P. free.

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Rotary on-off mains switch	1977	£0·50*
Push switch – Push to make	1978	£0·13*
Push switch – Push to break	1979	£0·18*

ROCKER SWITCH	Colour	No.	Price
A range of rocker	RED	1980	£0·30*
switches SPST – moulded	BLACK	1981	£0·30*
in high insulation.	WHITE	1982	£0·30*
Material available in a	BLUE	1983	£0·30*
choice of colours ideal	YELLOW	1984	£0·30*
for small apparatus.	LUMINOUS	1985	£0·30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0·50*
Miniature SPST toggle, 2 amp 250V a.c.	1959	£0·55*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0·70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0·85*
Push button SPST, 2 amp 250V a.c.	1962	£0·78*
Push button SPST, 2 amp 250V a.c.	1963	£0·83*
Push button DPDT, 2 amp 250V a.c.	1964	£0·98*

MIDGET WAFER SWITCHES

Single-bank wafer type – suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactiver loads make before break contacts. These switches have a spindle 0·25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0·48*
2 pole 6 way	1966	£0·48*
3 pole 4 way	1967	£0·48*
4 pole 3 way	1968	£0·48*

MICRO SWITCHES	Order No.	Price
Plastic button gives simple on-off action Rating 10 amp 250V a.c.	1969	£0·20
Button gives 1 pole change over action Rating 10 amp 250V a.c.	1970	£0·25

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0·07*
1¼in x ¼in chassis mounting	507	£0·12*
1¼in car inline type	508	£0·15*
Panel mounting 20mm	509	£0·20
Panel mounting 1¼in	510	£0·30

QUICK BLOW 20mm

Type	No.		Type	No.		Type	No.	
150mA	611	6p	1A	615	5p	3A	619	5p
250mA	612	5p	1·5A	616	6p	4A	620	6p
550mA	613	5p	2A	617	6p	5A	621	5p
800mA	614	7p	2·5A	618	6p			

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2·5A	628
250mA	623	2A	626	3·15A	629
500mA	624	1·6A	627	5A	630

All 7p each

QUICK BLOW 1¼in

Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634

All 7p each

Type	No.	Type	No.	Type	No.
1A	635	2·5A	638	5A	642
2A	637	3A	639		

All 6p each

CASES AND BOXES

INSTRUMENT CASES. In two sections vinyl covered top and sides, aluminium bottom, front and back.

No.	Length	Width	Height	Price
155	8in	5¼in	2in	£1·25*
156	11in	6in	3in	£2·12*
157	6in	4¾in	1¾in	£1·30*
158	9in	5¼in	2¼in	£1·76*

ALUMINIUM BOXES. Made from bright ali., folded construction each box complete with half inch deep lid and screws.

No.	Length	Width	Height	Price
159	5¼in	2¼in	1½in	62p*
160	4in	4in	1½in	62p*
161	4in	2¼in	1½in	62p*
162	5¼in	4in	1½in	70p*
163	4in	2½in	2in	64p*
164	3in	2in	1in	44p*
165	7in	5in	2½in	£1·04*
166	8in	6in	3in	£1·32*
167	6in	4in	2in	86p*

MIDGET WAFER SWITCHES

1965 – 1 pole 12 way	48p*
1966 – 2 pole 6 way	48p*
1967 – 3 pole 4 way	48p*
1968 – 4 pole 3 way	48p*

TRANSFORMERS

MINIATURE MAINS Primary 240V

No.	Secondary	Price
2021	6V-0-6V 100mA	90p*
2022	9V-0-9V 100mA	90p*
2023	12V-0-12V 100mA	95p*

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280-0-6V, 0-6V RMS	£1·50*
2025	MT150-0-12V, 0-12V RMS	£1·50*

1 AMP MAINS Primary 240V

No.	Secondary		Price	
2026	6V-0-6V	1 amp	£2·50*	P. & P. 45p
2027	9V-0-9V	1 amp	£2·00*	P. & P. 45p
2028	12V-0-12V	1 amp	£2·60*	P. & P. 55p
2029	15V-0-15V	1 amp	£2·75*	P. & P. 66p
2030	30V-0-30V	1 amp	£3·45*	P. & P. 86p

STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in ½ amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V.

Voltages available by use of taps:
4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

No.	Rating	Price	
2031	½ amp	£5·50*	P. & P. 86p
2032	1 amp	£6·60*	P. & P. 86p
2033	2 amp	£8·40*	P. & P. £1·10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0.60*
113	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0·75*
114	5 pin DIN plug to 3.5mm. Jack connected to pins 3&5. Length 1.5m	£0·85*
115	5 pin DIN plug to 3.5mm. Jack connected to pins 1&4. Length 1.5m	£0·85*
116	Car aerial extension. Screened insulated lead. Fitted plug & skt.	£1·10*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0·68*
118	5 pin DIN phono plug to stereo headphone jack socket	£1·05*
119	2+2 pin DIN plugs to stereo jack socket with attenuation network for stereo headphones. Length 0.2m	£0·90*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8 track cartridge & combination units. Supplied with inline fused power lead and instructions.	£0·60*
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1·50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0·75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0·75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0·75*
127	5 pin Din plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1·30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1·05*
130	2 pin DIN plug to 2 pin DIN Inline socket. Length 5m	£0·68*
131	5 pin DIN plug to 3 pin DIN plug. 1&4 and 3&5. Length 1.5m	£0·83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0·98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3&5. Length 1.5m	£0·75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3&5. Length 23cm	£0·68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3&5. Length 23cm	£0·68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1·75*
178	AC mains lead for calculators etc.	£0.45*

AVDEL BOND CYANOACRYLATE G2

The wonder adhesive which works in seconds. Bonds plastic, rubber, transistors, components, permanently – Immediately! O/D143. ONLY 70p* *for a 2gm phial.*

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NEW EDITION NOW AVAILABLE

Send for your copy of our revised catalogue and price list NOW! It contains 127 pages packed with literally hundreds of semiconductors, components and our famous range of BI-KITS audio modules.

ONLY 65p POST FREE

ORDERING Do not forget to state order number and your name and address.

V.A.T. Add 12½% to prices marked*. 8% to those unmarked. Items marked are zero rated.

P&P. 35p unless otherwise shown.

BI-PAK

DEPT. PE7, P.O. Box 6, Ware, Herts

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

High quality audio modules for Stereo and mono

S450

STEREO FM TUNER Fitted with phase lock-loop

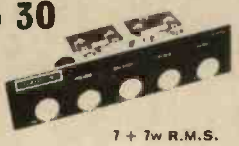
£22·30
+ 40p p&p
+ 12½% VAT

FREQUENCY RANGE	88–108 Mhz
SENSITIVITY	3·0 μV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22·5 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm × 110mm × 32mm

The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched AFC LED Stereo Indicator.

Stereo 30

COMPLETE AUDIO CHASSIS



£18·95
+ 40 p&p
+ 12½% VAT

7 + 7w R.M.S.

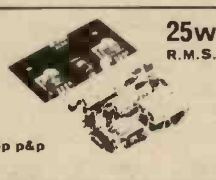
OUTPUT POWER	7 Watts RMS
LOAD IMPEDANCE	8 ohms
TOTAL HARMONIC DISTORTION	Less than ·5% (Typically ·3%)
FREQUENCY RESPONSE	50 Hz to 20 kHz ± 3dBs
TONE CONTROL RANGE	± 12 dBs at 100Hz and 10kHz
SENSITIVITY	190 mV for full output
INPUT IMPEDANCE	1 M ohms
TRANSFORMER REQUIREMENTS	22 V.A.C. rated at 1A
DIMENSIONS (Less controls and panel)	200mm × 130mm × 33mm

The Stereo 30 comprises a complete stereo pre-amplifier, power amplifiers and power supply. This, with only the addition of a transformer or overwind will produce a high quality audio unit suitable for use with a wide range of inputs i.e. high quality ceramic pick-up, stereo tuner, stereo tape deck etc. Simple to install, capable of producing really first class results, this unit is supplied with full instructions, black front panel, knobs, main switch, fuse and fuse holder and universal mounting brackets.

AL60

AUDIO AMPLIFIER MODULE 25 Watts RMS

25w R.M.S.



£4·55 + 25p p&p
+ 12½% VAT

OUTPUT POWER	25 Watts RMS
SUPPLY	30–50 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0·1%.

AL80

AUDIO AMPLIFIER MODULE

35w R.M.S.

£7·15*
+ 25p p&p
+ 8% VAT

OUTPUT POWER	35 Watts RMS
SUPPLY	40–60 V
LOAD IMPEDANCE	8–16 ohms
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·06%)
FREQUENCY RESPONSE	20 Hz to 30 kHz × 2 dBs
SENSITIVITY	280 mV for full output
MAX. HEAT SINK TEMPERATURE	90°C
DIMENSIONS	103mm × 64mm × 15mm

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0·1%.

AL250

POWER AMPLIFIER

125w R.M.S.

£17·25* + 40p p&p + 8% VAT

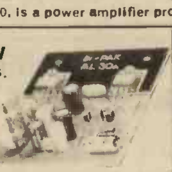
OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50–80 V
LOADS	4–16 ohms
FREQUENCY RESPONSE	25 Hz 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION	
50 WATTS into 4 ohms	0·1%
50 WATTS into 8 ohms	0·06%

This unit, designated AL250, is a power amplifier providing an output of up to 125W RMS, into a 4 ohm load.

AL30A

AUDIO AMPLIFIER MODULES

10w R.M.S.



£3·75 + 25p p&p
+ 12½% VAT

MAXIMUM SUPPLY VOLTAGE	30 V
POWER OUTPUT for 2% THD	10 Watts RMS
TOTAL HARMONIC DISTORTION	Less than ·25%
LOAD IMPEDANCE	8–16 ohms
INPUT IMPEDANCE	100 K ohms
FREQUENCY RESPONSE	50 Hz–25 kHz ± 3 dBs
SENSITIVITY	75 mV for full output
DIMENSIONS	74mm × 63mm × 28mm

These low cost 5 and 10 watt modules offer the utmost in reliability and performance, whilst being compact in size.

SPM80

STABILISED POWER SUPPLY

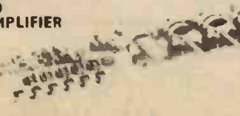
£4·25 + 25p p&p
+ 12½% VAT

INPUT A.C. VOLTAGE	33–40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA–1·5 amps
OVERLOAD CURRENT	1·7 amps approx.
DIMENSIONS	105mm × 63mm × 30mm

Designed to power two AL60s at 15 Watts per channel simultaneously. Circuit Techniques include full short circuit protection.

PA100

STEREO PRE-AMPLIFIER



£15·80
+ 40p p&p
+12½% VAT

FREQUENCY RESPONSE	20 Hz to 20 kHz × 1 dB
TOTAL HARMONIC DISTORTION	Less than ·1% (Typically ·07%)
SENSITIVITY INPUTS 1. TAPE	100 mV/100 K ohms (For an output 250 mV)
2. RADIO TUNER	100 mV/100 K ohms (For an output 250 mV)
3. MAGNETIC P.U.	3·5 mV/50 K ohms (For an output 250 mV)
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
BASS CONTROL RANGE	± 15 dBs at 75 Hz
TREBLE CONTROL RANGE	+ 10–20 dBs at 15 kHz
SIGNAL/NOISE RATIO	Better than 65 dBs (All inputs)
INPUT OVERLOAD	Better than 26 dBs (All inputs)
SUPPLY	20 to 40 V
DIMENSIONS	300 × 90 × 33mm (less controls)

A top quality stereo pre-amplifier and tone control unit, the PA100 provides a comprehensive solution to the front end requirements of stereo amplifiers or audio units. The six push button selector switch gives a choice of inputs together with two filters for high and low frequencies.

MPA30

MAGNETIC CARTRIDGE PRE-AMPLIFIER

£2·95
+25p p&p
+ 12½% VAT

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA 30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

SENSITIVITY	3·5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—re earth
DIMENSIONS	110 × 50 × 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

£7·10
+ 30p p&p
+ 12½% VAT

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL 20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

FREQUENCY RESPONSE	20 Hz–20 kHz (—3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	—60 dB
SIGNAL/NOISE RATIO	—65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm × 84mm × 25mm

PS12 POWER SUPPLY

Designed for use with the AL30A S.450 and MPA30 in conjunction with transformer T538.

INPUT VOLTAGE	17–20v AC
OUTPUT VOLTAGE	27–30v DC
OUTPUT CURRENT	800mA
SIZE	60mm × 43mm × 26mm

£1·30
+ 25p p&p
+ 12½% VAT

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max. Voltage handling 2 V RMS, T.H.D., 0·05%, input impedence 100K. Output impedence less than 10 K. Frequency response 20 Hz -20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192.

£22·00
+ 25p p&p
+ 12½% VAT

SG30 POWER SUPPLY BOARD for GE100 15-0-15 VOLT £5·50 + 12½% VAT + 25p p&p

SIREN ALARM MODULE

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15. No. BP124.
Only £3·50 + 8% VAT + 25p p&p

MA60 HI-FI AMPLIFIER KIT

Build you own top quality amplifier, save yourself pounds. The MA60 kit comprises the following Bi-kits modules, 2 × AL60 amps, 1 × PA100 pre-amp, 1 × SPM80 stab. power supply, 1 × BMT80 transf. giving 17 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad.
Price £32·00 + 12½% VAT + 62p p&p.

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Noen, etc. Ideal for the MA60. Size: 425mm × 290mm × 95mm.
Price £19·95 + 12½% VAT + 86p p&p

TRANSFORMERS

T538 For use with S.450 AL30A MPA30
Order No. 2036 Price: £3·20 + 55p p&p + 12½% VAT
T2050 For use with Stereo 30
Order No. 2050 Price: £3·25 + 55p p&p + 12½% VAT
BMT80 For use with AL60 SPM80
Order No. 2034 Price: £5·40 + 86p p&p + 12½% VAT
BMT250 For use with AL250
Order No. 2035 Price: £6·35 + £1·10 p&p + 12½% VAT

BI-PAK

DEPT. PE7, P.O. Box 6, Ware, Herts

SAXON ENTERTAINMENTS LTD

THE PIONEERS OF MODULAR DISCO/P.A. EQUIPMENT
NOW OFFER PACKAGE DEALS AT INCOMPARABLE PRICES

CENTAUR STEREO DISCOS

C/W LIGHT SHOW & DISPLAY, TWIN SPEAKERS & LEADS

Standard 100W
£225 or Deposit £50.80
12 Months @ £19.11 or 24 Months @ £10.66

Super 200W
£275 or Deposit £61.80
12 Months @ £23.17 or 24 Months @ £12.92

GXL 200W (with twin 200 watt cabinets)
£349 or Deposit £77.72
12 Months @ £29.19 or 24 Months @ £16.28

COMPLETE STEREO ROADSHOWS – BUILT IN SOUND TO LIGHT/SEQUENCER & DISPLAY

TWO YEAR GUARANTEE

illustration shows GXL Centaur System

These systems feature full mixing for two decks tape & mic with monitoring facilities – override and are supplied complete with sound to light sequencer, display, speaker leads etc.

JUST PLUG IN AND GO!

BSR Decks – 17,000 Line Loudspeakers – Rugged Aluminium Trimmed Cabinets – Cue Light And Phones Output – Slave Output – Deck Lights/Motor Starts (GXL)

MINI DISCO 100 WATT MONO SYSTEM

£179.50 Deposit £40.66
12 Months @ £15.45
or 24 Months @ £8.61

Similar in appearance to the Centaur and complete with loudspeakers and leads.

Headphones to suit any system	£7.50
EM507 Electret Mic	£15.00
ECM 81 Electret Mic	£19.95
Boom Stand	£13.50
Carriage on all disco and PA systems (Included in H.P. Prices)	£10.00

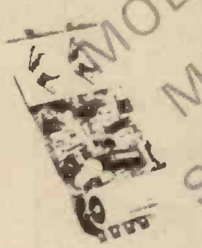
20% Deposit Terms On All Orders Over £150 – 12 or 24 Months – Low Interest

25% OFF LISTED PRICES OF ALL MODULES MIXERS SUPPLIES LIGHTING CONTROL AND STROBE VALID UNTIL JUNE

D.I.Y. MODULES FOR ALL DISCO/P.A. AMPLIFIERS

Module	Price	Supply	Supply price
SA308 30W 8 ohms 45V	£9.95*	SUPPLY FOR TWO MODULES	£10.90*
SA604 60W 4 ohms 50V	£13.25	SUPPLY FOR TWO MODULES	£13.50
SA608 60W 8 ohms 65V	£14.25	SUPPLY FOR TWO MODULES	
SA1204 120W 4 ohms 75V	£15.95	SUPPLY FOR ONE MODULE	
SA1208 120W 8 ohms 95V	£21.00	SUPPLY FOR TWO MODULES	£22.50
SA2404 240W 4 ohms 95V	£29.50	SUPPLY FOR ONE MODULE	

0.2% Distortion, 30Hz-20, KHz – 2dB, Fully Short/Open Circuit proof input sensitivity 240 mV to suit most mixers – D.C. & Output Fuses fitted.



TOP QUALITY COMPONENTS THROUGHOUT

DISCO MIXERS – COMPLETE OR MODULAR

MONO OR STEREO WITH AUTOFADE

Available complete and ready to plug in or as an easy to connect module with all controls except monitor switch already fitted – full instructions supplied.

FEATURES INCLUDE:
Twin Deck – Mic & Tape Inputs – Wide range bass & treble controls – Full headphone monitoring – Crossfade – Professional standard performance.

MODULES	
Mono module	£22.50
Stereo module	£33.50
Panel	£3.95
Kit of knobs/sockets etc	£5.50
COMPLETE MIXERS (with case)	
Mono 18V	£39.50
Stereo 18V	£57.50
Mono mains	£45.75
Stereo mains	£63.75

COMPLETE LIGHTING CONTROL AT YOUR FINGERTIPS!

Lighting Control Unit Mk II		£44.50
4kW Sequencer · Sound Light · Dimmers · Automatic Level Integrated Logic Circuitry	Module	£32.50
	Panel	£2.95
Three Channel Sound to Light		£26.75
3kW 1-240W input – master Plus channel controls	Module	£19.75
	Panel	£2.95

STROBE UNITS

Pro-Strobe 4-6 Joules £37.50
Super Strobe 2-3 Joules £22.50
(Pro-Strobe has external trigger facility).

SPARES & ACCESSORIES – LOUDSPEAKERS & CABINETS

Rope Lights – Red or Multicolour	£22.00 per 12 ft.	Melos Echo Chamber	£59.00
Rope Light Controller for up to 120 ft	£30.00	Headphones	£7.50*
Fuzz Lights–Red/Blue/Yellow/Green	£22.80	Sirens: English Police, USA Police, Destroyer, Alien Voice Simulator	£7.50
Magnetic Cartridge Equalisers	£3.50*	Bulgin 8 way lighting plug/socket	£1.90

100 Watt Chassis Loudspeakers 12" £23.50 18" £47.50 (Add £1.50 carr.)
Empty Loudspeaker Cabinets Small 12" £15.50, Large 2 x 12" £28, Large 12" £21.50, Small 2 x 12" £22.50, 1 x 18" £29.50

Projector lamps: A1167 £2.90, M6 £5.65.
100W Spot lamps Red/Blue/Yellow/Green £1.50 ea £13.50 for 10
MD Spot Banks: 3-way 300W £19.50, 4-way 400W £22.50.
Bubble machines (optikinetics) £36.50

Strobe tubes 80W £8.50
ICI Vynide 50" wide £3.50 Metre
Kickproof Grille 24" wide £3.25 Metre
Kick Resistant Grill 50" wide £3.25 Metre.
FULL RANGE OF RE-AN PRODUCTS IN STOCK
SEND FOR OUR BROCHURE NOW!!

PROJECTORS – PLUTO – NEW LOW PRICES!!!
CHOICE OF WHEEL/CASSETTE

P150 150W Tungsten	£37.50	Liquid wheels	£7.50
P500 100W Q.I.	£74.95	Cassettes	£8.00
P500 250W Q.I.	£84.95	Picture wheels from (Wide choice available)	£4.75

PIEZO HORNS only £7.50
YES! – only £7.50

(As fitted to our package PA system)

Direct from Motorola Inc., USA at an UNBEATABLE PRICE

No crossover required 4kHz – 30kHz rated 75W/8 ohms 150W/4 ohms use two per 100W amplifier – Full instructions supplied.

AND

PACKAGE P.A. SYSTEMS (2 Year Guarantee)

Complete with PIEZO horn columns fitted with 100 watt units (100 watt system illustrated)

100 Watt £149.50

Deposit £35.26

12 Months @ £12.91 or 24 Months @ £7.20

Includes 4 Channel 100 Watt Amplifier with Treble, Bass and Master Controls plus Leads and Twin Piezo Horn Columns (shown on right).

200 Watt £225.00

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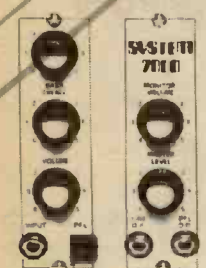

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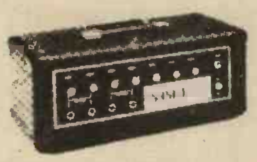

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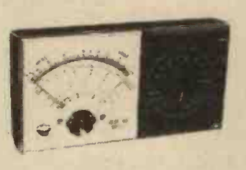

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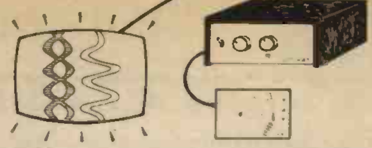

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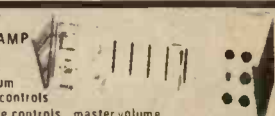

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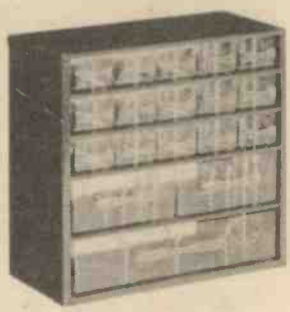

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PE VOLUME 14 No. 11 JULY 1978

TV GAMES

IN THIS issue we present what we feel is the best combination of TV games available. The *P.E. TV Game Centre* has 14 different game options and can provide hours of amusement for a single player or for the whole family. When we tested this unit we found that a couple of four-year-olds could play at least one of the games and, in fact, they got very upset when we took the Centre away to work on the article. The Centre has also provided an afternoon's enjoyment for a large family and even "grandad" got quite enthusiastic—well he was unable to watch the football!

We must point out that with colour, sound-through-the-set and all those game options, the unit is quite complex and not one for the beginner to tackle. However, there is much enjoyment to be gained from both building and using the unit. (The main part of the project is in this issue and concludes with construction details next month).

TV ENGINEERING

A recent lecture by Dr Boris Townsend, head of the IBA's Engineering Information Service, has given rise to various comments in the technical press about some of his predictions. We have taken the trouble to bring you most of what he said in this issue. We do not feel that the predictions require further comment from us as Dr Townsend is in a much better position to make such predictions than we are, and no doubt most readers will have their own opinions anyway.

To many the review of the present state of the art may be an eye opener but we are sure that to most readers the 1984 and 1989 sections will start some thoughts.

Having made a few predictions in the past and been hounded by them later, we do not intend to start exploring the future of this or other fields. Reference to the editorial of March '78 is recommended for those who would like to try this particular pastime—we will not be drawn into the trap.

Part of Dr Townsend's lecture which, due to space restrictions, we have had to omit said:

"Samuel Butler once said that a hen is merely an egg's way of making another egg. Now, I don't know how many of you would regard that as a valid statement, but I warn you that I may not say anything which has greater validity—nor indeed shall I say much that is capable of proof, though perhaps some of my remarks may turn out to have been correct.

Neither am I intent on arguing that an engineer is merely a television studio's way of making another television studio—although financial controllers firmly believe that studios do spawn engineers. No, any engineer is far too arrogant to denigrate his importance in the scheme of things. But since I am here not so much as an engineer but as a soothsayer, it behoves me to begin modestly, once I have gently indicated that peering into our future may call for a little lateral thinking."

TV COMPETITION

It is also interesting to note that the use of the TV set for purposes other than watching broadcasts will probably mean the TV companies have more to compete with than each other. We could be said to be adding to this competition by presenting our Game Centre—not a bad thing perhaps?

Mike Kenward

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PE TV GAME • CENTRE

THIS is really two separate t.v. games circuits combined in one box to give a selection of stunt motorcycle games *and* a large variety of ball games too.

The four "bike" games comprise: *Stunt Cycle, Drag Race, Super Stunt Cycle, and Motocross.* These are provided by the AY-3-8760-1 games chip, and occupy the right-hand side of the Game Centre fascia.

There are ten ball games comprising *Solo Target, Solo Basketball, Solo Squash, Tennis, Double Target, Gridball, Soccer, Ice Hockey, Basketball* and *Squash.*

STUNT CYCLE SECTION

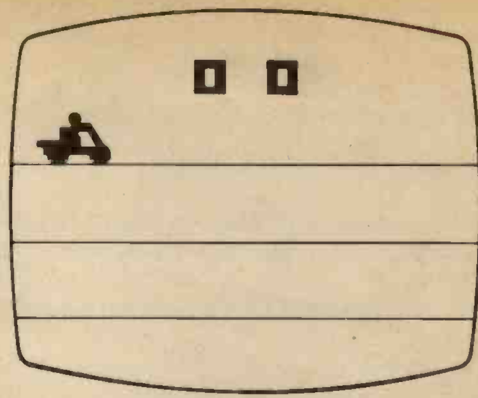
These are games for one player who controls the speed of a motorbike and rider. At the start of each game, the motorbike and rider are stationary at the upper left-hand side of the TV screen. As the player turns the throttle controller, the motorbike and rider move across the screen on track 1. The motorbike sound starts with the bike movement and as the bike and rider accelerate, the motorbike sound reflects these speed changes. The motorbike wheels have an appearance of rotating at a speed also related to the throttle setting. At the end of track 1, the bike and rider reappear on track 2 at the left-hand side, and likewise at the end of track 2, the bike appears on track 3 at the left-hand side of the screen. Movement of the bike and rider on track 3 over the right-hand edge of the screen causes a reinitialisation of the bike and rider to the left of the screen on track 1. There is no further movement until the throttle is reset to a slow speed and then increased again. The playing field for each game is shown opposite.

DRAG RACE

The object of this game is to reach the end of track 3 in the shortest time. The three-digit score is automatically reset as the rider first begins to move on track 1 and the score is incremented until the game is over. The score appears centred on the screen above track 1, and remains until the start of the next game.

Drag Race requires a speed shifting to achieve the lowest time scores. As the throttle speed is increased and the rider begins to move, the bike is in speed one and moves at a set rate across the screen. The only way to accelerate the bike motion is to return the throttle to a "slow" position and then return to a "fast" position. This shifting procedure will move the bike into speed 2, which will then go across the screen at a faster rate. Another "shift" will allow speed 3.

A PROFESSIONAL/AMATEUR switch is provided to select a difficulty factor. In the professional mode, a crash occurs if the player tries to increase the throttle speed too rapidly. A crash will flip the bike and rider upside down, and the sound will be a high-pitch screech. At the end of the crash, the bike and rider are reinitialised on track 1, and the score reset. In the easy mode, no crash is allowed.



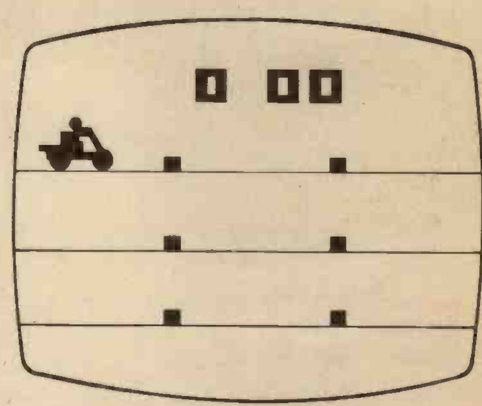
DRAG RACE

MOTOCROSS

As the throttle speed is increased, the bike and rider move across track 1 at a rate determined by the throttle controller setting. Motocross has no speed shifting. Located on each of the three tracks are obstacles. The PRO'/AM' option switch selects the number of obstacles per track. The easier mode has one obstacle per track and the harder mode has two obstacles per track.

The object of this game is to traverse the three tracks in the shortest time, doing a "wheelie" over each obstacle. The score counters record the run time in the same manner as the Drag Race game.

In Motorcross the crash is not caused by accelerating too rapidly. The crash is caused by not doing a "wheelie" over an obstacle. In the "wheelie" position, the bike will have the front wheel lifted off the track. A crash into an obstacle will flip the bike upside down and produce the screech sound. The score resets at the end of the crash.

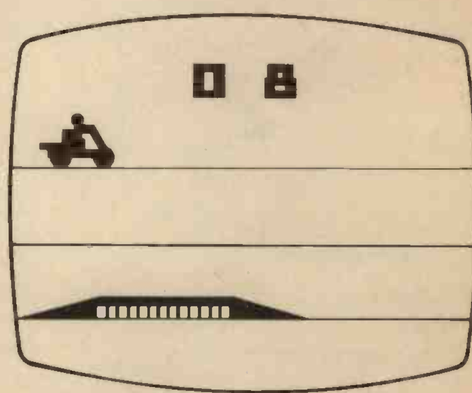


MOTOCROSS

STUNT CYCLE

The object of this game is to control the throttle speed to properly jump the ramp and buses located on track 3. The game begins with 8 buses and with each successful jump over the ramp and buses, an additional bus appears. The game is over when the maximum number of errors has been reached, which is 3 or 7 errors depending on the position of the PRO'/AM' switch or when 36 buses have been jumped, in which case the screen will fill up with buses. The game is then started by reselecting the Stunt Cycle game input.

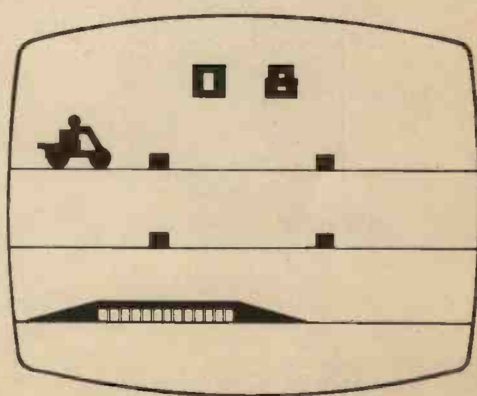
Errors are caused by accelerating too rapidly, insufficient speed to clear the buses, or landing too far past the back ramp after the jump. The bike and rider flip upside down and a screeching sound indicates an error. The score records the number of errors in the first digit and the number of displayed buses in the next two digits.



STUNT CYCLE

SUPER STUNT CYCLE

This game is similar to Stunt Cycle with the addition of obstacles on track 1 and track 2. The object is to do a "wheelie" over each obstacle and then adjust the throttle for the correct speed to jump the buses on track 3. The PRO'/AM' option switch selects 2 obstacles per track and allows 3 errors per game in the harder mode, and 1 obstacle per track and 7 errors per game in the easy mode. Errors are



SUPER STUNT

caused by accelerating too rapidly, not being in the "wheelie" position over the obstacles, insufficient speed to clear the buses, or landing too far past the back ramp after the jump. The score records the number of errors and the number of buses displayed, the same as in the game of Stunt Cycle.

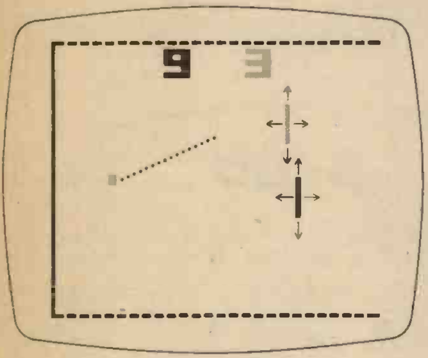
BALL AND PADDLE SECTION

In all games, the ball starts at slow speed. If the high speed mode has been selected the ball will switch to high speed after seven consecutive hits by the players without a goal being scored.

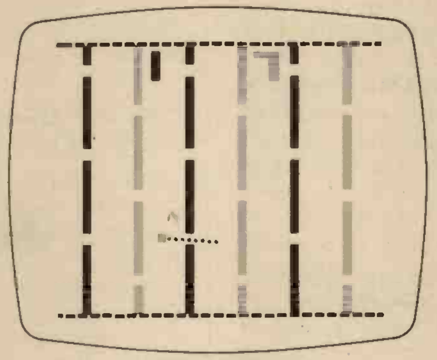
The bats are segmented into five zones, each zone defining a different rebound angle. The zones listed from top of bat to bottom are nominally 40° up, 20° up, horizontal, 20° down, 40° down. A ball passing through a bat from behind will have its angle influenced as above, but not its left/right direction.

All two player games terminate when one player has 15 points at which time the score flashes and the bats have no further effect on the ball.

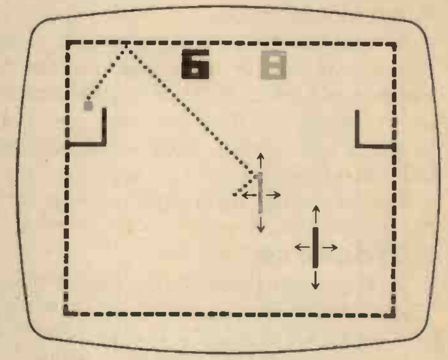
A tone of approximately 500Hz, 1kz and 2kHz will be generated for a nominal period of 32ms for "ball hits wall", "ball hits bat" and "score". The output is capable of direct driving a 100Ω speaker.



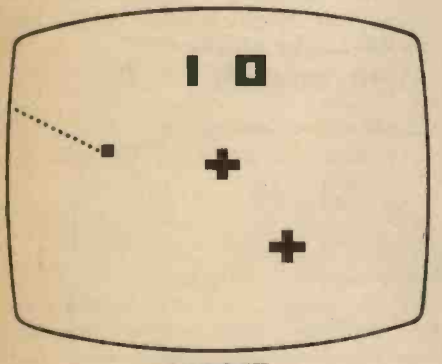
SQUASH



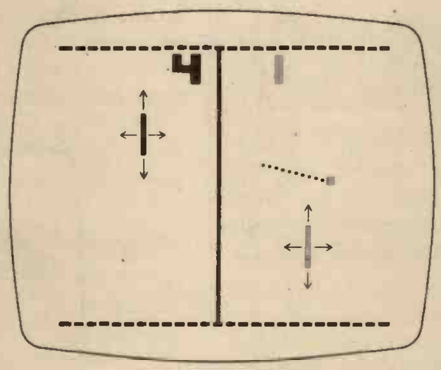
GRIDBALL



BASKETBALL



TARGET



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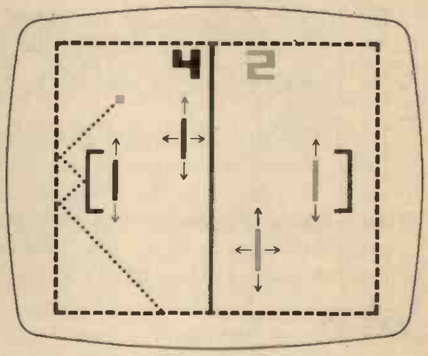

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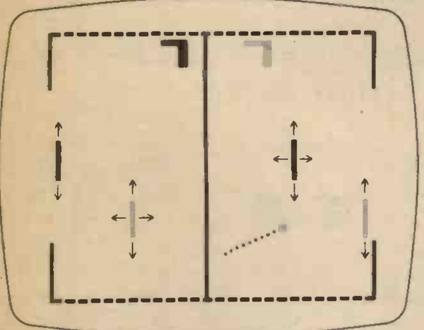

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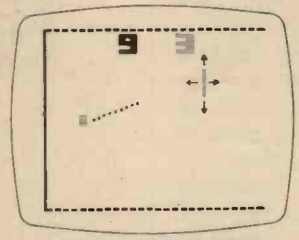

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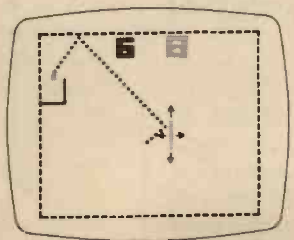


SOLO BASKETBALL

BALL GAMES

SQUASH

This game uses the playing area shown opposite. Each player can move over the whole court. The game will start when the player whose service it is, depresses his SERVICE button. The ball moves off with a random angle towards the front wall. The colour of the ball will change to the colour code of the next player to hit the ball. Should the wrong player intercept or be hit by the ball it will be considered a fault. Points will only be given if won on player's own service. Points won on opponent's service will only cause a service change.

SOLO SQUASH

This game is for a single player. The right score counts the number of successive hits in the current game (to a maximum of 15), the left score the number of volleys played.

GRIDBALL

This is a game of considerable mental agility. Each player has three sets of vertically moving barriers to block the ball from approaching his end of the field, and openings in the barriers to permit the ball to advance towards the opponent's end. The game starts when both players have depressed their SERVICE buttons. The ball moves away from the face off point with a random angle in either direction.

BASKETBALL

The basketball games use the closed playing area shown. Participant players must deflect the ball and cause it to enter the top of the goal to score. The game starts when both players depress their SERVICE buttons simultaneously. The ball moves from the service point with a random angle in either direction.

SOLO BASKETBALL

Basketball practice is a one player game which utilises only the left basket (see opposite). The right counter displays the number of hits the player makes without scoring while the left counter shows the number of baskets made. Play starts when the right SERVICE button is depressed.

TARGET

In the double game each player has a cross which he can move to any point on the screen. From the edge of the field will come moving targets one at a time, and a player must position his cross over the target and simultaneously push the SERVE button to get a hit. Moving the cross towards the origin of the moving target will give a player the chance to beat his opponent to a score, but will also give him less thinking time in which to react when the target flies out. All scores are shown at the top of the screen.

Only one cross appears for the single player version of this game.

TENNIS

The game uses the playing area shown (opposite). Each player can only move around his side of the court. The game will start when the player whose turn it is to serve, pushes his SERVICE button. The service will automatically change every five points scored. At service the ball will move away from the service point with a random angle but always towards the net.

HOCKEY

Forwards on both sides have freedom to move over the entire playing area. The goal keepers will be locked in the horizontal axis in front of their respective goals, but will move in the vertical axis in the same manner as the forwards.

The game starts when both players have depressed their SERVICE buttons. The ball will move away from the face-off point with a randomly selected angle in either direction.

SOCCER

Motion of the players is as in the hockey game. The game will start when the loser of the previous goal depresses his SERVICE button. The ball will move away from the kick-off point with a randomly selected angle but always towards the goal of the winner of the previous goal.

CIRCUIT DESCRIPTION

No simple description can be given for the extensive internal workings of the two l.s.i. games chips, and most of the remaining electronics fall into two categories: game selection and t.v. interfacing, so that the games unit may be plugged directly into the t.v. aerial socket. See Fig. 1.

Because there are two games chips, a system is necessary to switch from one to the other and this is the function of IC9. The ball and paddle games are selected on IC1 by momentarily connecting certain combinations of Strobe (STR) and select (SEL) lines, but when any of these selection switches (S1–8, S10, S11) are pushed, generating a low input to the IC10(a) NAND gate, the output IC10(a) pin 13 goes high which will *reset* the D-type flip-flop IC9(a.) By the same mechanism IC9(a) can be *set* via IC10(b) when a motorcycle game is selected.

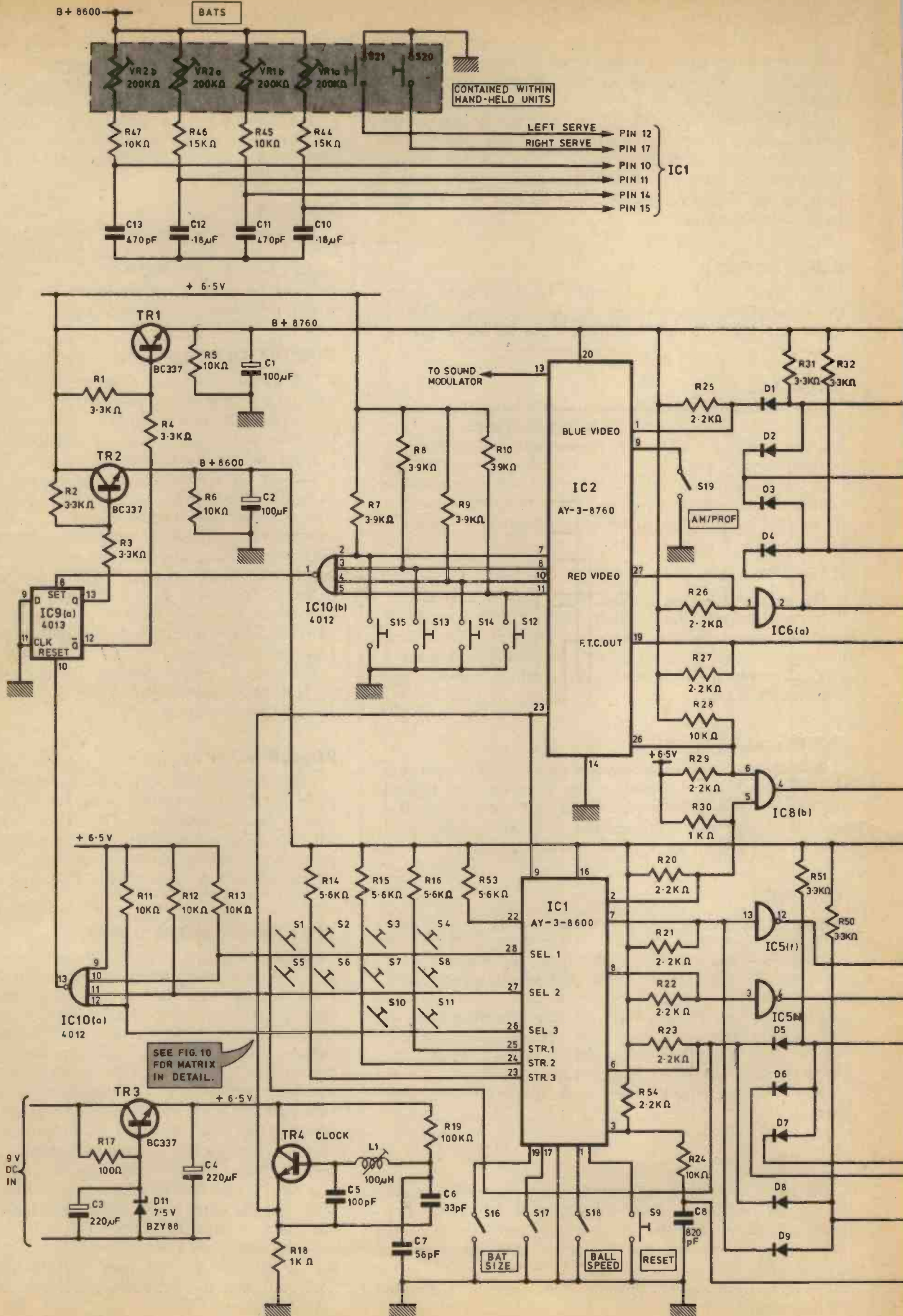
The Q and $\overline{Q}$ outputs from the flip-flop are used to control the 6·5V power supply lines to both games i.c.s, thus shutting down the one not in use.

POWER SUPPLY

The d.c. input enters via a miniature jack socket, and is generated by an external mains power pack which plugs directly into a 13A socket. The Zener stabiliser comprising TR3 and D11, etc. produces 6·5V to supply the unit. Both games i.c.s are motivated by a clock signal which is provided by the oscillator designed around TR4.

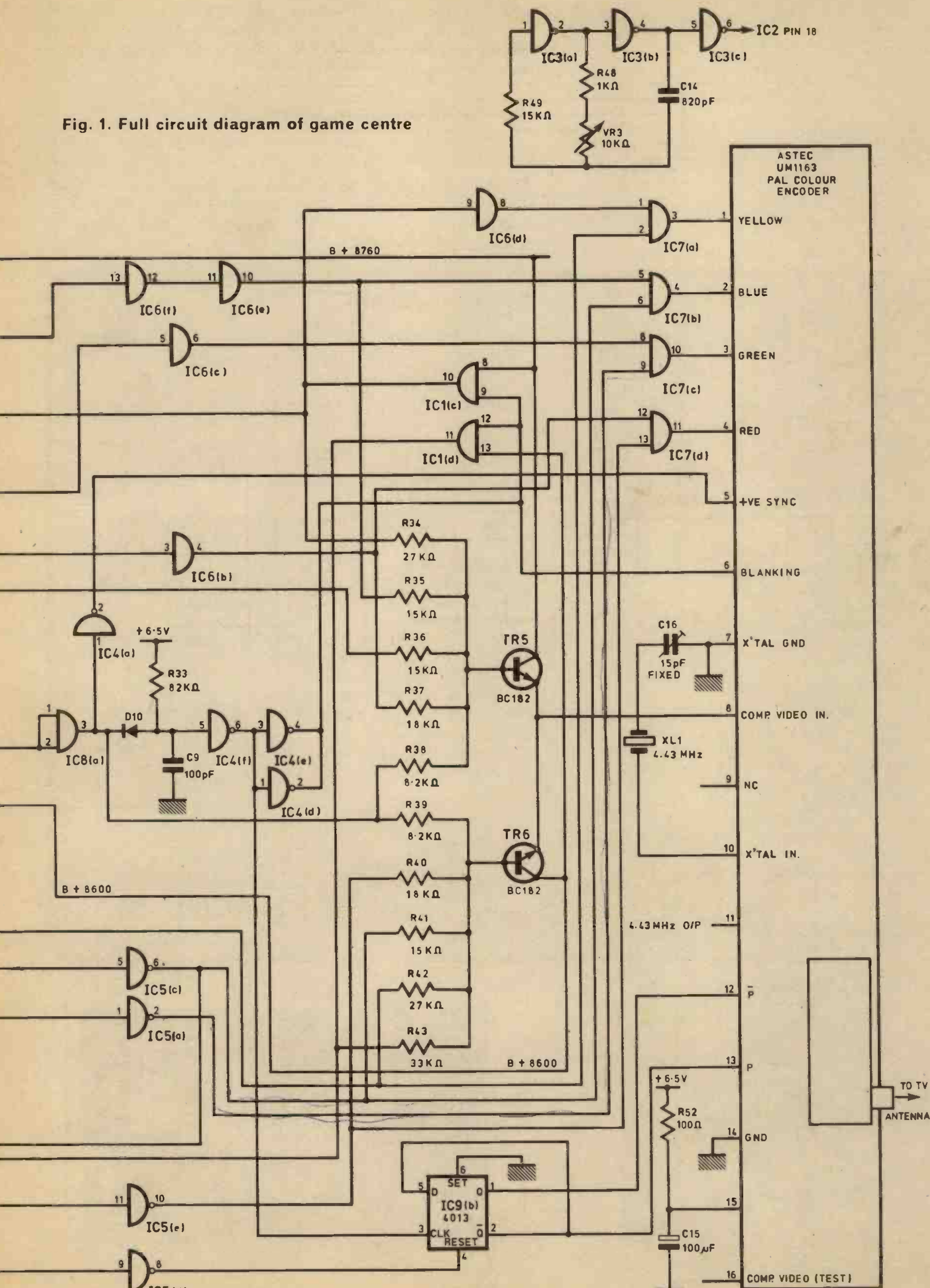
COLOUR ENCODER UNITS

As can be seen in Fig. 1, the colour encoder has four inputs: yellow, blue, green and red. The bus carrying the video outputs from IC1 can be identified, and these are ORED at IC7 with the video outputs from IC2. This is arranged so that whichever games chip is in use, the colour encoder will receive the necessary signals. It is in this "colour bus" that the colour system departs from a black and white system, where a composite signal only is generated. In this game, the right video output (for right player) is fed to the blue input, and likewise the left video goes to yellow. The players' bats then comply with this colour coding. Some diode OR signal processing is also necessary, and can be seen around IC5. A composite signal *is* generated, and the cycle games composite signal is produced by the summing amplifier TR5. The ball games signals are similarly summated at amplifier TR6. These two composite signals are then ORED by means of the mutual emitters of TR5 and TR6, and fed to the composite video input of the modulator system.



B + 8600
BATS
VR2b 200KΩ
VR2a 200KΩ
VR1b 200KΩ
VR1a 200KΩ
S21
S20
CONTAINED WITHIN HAND-HELD UNITS
R47 10KΩ
R46 15KΩ
R45 10KΩ
R44 15KΩ
LEFT SERVE
RIGHT SERVE
PIN 12
PIN 17
PIN 10
PIN 11
PIN 14
PIN 15
IC1
C13 470pF
C12 ·18µF
C11 470pF
C10 ·18µF
+ 6·5V
TR1
BC337
B + 8760
R5 10KΩ
C1 100µF
R1 3·3KΩ
R4 3·3KΩ
TR2
BC337
B + 8600
R2 3·3KΩ
R6 10KΩ
C2 100µF
R3 3·3KΩ
SET
IC9(a) 4013
CLK
RESET
TO SOUND MODULATOR
R7 3·9KΩ
R8 3·9KΩ
R9 3·9KΩ
R10 3·9KΩ
IC10(b) 4012
S15
S13
S14
S12
IC2
AY-3-8760
BLUE VIDEO
RED VIDEO
F.T.C.OUT
S19
AM/PROF
R25 2·2KΩ
R26 2·2KΩ
R27 2·2KΩ
R28 10KΩ
R29 2·2KΩ
R30 1KΩ
+6·5V
R31 3·3KΩ
R32 3·3KΩ
D1
D2
D3
D4
IC6(a)
IC8(b)
+ 6·5V
R11 10KΩ
R12 10KΩ
R13 10KΩ
R14 5·6KΩ
R15 5·6KΩ
R16 5·6KΩ
R53 5·6KΩ
S1
S2
S3
S4
S5
S6
S7
S8
S10
S11
IC10(a) 4012
SEE FIG. 10 FOR MATRIX IN DETAIL.
IC1
AY-3-8600
SEL 1
SEL 2
SEL 3
STR.1
STR.2
STR.3
R20 2·2KΩ
R21 2·2KΩ
R22 2·2KΩ
R23 2·2KΩ
R54 2·2KΩ
R24 10KΩ
R51 3·3KΩ
R50 3·3KΩ
IC5(f)
IC5(b)
D5
D6
D7
D8
D9
TR3
BC337
+ 6·5V
R17 100Ω
C4 220µF
9V DC IN
C3 220µF
D11 7·5V BZY88
TR4 CLOCK
L1 100µH
R19 100KΩ
C5 100pF
C6 33pF
R18 1KΩ
C7 56pF
S16
S17
S18
S9
C8 820pF
BAT SIZE
BALL SPEED
RESET

Fig. 1. Full circuit diagram of game centre



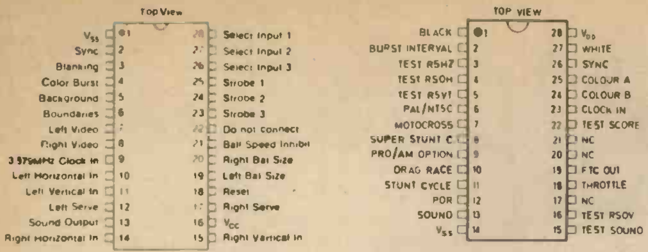


Fig. 2. Pinouts for games i.c.s
(a) AY-3-8600 (b) AY-3-8760

The sync and vertical flyback pulses, etc. generated by IC1 and IC2 are combined at AND gate IC8(b) to drive the video modulator directly, and the summing amplifier for inclusion in the composite video signal.

Sound effects come from the television receiver's own loudspeaker, and these signals are modulated onto a 6MHz carrier generated within MOD 1. This r.f. output is fed to the u.h.f. modulator via C17.

UHF VISION MODULATOR

The u.h.f. vision modulator unit MOD 2 receives the sync and video signals from the games chips, and also the r.f. frequency-modulated carrier from the audio modulator MOD 1. The u.h.f. carrier generated within MOD 2 is modulated by these inputs and the carrier is pretuned to the European Channel 36 (591·5MHz).

COMPONENTS . . .

Resistors

R1–R4, R31, R32, R50, R51	3·3kΩ (8 off)
R5, R6, R11–R13, R24, R28, R45, R47	10kΩ (9 off)
R7–R10	3·9kΩ (4 off)
R14–R16	5·6kΩ (3 off)
R17, R30, R48, R18	1kΩ (4 off)
R52	100Ω (1 off)
R19	100kΩ (1 off)
R20–R23, R25–27, R29	2·2kΩ (8 off)
R33	8·2kΩ (1 off)
R34, R42	27kΩ (2 off)
R35, R36, R41, R49, R44, R46	15kΩ (6 off)
R37, R40	18kΩ (2 off)
R43	33kΩ (1 off)

All resistors ¼W 5%

Potentiometers

VR1 200kΩ lin carbon (dual axis)
VR2 200kΩ lin carbon (dual axis)
VR3 10kΩ lin carbon

Capacitors

C1, C2	100μF/6·3V (2 off)
C3, C4	220μF/10V (2 off)
C5	100pF silvered mica (1 off)
C6	33pF silvered mica (1 off)
C7	56pF silvered mica (1 off)
C8, C14	820pF silvered mica (2 off)
C9	100pF silvered mica (1 off)
C10, C12	0·8μF Mullard C280 (2 off)
C11, C13	470pF silvered mica (2 off)
C15	100μF/6·3V (1 off)
C16	10–40pF trimmer (1 off)

Transistors and Diodes

TR1–TR3	BC357 (3 off)
TR4–TR6	BC182 (3 off)
D1–D10	Silicon signal diode (10 off)
D11	BZY88 8V2 (1 off)

Integrated Circuits and Modules

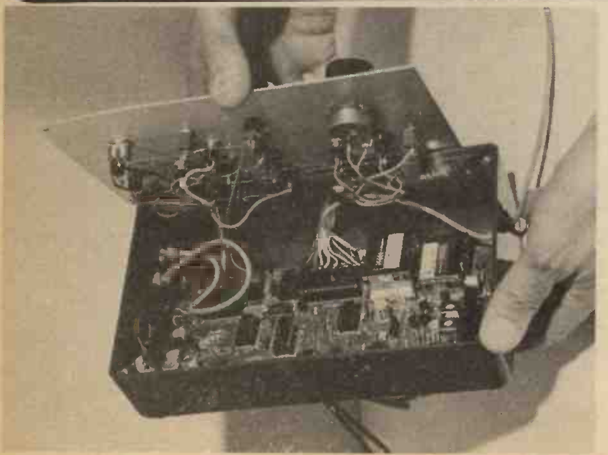
IC1	AY-3-8600 (1 off)
IC2	AY-3-8760-1 (1 off)
IC3–IC6	CD4069B (hex inverter) (4 off)
IC7	CD4071B (quad OR) (1 off)
IC8	4081B (1 off)
IC9	4013A (dual D/) (1 off)
IC10	4012B (quad NAND) (1 off)

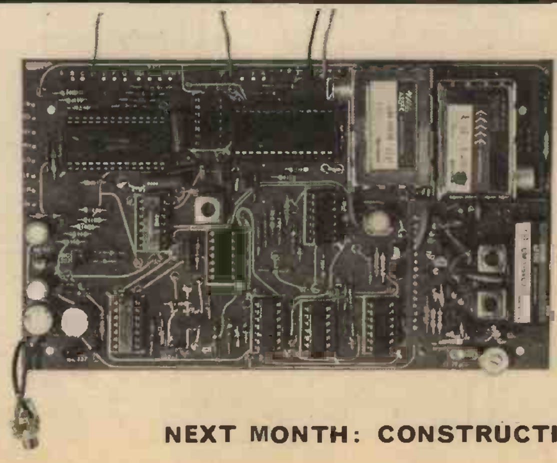
Miscellaneous

Module 1	UM1263 sound modulator (Astec)
Module 2	UM1163E36 vision modulator (Astec)
Module 3	UM1164E36 sub-assembly
L1	100μH tunable choke (screened)
XL1	4·4336MHz crystal

28-pin i.c. socket (2 off)
14-pin i.c. socket (8 off)
Plastics boxes for hand held units, 113 × 63 × 30mm (2 off)
Plastics box for main unit, 215 × 130 × 70mm sloped (1 off)
Push-to-make switches for S1–S15, S19, S20 (17 off)
Single-pole, single-throw toggle switches for S16–S19 (4 off)
Knob for "throttle" control. Mains power pack (V)
Low loss coaxial cable and TV aerial plug
4-way screened cable for hand held units
Printed circuit board

All components are available from Teleplay





NEXT MONTH: CONSTRUCTION

Market Place

Items mentioned 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.

ARALDITE RESIN PACKS

Araldite, the two-part mineral-filled epoxy resin system which is widely used throughout the electronic industry for potting small components, is now available in the form of a two-part sachet containing 200g of material from Ciba-Geigy Plastics.

The pack is in two sections, one containing the resin and the other containing the hardener: the two parts are separated by a clip. When the clip is removed, the two components come into contact with each other and can be mixed thoroughly by manipulation. To use, the bag is pierced at one end and the mixture squeezed out to be used as required.

The performance of the epoxy resins can vary if the two components are not mixed in the correct ratio, and the two-part sachet is a good way of ensuring that the optimum performance is achieved, and as the two components differ in colour the operator has a visual means of checking that the two parts are thoroughly mixed before use.

The hardener was chosen to give the system rapid curing properties at moderate temperatures, and is therefore particularly suitable for small castings. The mixture will cure fully at 25°C in between 24 and 36 hours, but will cure in as little as three hours at 60°C. Once mixed, the system has a life at 25°C of about 2–3 hours.

For further information contact Ciba-Geigy Plastics and Additives Company, Plastics Division, Duxford, Cambridge.

DIGITAL MULTIMETER

The new digital multimeter available from Farnell Instruments Ltd will be of interest to anyone who has used a multimeter switched to the incorrect range with disastrous results.

This meter, called the Data Precision 1350 can withstand 500V on its resistance ranges; and a 6,000V spike on any voltage range for 500nS.

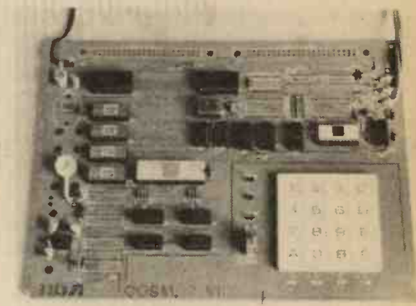
The 1350 offers a basic accuracy of 0·1 per cent and the instrument has a total of 26 ranges; a.c. and d.c. voltages from 100mV f.s.d. to 1,000V, resistance from 100mΩ to 20MΩ and a.c. and d.c. currents from 0·1μA to 2A.

The instrument is mains powered and has a 0·43 inch 3½ digit l.e.d. display. Recalibration is required once a year with only two adjustments necessary.

The cost of the unit is £115 excluding VAT and further details can be obtained from **Farnell International Instruments Ltd, Sandbeck Way, Wetherby, West Yorkshire LS22 4DH.**

COMPUTER KIT

A new do-it-yourself computer kit, the COSMAC VIP (Video Interface Processor) has been launched by RCA Limited. The system is designed to interface with a cathode-ray display or, via a suitable modulator, with a TV receiver and allows the user to assemble a complete microcomputer for creating and playing video games, generating computer graphics and developing microprocessor control functions.



The VIP offers a complete computer system on a printed-circuit board, using only 4k bits of ROM. Programs can be generated and stored in an audio cassette tape recorder for easy retrieval and use.

At the heart of VIP is RCA's COSMAC CDP1802 microprocessor, incorporating C-MOS circuitry for low power consumption and an 8-bit architecture for ease of application.

The CDP1802 microprocessor chip has a 2048 byte RAM, a single-chip graphic video display interface, a built-in hexadecimal keyboard, a 100 byte audio tape cassette interface, power supply and facilities for expanding both memory and input/output interfaces. An interpretive programming language known as CHIP-8 simplifies the programming of video games using hexadecimal code.

The VIP system is readily expandable, both on the printed-circuit board and through connectors. RAM capacity can be doubled on the board to 4096 bytes by adding four 4k bit devices, and can be expanded to 32 kilo bytes by adding further memory capacity through a 44-pin connector socket in the board. Parallel input/output expansion to 19 lines can be achieved for use with music synthesisers, relays, a low-cost printer or an ASCII keyboard.

The VIP hobbyist manual contains detailed information on kit assembly, operating procedures, CHIP-8 interpreter programming technique, machine-language programming, logic description, test programs, troubleshooting guides and system expansion. The manual also includes program listings for 20 video games, with simple instructions to non-programmers for using the hexadecimal keyboard.

VIP is usable with NTSC monochrome TV standards, but a PAL interface chip with colour and programmable sound capability will be available soon.

For further details contact: **RCA, Sunbury-on-Thames, Middlesex.**

VIDEO AGE BEGINS

Sony's Betamax home video recorder will be in the shops from June at an expected price of £750, with half hour cassettes at £7.

The PAL colour recorder/player can record programmes via its own tuner. In fact it can be timed to record a chosen programme up to three days in advance.

By having its own tuner, recording and viewing of two different channels can take place simultaneously. Also the potential fire hazard of an unattended live TV is avoided.

Recording duration can be set to 15, 30 or 60 minutes, any multiple of 15 minutes, or to the end of the cassette. A 3¼ hour cassette will cost £13·50.

Pre-recorded video material will presumably become as readily available as sound cassettes are now. In 1971 Sony and Time Life jointly announced plans to produce video programmes.

With a small video camera and microphone, simple home video programmes can be produced on the Betamax.

During recording a remote pause control enables material to be edited from the armchair.

Sony claim head life of over 1,000 hours with replacement heads very approximately costed at £60. The slanted azimuth head was developed by Sony and the tape speed is an incredible 19mm per second. Tape width is 13mm. Recorded picture quality is visibly indistinguishable from transmitted pictures.

TELEPHONE CHARGE CLOCK

A new microprocessor based product will, for the first time, enable telephone users to control the cost of each call as it is being made.

The Monitel telephone charge clock, computes and displays the actual cost of the call in pounds and pence, automatically accounting for the day of the week, the time of day, charge band tariffs and the VAT rate.

The unit is based on the Rockwell PPS4/1 microprocessor range and is programmed by insertion of a punch card. When the telephone rates change a new card is automatically supplied for a nominal fee.

Two models cater for world wide needs; a UK type and an International version. Designed to complement Post Office telephones the Monitel is available in all seven standard colours; ivory, grey, green, black, red, blue and yellow.

It does not infringe the Post Office Act because it is not directly connected to the telephone, but runs off mains power and is activated by the user.

When not being used to monitor calls the Monitel reverts to a 12 hour clock which can be set by keys hidden from view on the top surface of the unit where the telephone is placed.

The only manual selections required by the user are operation of the touch keys on the face of the display which coincide with the Post Office charge bands "l" local, "a" up to 56km, "b" over 56km, which are given in the telephone dialling code booklet, and touching the start/stop keys when the call is connected and again when it is completed.

The International model incorporates six alternatives, the three UK charge bands plus international bands 1, 2 and 4 which cover all of Europe, North America and the Caribbean.

The price of the UK model is £29·00 and the International version £39·00 both inclusive of VAT. Further details are available from **Monitel Limited, Berechurch Road, Colchester, Essex.**

MULLARD MODULES

Three new economy priced amplifier packages which utilise proven Mullard modules have been introduced by Radio and Television Components Ltd.

Package One consists of two LP1173 audio modules and an LP1182/2 stereo preamplifier module.

Package Two features two LP1173 modules plus an LP1184/2 stereo pre-amp with integral magnetic pre-amp.

Package Three includes two simple LP1173 audio modules LP1182/2 stereo pre-amp LP1179 FM tuner and a 1165 AM/FM IF strip.

Each package comes complete with application sheets detailing the performance and termination of each module. To complete the construction of an amplifier or tuner amplifier, volume controls and power supply can also be obtained from the company.

A very substantial saving over list prices being offered on these units: Package One components are £4·95 (normally £25·50), Package Two £6·95 (normally £27·50) and Package Three £9·95 (normally £37·00). Post and packing is £1·00 for any of the packages.

Further details can be obtained from **R & TVC, 323 Edgware Road, London W2.**

LINEAR CAPACITANCE METER PROJECT

We are informed that Watford Electronics can supply all the components for the Linear Capacitance Meter project as given in last month's issue. Perplexed hobbyists will be pleased to know that that includes the 1μF 1% polycarbonate capacitor and the 10MΩ 1% resistor.

Watford Electronics, 35 Cardiff Road, Watford, Herts.

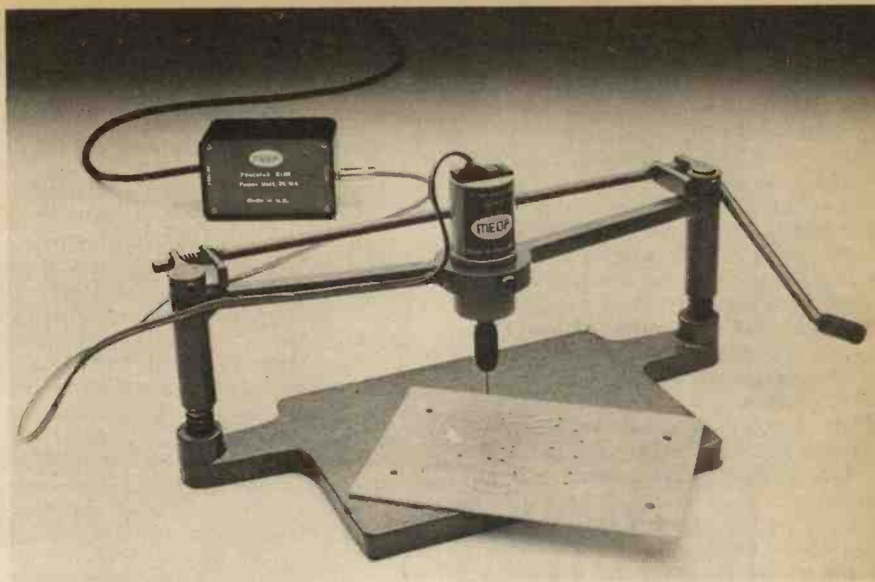
FRENCH VICE

The Nodex Quick Grip can be mounted horizontally on a bench top or on the bench edge. As a vice or a press its patented hand lever locking system makes for quick firm locking or loosening.

V notched jaws enable a wide variety of profiles to be held and the vice is adaptable on all drill supports. Maximum jaw opening is 70mm and jaw area is 70 × 35mm.

At 850gms it is easily carried in a tool kit.

This French vice is only £6·50 and is distributed by **Special Products Distributors Ltd., 81 Piccadilly, London WIV 0HL.**



P.C.B. DRILL STAND

The Mega Photolab is a new, low cost p.c.b. drill stand designed for use with conventionally hand-held p.c.b. drill units. It has been specifically introduced to meet requirements in the production of prototype p.c.b.s.

A strong base of machined cast iron supports precision steel guides by means of which the standard 12V drill is raised and lowered.

Important features are its combined simplicity and accuracy, and the fact that it will accept Mega and other proprietary drills of 34mm diameter as well as drills such as the Titan, at 41mm.

Additionally, the same basic drill stand is available to special order capable of accepting drills between 20 and 41mm diameter, at marginal extra cost.

The stand will accept p.c.b.s up to 10 × 9 in.

Priced at £14·50, the PLST-12A is manufactured by **Mega Electronics Ltd., 9 Radwinter Road, Saffron Walden, Essex CB11 3HU.**

TEN YEARS ON

Bandridge, the component and accessory wholesalers, recently celebrated their tenth anniversary. Operations started in the founder's front room and today the turnover is over £¾M. Bandridges "own brand" sales now account for more than half of their turnover.

Most of their customers are one or two man retailers, 90 per cent of the company business being in the UK.

Speed of delivery is thought to be so important that Securicor is used and despatch occurs within 24 hours.

The company's motto is *fast and friendly* and special effort is made to train staff to be familiar with items, prices and stock availability to ensure quick telephone replies.

Initially they specialised in components only but now accessories are as important. Constructors must be particularly pleased that Bandridge made available the S-DECs, T-DECs, μ-DECs and Blob Boards.

New products are shortly to accompany the already established range of audio accessories under the "Bandridge" banner. They include a range of intercoms and a range of quality amplifiers to supplement the already highly successful Quantum 150.

Plenty of literature and a sizeable trade catalogue are available to retailers from **Bandridge at 80a Battersea Rise, London, SW11 1EH (01-228 9227).**

INSTRUMENT CASES

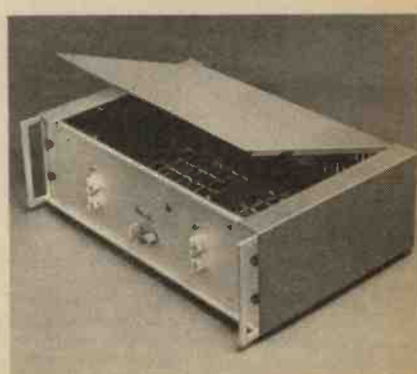
A new range of instrument cases has just been launched by Vero Electronics.

The new cases are designed to present the same appearance as the existing range, ensuring users of continuity of design, but have been modified to allow the top panel to be easily removed for servicing and calibration.

The range includes 19in and half width models, which are available with or without front handles as required.

The standard colour of the cases is blue/grey but four other colours are available to special order.

For more information about the Mk II D-Case ABO17 contact **Vero Electronics Limited, Industrial Estate, Chandler's Ford, Eastleigh, Hampshire.**



FRANK W. HYDE

SOVIET ACTIVITY

The launching of the Cosmos research satellite in March marked two important events. The first was that the 1,000th Cosmos was put into orbit with 83° inclination, a period of revolution of 104·9 minutes, apogee of 1,024 kilometres and perigee of 978 kilometres.

This satellite is a navigational vehicle to aid shipping and establish precise parameters and geographic coordinates. Like other satellites of this class Cosmos 1000 has influenced the weather forecasting techniques and aided geological prospecting. Though of the same class the Cosmos series vary considerably in design depending upon the tasks they have to carry out. In most cases the end of life of each vehicle has been to burn up in the higher atmosphere after their individual missions were completed. Some however were designed to have a soft landing return.

The most famous of these was Cosmos 110. This satellite made a 22 day trip with two dogs aboard. The successful return provided vital information for the design of future manned missions. No regular pattern has been followed in the launchings but the general level of activity was increased as the programmes advanced. It took more than ten years for the first 500 of these vehicles to be launched. The second 500 of the programme was accomplished in half that time.

THE SALYUT MISSION

The two astronauts who made the record for the longest weightless mission ceased to feel the effects of the prolonged space conditions a short time after their return to Earth. They celebrated it by going for a walk. This marked the end of their first re-adjustment to Earth conditions. Some fatigue was felt at first when standing up for a prolonged period. However each day this condition was improved. After four days they began to put on some of the 11lbs they had lost in weight.

Geori Grechko when commenting on his space walk, recalled that the sky had seemed more vast and more colourful than it had appeared from the portholes of the satellite. He also said that the Sun had felt hot in spite of the special space suit. In assessing the work programme both Grechko and Romanenko made reports of the success of the newly designed spacesuits. The load suit and the "Chibis" suit, designed to control the blood flow in the normal pattern on Earth, were highly beneficial. The space "bike" and the running track had also contributed a great deal to their comfort and well-being.

A point was made by the controller of the medical group, Professor Anatoli Yegorov, that the compatability of these two men was a very important factor in the success of the mission and had now contributed enough data to show that man could live quite satisfactorily for over a year, without disturbance of physical or mental conditions.

FUTURE PLANS

A Polish and a German cosmonaut will take part in the next missions, following the Soviet members to start the new series. The exact details are not yet ready for release as further study of the data is still proceeding. It is however certain that another supply ship will be part of the programme and that a regular set of shifts will be the main object of the missions. The fact that efficiency improved with time during the first group of multiple manning, will certainly mean that extra experiments will be added. The timing of the tasks and the days according to the normal Moscow time seemed to contribute not only to the efficiency but also to the high morale. It would appear that the biological clock is also an important factor in success in space.

Is it perhaps possible that a "special" atmosphere contains some special merit where the efficiency of the biological machine is concerned.

No doubt the new plans will include the dropping of sub-satellites as in the past. Remote control and operation of surveillence, both radar and photographic missions, have covered many fields. All of the missions in the past seem to have had multiple purpose types of programme. Many of the missions have appeared rather puzzling. For example Cosmos 881 and 882 launched by the same rocket and in different conditions returned to earth the same day or shortly after. Similarly Cosmos 997 and 998. Certain of this group of Cosmos vehicles such as 921 and 972 went into an unusual orbit at 75·8° inclination. Cosmos 929 was made to perform extensive changes of parameters. This was a rather larger vehicle than the others. The success of the geodesy and the weather forecasting enable very close touch to be maintained with the Soviet fleet of ships and submarines in all parts of the world.

It would seem logical that with all the increasing activity the Soviet space programme must include some form of shuttle system. Clearly it would be more economic and it is known that drop tests have been made with a delta-wing spaceplane. One possibility is that, in accordance with their usual testing of unmanned vehicles in assessing new designs, some of the more recent launches are the precursors of a new series of vehicles.

A NEW CANDIDATE

Another candidate for the honour of black hole has now appeared. The "Jet" Galaxy M87 has been under extensive examination at Kitt Peak National Observatory in Arizona; there is an increase in the velocity of matter circling the nucleus. The increase is of the order of 100 kilometres a second. This is the strongest evidence for a massive black hole in the centre of M87.

This work began at Mount Palomar Observatory where J. Kristian and his colleagues found that the galaxy had a brilliant pin point of light.

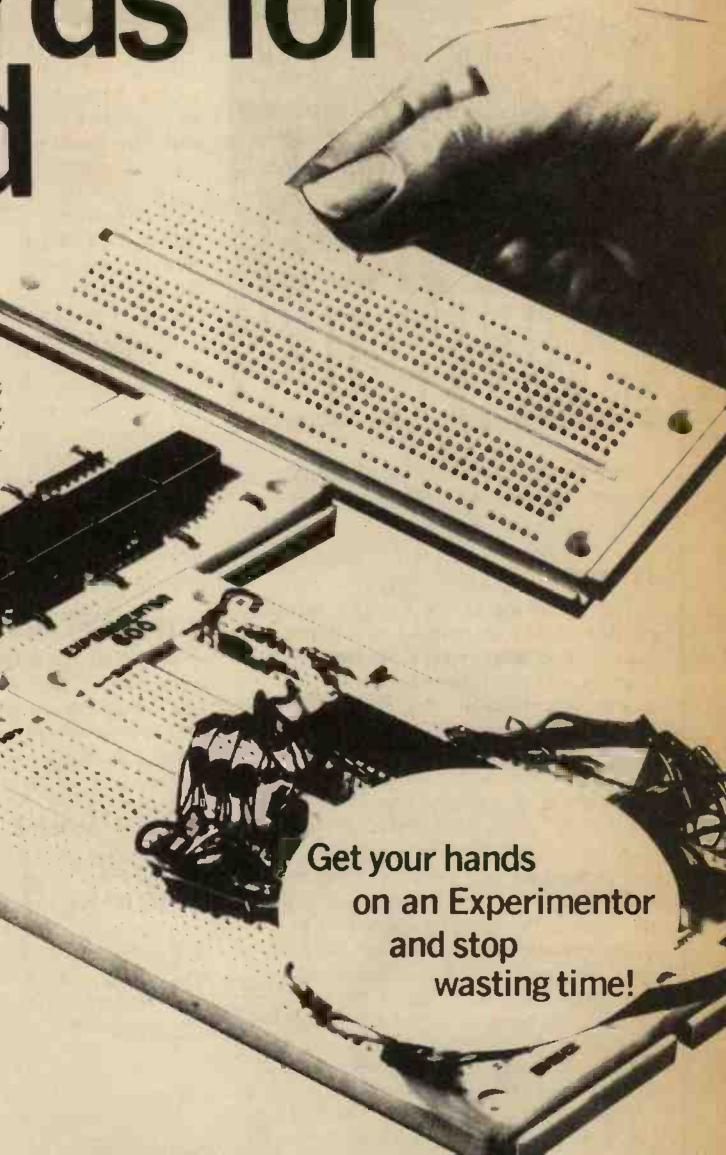
The next step in obtaining confirmation of this theory will be to scan other elliptical galaxies for similar evidence of massive black holes.

COMETS AND ICE AGES

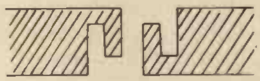
Comets have been very much in the news of late so it is not surprising that there should be a follow up from Fred Hoyle and Wickramsinghe. They have suggested that passing comets may have been responsible for large masses of dust particles injected into the solar system. These are perhaps the cause of a cooling process. It would be necessary for the Earth to pass through the dense inner halo of the comet. If it is assumed that there is an average of say five comets per year which come within one astronomical unit of the Earth, the chances of a mass acquisition of cometary dust is of the order of 10^8. Such an order of real happening would agree very roughly with the chronological order of geology.

It could be possible that the size of the particles would lead to an effective reduction in light reaching the Earth. Many things could happen, from the reduction of photosynthesis to the disruption of the food chains within a short time. The picture painted by Hoyle and Wickramsinghe of an initial fast freezing which would see the rapid demise of large animals but the longer continued existence of seeds and nuts with small animals and freshwater organisms surviving. This situation does roughly compare with the conclusions for the past eras. The recovery it is suggested would be quite rapid, something of the order of 1,000 years.

Mini-priced breadboards for maxi-sized projects.

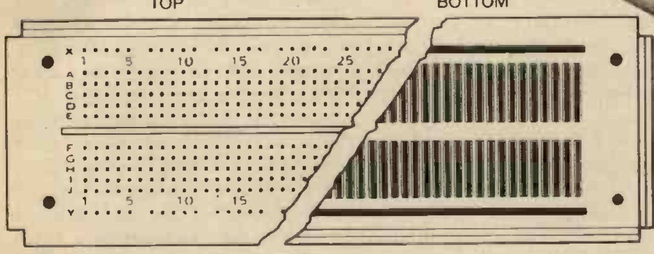


Experimentor* low-cost solderless breadboards are the first in the world specially designed for 0.3" and 0.6" pitch DIP's.



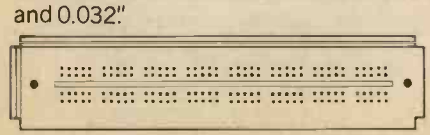
They clip together by an exclusive interlocking system in any configuration, (just like dominoes), so you arrange the breadboards to suit your circuit, not vice-versa.

They are precision moulded from durable, flame-retardant plastic, and feature alphanumeric coding for easy circuit building, and non-corrosive, pre-stressed nickel-silver alloy contacts—reliable for well over 10,000 insertions.



Contact resistance is a mere 0.4 mΩ and interterminal capacitance is typically less than 5pF. The **Experimentor** is usable to over 100 MHz.

Experimentor 600 and 650 models are ideal for RAM's ROM's and PROM's (0.6" centre IC's) while the 300 and 350 models are for smaller DIP's (0.3" centres). All four models, of course, also take all standard components, the 0.1" grid being compatible with transistors, diodes, LED's, capacitors, resistors, pots—in fact any component with lead sizes between 0.015" and 0.032".



A useful quad bus strip (EXP4B) further expands the versatility of the system for the MPU user.

Model	Length"	Width"	Centre channel"	5-way tie points	Bus	Price	
							All units are 0.330" deep.
EXP300	6.0	2.1	0.3	94(470)	2(80)	£7.29	Prices include VAT (8%) and p&p for
EXP350	3.6	2.1	0.3	46(230)	2(40)	£4.21	UK Orders.
EXP600	6.0	2.4	0.6	94(470)	2(80)	£7.88	Add 5% to all orders outside UK.
EXP650	3.6	2.4	0.6	46(230)	2(40)	£4.69	All prices and specifications correct
EXP4B	6.0	1.0	N/A	N/A	4(160)	£3.29	at the time of going to press.

Experimentor breadboards can be used alone or mounted on any convenient flat surface, thanks to moulded-in mounting holes and vinyl insulation backing that prevents short circuits. Mount them from the front with 4-40 flathead screws or from the rear with 6-32 self tapping screws.

But however you use them, **Experimentor** breadboards are the quickest and easiest way to build and test circuits.

If you're working on IC's, MPU's, memories, displays or any other circuits, buy the breadboards that are designed for you.

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TRANSISTORS

Type	Price
2N696	0.39
2N697	0.31
2N698	0.49
2N699	0.58
2N706	0.30
2N706A	0.30
2N708	0.30
2N718	0.30
2N718A	0.54
2N720A	0.85
2N722	0.45
2N727	0.50
2N914	0.38
2N916	0.33
2N917	0.38
2N918	0.45
2N929	0.37
2N929A	0.37
2N930	0.37
2N930A	0.95
2N1711	0.30
2N1889	0.30
2N1890	0.30
2N1893	0.30
2N2102	0.50
2N2192	0.58
2N2193	0.50
2N2193A	0.52
2N2194	0.42
2N2194A	0.45
2N2195	0.40
2N2195A	0.40
2N2217	0.55
2N2218	0.35
2N2218A	0.38
2N2219	0.38
2N2219A	0.39
2N2220	0.39
2N2221	0.25
2N2221A	0.25
2N2222	0.25
2N2222A	0.25
2N2369	0.27
2N2369A	0.27
2N2646	0.80
2N2647	1.55
2N2903	1.60
2N2904	0.31
2N2904A	0.31
2N2905	0.31
2N2905A	0.31
2N2906	0.25
2N2906A	0.25
2N2907	0.25
2N2907A	0.25
2N2923	0.17
2N2924	0.17
2N2925	0.19
2N2926	0.17
2N3053	0.25
2N3054	0.72
2N3055	0.75
2N3390	0.50
2N3391	0.40
2N3391A	0.45
2N3392	0.17
2N3393	0.17
2N3394	0.17
2N3395	0.19
2N3396	0.19
2N3397	0.19
2N3438	0.85
2N3440	0.75
2N3441	0.92
2N3442	1.45
2N3638	0.17
2N3638A	0.17
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2N3703	0.14
2N3704	0.14
2N3705	0.14
2N3706	0.14
2N3707	0.14
2N3708	0.12
2N3709	0.12
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2N3772	2.20
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2N3820	0.39
2N3821	0.96
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2N4037	0.60
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2N4288	0.22
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2N6108	0.55
2N6109	0.55
2N6111	0.49
2N6121	0.41
2N6122	0.44
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2N6124	0.45
2N6125	0.47
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40363	1.45
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40410	0.82
40411	3.10
40594	0.87
40595	0.98
40673	0.80
40669	1.30
AC126	0.48
AC127	0.48
AC128	0.48
AC151	0.43
AC152	0.54
AC153	0.59
AC153K	0.59
AC176K	0.70
AC176	0.64
AC187	0.59
AC187K	0.65
AC188	0.54
AC188K	0.65
AD161	1.00
AD162	1.00
AF106	0.60
AF109	0.52
BC107	0.16
BC107A	0.16
BC107B	0.16
BC108	0.16
BC108A	0.16
BC108B	0.16
BC108C	0.17
BC109	0.16
BC109B	0.17
BC109C	0.18
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BC141	0.32
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BC148	0.13
BC148B	0.13
BC148C	0.13
BC149	0.15
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BC168A	0.13
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BC212	0.15
BC212A	0.15
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BC213	0.15
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BC257A	0.18
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BC307A	0.16
BC307B	0.16
BC308	0.16
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BC337	0.20
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BC547B	0.13
BC548	0.13
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BC549B	0.14
BC549C	0.15
BC557	0.14
BC558	0.13
BC559	0.15
BCY70	0.21
BCY71	0.26
BCY72	0.18
BD115	0.88
BD131	0.55
BD132	0.75
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BD136	0.40
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BD140	0.43
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BD183	2.35
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BD237	0.44
BD238	0.44
BD239A	0.44
BD239C	0.59
BD240A	0.49
BD240C	0.59
BD241A	0.49
BD241C	0.65
BD242A	0.55
BD242C	0.62
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BD243C	0.87
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BD244C	0.87
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BD245C	0.85
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BD246C	0.93
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BD434	0.46
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BD529	0.49
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BD535	0.70
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BD539	0.60
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BDX18	1.90
BDY20	1.10
BDY55	1.90
BDY56	2.10
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BF160	0.33
BF161	0.65
BF167	0.37
BF173	0.37
BF177	0.27
BF178	0.27
BF179	0.33
BF180	0.37
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BF196	0.16
BF197	0.18
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BF225J	0.27
BF244A	0.38
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BF245A	0.44
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BF336	0.42
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BF338	0.52
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BFR40	0.29
BFR41	0.30
BFR79	0.30
BFR80	0.30
BFR81	0.30
BFX29	0.34
BFX30	0.34
BFX84	0.30
BFX85	0.38
BFX86	0.30
BFX87	0.35
BFX88	0.30
BFX89	1.37
BFY50	0.27
BFY51	0.27
BFY52	0.27
BFY90	1.36
BR101	0.55
BRY39	0.55
BSX19	0.35
BSX20	0.35
BSX21	0.35
BU104	1.80
BU105	1.55
BU126	1.08
BU204	2.20
BU205	2.40
BU206	2.70
BU208	2.70
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ME0402	0.22
ME0404	0.17
ME0412	0.22
ME0414	0.22
ME4001	0.16
ME4002	0.16
ME4003	0.16
ME4101	0.11
ME4102	0.11
ME4103	0.11
ME4104	0.11
ME6101	0.22
ME6102	0.22
MJ2955	1.35
MJE340	0.62
MJE370	0.62
MJE371	0.86
MJE520	0.50
MJE521	0.70
MJE2955	1.65
MPF3055	1.05
MPF102	0.33
MPF103	0.44
MPF104	0.44
MPS105	0.44
MPSA05	0.27
MPSA06	0.27
MPSA12	0.44
MPSA14	0.33
MPSA55	0.27
MPSA56	0.27
R2008B	2.45
R2010B	2.15
TIP29A	0.49
TIP29C	0.65
TIP30A	0.54
TIP30C	0.70
TIP31A	0.54
TIP31C	0.72
TIP32A	0.59
TIP32C	0.82
TIP41A	0.76
TIP41C	0.97
TIP42A	0.86
TIP42C	1.08
TIP2955	0.70
TIP3055	0.59
TIS34	1.05
TIS42	0.50
TIS43	0.47
TIS90	0.22
TIS91	0.27

LINEAR CIRCUITS

Type	Price
CA3018	0.75
CA3018A	1.10
CA3020	2.20
CA3020A	2.50
CA3028A	0.90
CA3028B	1.25
CA3030	1.50
CA3030A	2.20
CA3038	2.90
CA3038A	4.10
CA3045	1.55
CA3046	0.77
CA3048	2.45
CA3052	1.78
CA3080	0.85
CA3080A	2.10
CA3086	0.50
CA3088B	1.87
CA3089B	2.90
CA3090Q	4.40
CA3130	1.06
CA3140	1.04
LM301	0.30
LM307N	0.50
LM308N	0.95
LM309KC	1.95
LM317K	3.35
LM318N	2.45
LM320TS	2.15
LM320T12	2.15
LM320T15	2.15
LM320T24	2.15
LM320P5	1.15
LM320P12	1.15
LM320P15	1.15
LM320P24	1.15
LM323K	6.95
LM339N	0.60
LM340T5	0.88
LM340T15	0.88
LM340T24	0.88
LM341P5	0.80
LM341P12	0.80
LM341P15	0.80
LM341P24	0.80
LM348N	0.95
LM358N	0.60
LM360N	3.00
LM370N	3.30
LM371H	2.35
LM350K	6.45
LM373N	3.35
LM374N	3.36
LM377N	1.80
LM378N	2.40
LM379S	4.25
LM380N8	0.96
LM380N14	1.08
LM381AN	2.70
LM381N	1.69
LM382N	1.32
LM384N	1.55
LM386N	0.88
LM387N	1.10
LM388N	1.00
LM389N	1.00
LM702C	0.81
LM709	0.70
LM7098	0.50
LM70914	0.49
LM710	0.67
LM71014	0.64
LM711CN	0.72
LM723C	0.75
LM723C14	0.45
LM726	5.80
LM741C	0.70
LM741C8	0.30
LM741C14	0.30
LM747CN	0.99
LM7488	0.50
LM74814	0.90
LM1303N	1.15
LM1304N	1.52
LM1305N	1.52
LM1307N	1.22
LM1310N	2.10
LM1351N	1.30
LM1458N	0.45
LM1496N	0.97
LM1808N	2.10
LM1812N	6.20
LM1820N	1.16
LM1828N	1.90
LM1830N	1.90
LM1841N	1.90
LM1845N	1.50
LM1848N	1.98
LM1850N	1.90
LM1889N	4.90
LM3301N	0.60
LM3302N	0.55
LM3401N	0.55
LM3900N	0.68
LM3905N	1.15
LM3909N	0.78
LM3911N	1.10
LM7805K	1.75
LM7812K	1.75
LM324	0.75
LM7815K	1.75
LM7824K	1.75
LM78L05CZ	0.30
LM78L12CZ	0.30
LM78L15CZ	0.30
MM5314	4.60
MM5316	4.60
NE555	0.33
NE556	0.85
NE558N	1.98
NE560	4.50
NE561	4.50
NE562	4.50
NE565	1.39
NE566	1.75
NE567	1.90
NE571N	4.95
SAS560	2.70
SAS570	2.70
SAJ110	2.10
S041P	1.35
S042P	1.35
SN76001N	1.30
SN76003N	2.38
SN76013N	1.50
SN76023N	1.50
SN76033N	2.35
TAA263	1.35
TAA300	3.70
TAA320A	1.15
TAA350A	3.00
TAA521	1.10
TAA522	2.10
TAA550	0.48
TAA560	2.10
TAA570	2.20
TAA370A	5.45
TAA630	2.40
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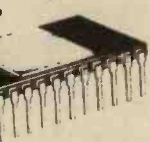

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74LS54N	0.26
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74LS76N	0.42
74LS78N	0.42
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74LS86N	0.44
74LS90N	1.10
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74LS109N	0.42
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74LS139N	0.65
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74LS169N	2.43
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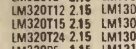

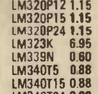

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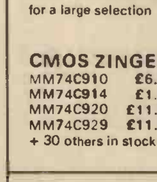

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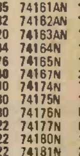

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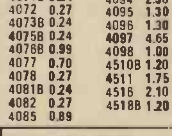

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INDUSTRY NOTEBOOK

By Nexus

MATS

There's nothing quite like having a telephone in your car linked into the public network. Once a toy for the affluent it is now appealing to ordinary business people.

In the UK the service is manual. That is, you need to call up by radio from your car and an operator will connect you to the telephone number you want.

A big advance on this system is now appearing in the Middle East whereby you can dial the number directly from your car to any subscriber in the world who can be accessed through local or international STD. Similarly a fixed or mobile subscriber can call a remote mobile just by dialling his number and be connected automatically without operator intervention.

Cable & Wireless engineers have recently engineered such a system for Bahrain Telephones and the Mobile Automatic Telephone System (MATS) went into service on April 25 with a capacity of 50 mobile subscribers with facilities to expand the service to as many as 1,500 subscribers. A similar system has been operating in Qatar but the Bahrain system is said to use more advanced technology.

There seems to be an insatiable demand for communications in the whole of the Middle East. Bahrain, of course, is now emerging as a major business centre for the area, displacing Beirut where political problems and civil disturbances have forced many companies to look elsewhere for a secure operating base.

So great is the demand for communications and the ensuing business for equipment suppliers that Bahrain is to have its own communications exhibition and conference. It is called MECOM 79 and opens on April 23 next year. Organised by a British exhibition company, it is sponsored by the Bahrain Ministry of Communications and Transport and also has the support of the PTT administrations of Saudi Arabia and Qatar.

The associated technical conference has the support of the Bahrain Society of Engineers and the British journal *Communications International*.

COMMUNICATIONS 78

From looking forward we now look back on Communications 78 which, this year, moved from Brighton to Birmingham. I didn't welcome the move and I was not alone in preferring the civilised pleasures of Regency Brighton to those of Britain's second largest city. But arriving for the show on the first day it was quite obvious that the facilities at Brighton's Metropole exhibition centre could not have physically accommodated the enormous expansion since 1976.

So we suffered in silence in the courtesy coaches from the remote car parks to the exhibition hall and the ten-minute trudge in chilling gales from the hall to the conference centre, knowing it was in a good cause and finally dispelling any doubts that communications is the great growth area of this decade and, for that matter, decades ahead.

The event was a triumph for Tony Davies, the organiser, and his committee drawn from Government departments, the armed forces and from industry, right through from the inaugural luncheon graced by the Duke of Kent to the final attendance count of over 15,000 registered visitors from over 40 countries, more than twice as many as attended the 1976 event. The conference, too, broke all records with 825 registered delegates and proceedings which ran to more than 400 pages of condensed print.

Although not a direct result of the exhibition, some exciting contracts were announced at the same time. One was a multi-million pound contract from Saudi Arabia awarded to Cable and Wireless to equip the para-military Saudi National Guard with a communications system. The other was awarded to Marconi Space and Defence Systems who are to develop, in conjunction with Cincinatti Electronics, the next generation of v.h.f. mobile radio equipment for the United States Army, the Sincgars project.

Racal and Plessey were also in the bidding for the US Army contract, both with American partners. It was understood at one time that of all those bidding only one winner would be selected. In the event the Americans selected two winners (the other being ITT) and each will have to produce evaluation models for a final play-off to determine the ultimate winner who then gets the jackpot of orders which some observers estimate as being worth 500 million pounds.

Meanwhile the Ptarmigan tactical trunk communications system for the British Army is forging ahead with Plessey as main contractors. A Plessey spokesman told me that the project was on target both in performance and timescale and, in fact, system hardware was on public show for the first time and is already in the hands of the users who describe the system as a "healthy bird". Project development started in 1973 on a seven-year time scale. Plessey also introduced two new military radios at the show, both private venture, claimed to fill gaps in the present Clansman range for military use.

HANDS OFF!

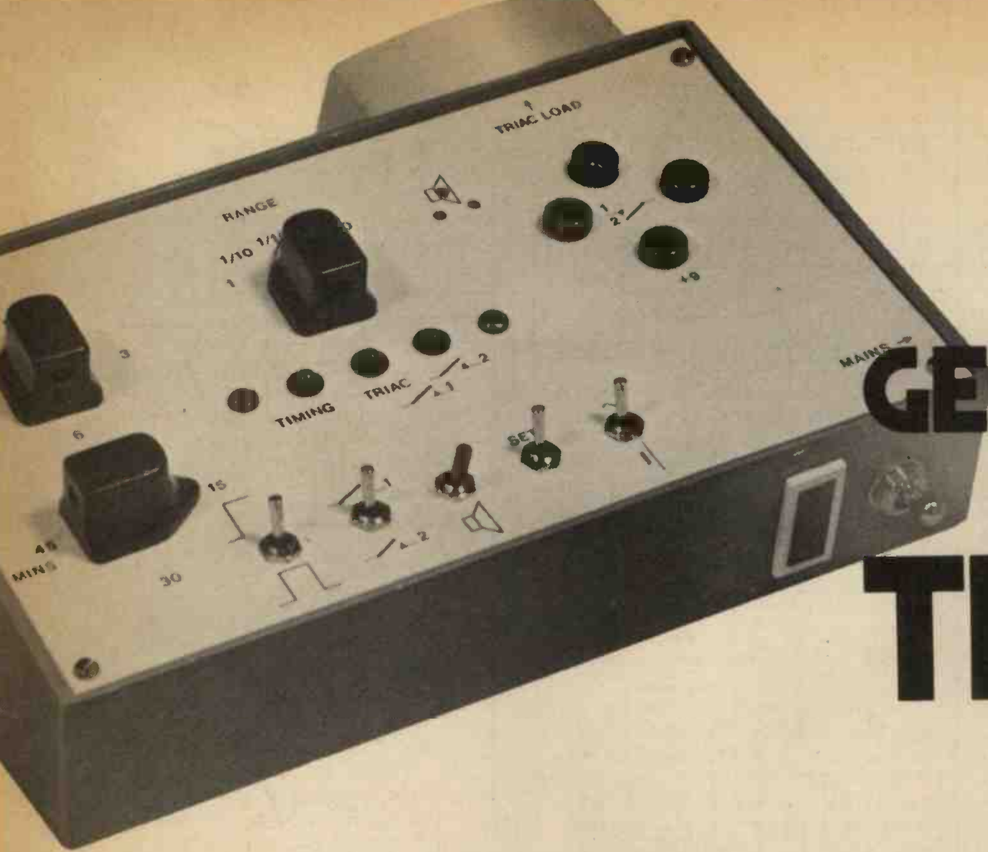
When Racal Electronics Group purchased Milgo of Miami, Florida, last year they also bought some outstanding litigation which involved patent infringement against United Business Communications Inc. The company, wholly British-owned and re-named Racal-Milgo Inc., has received awards of about three million dollars by the US District Court in Kansas in court costs, damages and interest since 1972. Three patents were involved and the infringement, according to Senior Judge George Templar, was so serious that he ruled that Racal-Milgo were entitled to treble damages.

INVESTMENT OVERSEAS

British companies, still nervous of industrial unrest, creeping nationalisation and inflation at home, are continuing to search for better returns overseas. Thorn, for example, has just bought two US companies, spending six million pounds in the process. Both will complement the Thorn Industrial Control Engineering Group. This at the time when Thorn was facing the prospect of strikes at the company's Yorkshire TV factories over proposed redundancies.

And, Racal, always on the look-out for acquisitions has gathered in California-based Vadic Corporation in the low-speed modem business and its first French company, Dana Electronics France SA. Vadic complements the high-speed modem business of Racal-Milgo giving Racal a complete modem product range, while Dana in France is the tail-end of the purchase of Dana Laboratories Inc. of California, the acquisition of which was announced last October.

Racal paid nearly 5·4 million pounds for Vadic Corporation (now to be known as Racal-Vadic Inc.) which has only 200 employees producing a profitable turnover of five million pounds per annum and expanding fast. This is a turnover of 25,000 pounds per employee representing a level of productivity which good business demands and expects, and it well illustrates the sinking labour content of modern electronic equipment.



GENERAL PURPOSE TIMER

M. PLANT

An accurate wide range timer with audio and visual alarms

THE electronic timer described here was developed to meet two requirements: the need for a general purpose twelve hour timer capable of switching on an external load (low voltage d.c. to 240V mains a.c.) at the end of preset time periods; and also capable of enabling a cine camera to take time lapse sequences so that observations could be made of growing plants, etc.

For the latter technique the timer is able to switch on a flood lamp at the end of a preset period and then to release a camera shutter while the subject is illuminated; the timer then resets itself automatically for another sequence.

The meeting of these two needs has resulted in a very versatile timer which has the following specification:

(a) Mains or battery operation.
(b) Battery operation provides a portable timer (with optional audio alarm) which can be used to switch on low voltage battery-operated equipment.
(c) Mains operation provides, in addition to (b), triac control of mains powered loads up to 1,000W.
(d) In both battery and mains modes of operation, "one shot" or "repeat" timing can be selected.
(e) Two linked 12-way wafer switches select 11 delay periods of 1 hour and 11 delay periods of 5 minutes giving a maximum delay of 11 hours 55 minutes in 121 intervals of 5 minutes.
(f) A range switch divides the above intervals by factors of 10, 100 and 500 giving, on the "1 hour" wafer switch, intervals of 6 minutes, 36 seconds and 7·2 seconds respectively; and on the "5 minutes" wafer switch intervals of 30 seconds, 3 seconds and 0·6 seconds, respectively.
(g) When the timer is operated from the mains and is in the "repeat" mode, the triac drive circuitry can be used to switch on a flood lamp (max 1,000W) for 2·5 seconds. During this period, a low voltage pulse is available of about 0·5 seconds duration for driving a solenoid to operate a camera shutter. The lamp then goes out with the timer having already set itself for another cycle. In the "one shot" mode, once mains switching is initiated the load remains energised.
(h) Repeatability of any time intervals is to within 0·01 per cent but the accuracy of the preselected intervals depends on the care with which the constructor selects the values of 22 resistors and 3 capacitors and upon the stability of these components.

CIRCUIT OPERATION

The complete circuit diagram of the unit is shown in Fig. 1. IC1 is a precision digital timer which makes use of an "on chip" oscillator the frequency of which is set by an externally connected CR network. Pulses from this oscillator are fed through a twelve stage binary counter which switches the output stage after 1,095 counts.

Timing is started by closing S4 to provide power to the timer, the time period being set by the values of R22 to R32 and R33 to R43 which are in series and selected by the wafer switches S5 and S6, and the values of the capacitors C6, C7 or C8 selected by S7. This CR combination across pins 13 and 14 sets the frequency of the internal oscillator which times out after a time T given by $T = 2736\ CR$.

During the count down period, pin 3 of IC1 is high, allowing D2 to light. At the end of the count down, output pin 2 goes "high" and pin 3 goes "low": D2 goes out and TR1 is switched on. What happens subsequently depends upon the settings of the various switches.

Firstly, if S1a is open, the voltage at pin 3 stays "low" and TR1 remains switched on: if S1a is closed, R2 and C5 ensure that the timer automatically resets after about one second via the trigger of IC1 (pin 1). The period "t" before resetting takes place is given by $t = 0{\cdot}6\ R2\ C5$, approximately.

If S3 is closed, the audio alarm signal of IC2 is switched on

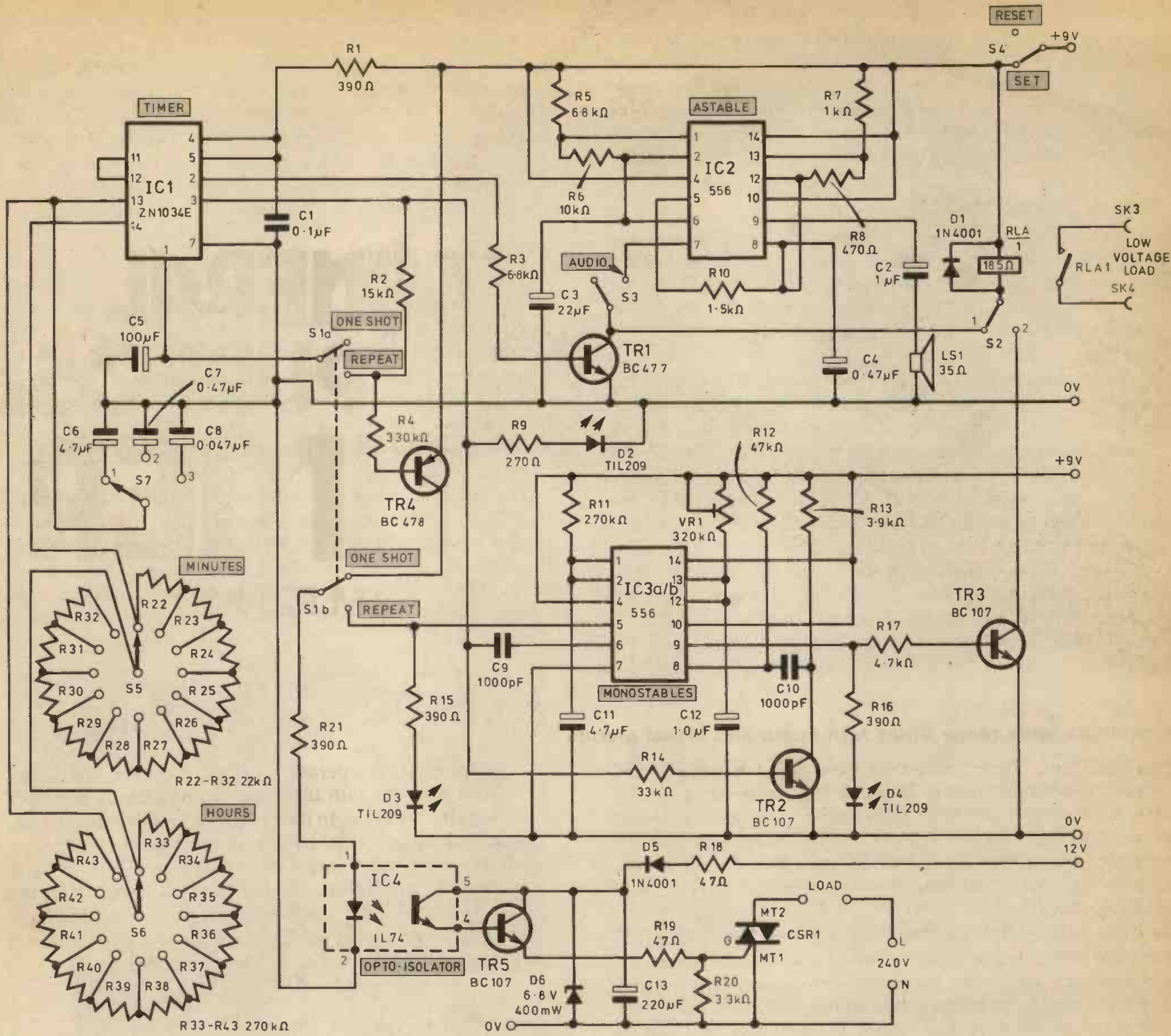


Fig. 1. Circuit diagram of the General Purpose Timer

whilst TR1 is on. This dual "555" timer (IC2) is operated as a dual astable multivibrator which is d.c.-connected via R10 so as to produce a repeated "pip" from the speaker. With or without S3 closed, transistor TR1 can energise relay RLA if S2 is in position 1. In the "one shot" mode, RLA remains energised and can be used to switch on a low voltage load (not mains) for an indefinite period at the end of the timing period. In the "repeat" mode, TR1 is energised for about one second so the alarm and RLA are energised briefly at the end of the time period.

If S2 is in position 2, RLA is energised via a positive pulse appearing at pin 9 of IC3. Once again a dual "555" timer integrated circuit is used for IC3 but each individual timer is wired as a monostable multivibrator. These two monostables are arranged to be triggered one after the other by the square wave pulse appearing at pin 3 of IC1 when operating in the "repeat" mode. But the trigger pins 6 and 8 of IC3 require negative-going trigger pulses via capacitors C9 and C10, respectively, in order to initiate delays determined by the values of R11/C11 and VR1/C12 respectively.

When the voltage at pin 3 of IC1 rapidly goes negative at the end of the timing period, monostable IC3a is triggered for a period of about 2·5 seconds; this negative going pulse keeps transistor TR2 turned off allowing pin 8 to remain "high" via R12. However, if IC1 is in the "repeat" mode, one second after IC3a has been triggered pin 3 goes "high" once again for another timing period "T".

This rapidly rising positive voltage switches on TR2 so that the sharp rise in current through R13 provides the required negative pulse at the collector of TR2 which, applied to pin 8 by C10, triggers the second monostable IC3b. Thus a positive pulse of about ½ second duration appears at pin 9 approximately one second after the positive pulse has appeared at pin 5.

The "on" states of the monostables are indicated by diodes D3 and D4. Transistor TR3 enables RLA to be energised for about 0·5 second if required so that its normally open contacts can be used for providing solenoid drive for a camera release button.

Note that RLA can be energised by either the positive pulse from IC1 pin 2 (for one second or for an indefinite period at the end of the timing period depending upon the position of S1), or by the positive pulse at pin 9 of IC3b thereby not being energised when IC1 is operating in the "one shot" mode or for one second after IC1 has timed out if in the "repeat" mode. This latter pulse lasts only long enough to provide camera shutter drive through a solenoid.

TRIAC OPERATION

Whether the triac provides switching for a mains load over an indefinite period or for about 2·5 seconds at the end of the timing period depends on the position of S1b. In the "repeat" mode, S1b directs the 2·5 second pulse from pin 5 of IC3a to the opto-isolator IC4 to energise the load.

At the end of this period the triac automatically switches off this a.c. load. In the "one shot" mode, S1b directs the negative going pulse from IC1 (pin 3) to pin 1 of IC4 (after inversion by TR4) in order to switch on the load for an indefinite period. Transistor TR4 was found necessary to ensure that pin 3 was not too heavily loaded for this caused erratic operation of IC1 in the "repeat" mode. Note that TR4 is base biased by R4 just sufficient for its collector current to bring on the internal l.e.d. of IC4.

The one shot operation of the timer means that mains operated appliances can be switched on after any one of the preselected time periods up to a maximum of 11 hours 55 minutes. The mains load can be switched off using either the "set/reset" switch or, of course, by switching off the mains.

AUDIO ALARM

This can be switched in and out by means of S3 and is based on IC2; it can be operated in both the mains and battery modes. In the "repeat" mode operation of timer IC1, a one second burst of "pips" is heard at the end of each delay period. In the "one shot" mode the pips sound continuously until the timer is switched off.

The alarm will work on battery or mains; care should be taken to ensure that, when the timer is operated using a battery, it does not become discharged during long preset delay periods.

POWER SUPPLY

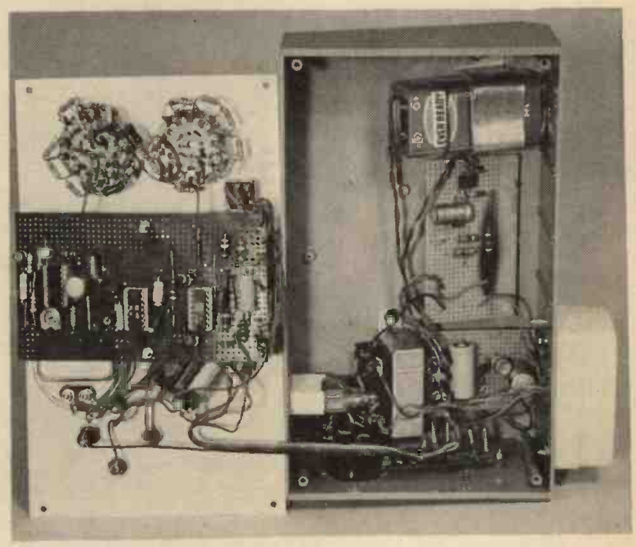
The circuit diagram of the p.s.u. is shown in Fig. 2. Switch S8 selects mains or battery operation. Approximately 9V is derived from the mains using one winding of the transformer and the bridge rectifier (D8 to D11). This voltage is stabilised by the Darlington series regulator.

The other winding provides the supply for TR5 on the triac drive board and for the internal phototransistor of IC4. The 12V a.c. from the transformer is rectified by D5 before being applied to the collector of TR5. The Zener diode D6 and the electrolytic capacitor C13 ensure that the voltage is sufficiently steady for reliable operation of the triac. It is the rising emitter voltage of TR5 which switches on the triac.

CONSTRUCTION

Three pieces of 0·1 inch matrix stripboard were used for the circuit assembly: the main timer board, the triac drive board and the low voltage board. The component layouts for these boards are shown in Figs. 3, 4 and 5. All external connecting wires to the boards should be made longer than required and then cut to the correct length prior to being soldered to the l.e.d.s and switches. Note that the l.e.d.s have polarised leads and care should be taken to ensure correct connection to the circuit board.

The timer was housed in a polystyrene case with a sloping front panel. The aluminium panel was removed and replaced by a polystyrene one to avoid the necessity of having to earth it although no mains connection is made to this panel. The stripboard circuit of the timer is attached to this control panel by stand-off studding to clear the switches and the l.e.d.s, etc.



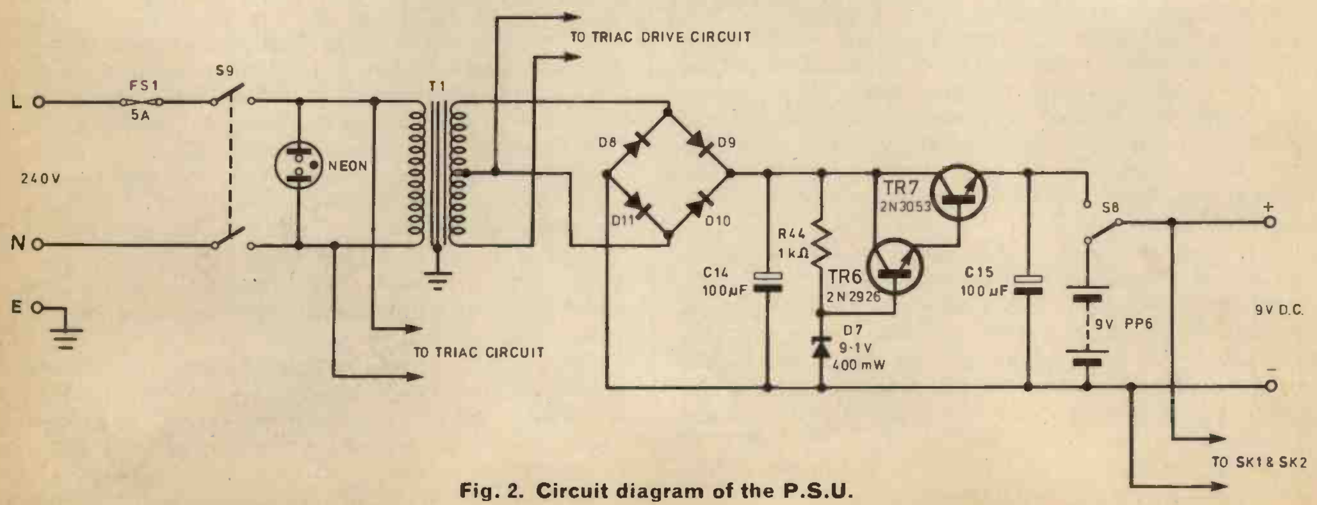


Fig. 2. Circuit diagram of the P.S.U.

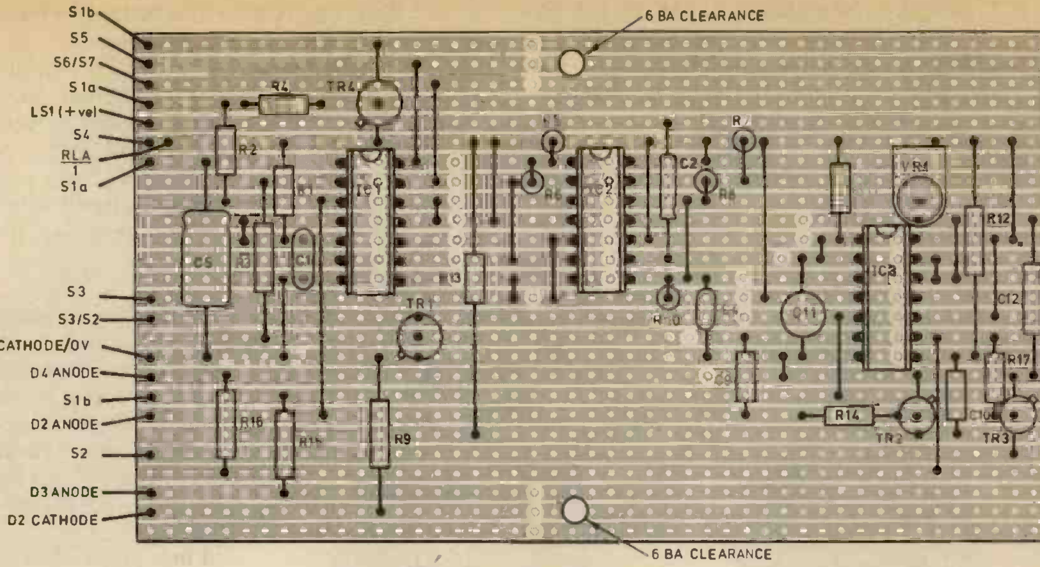


Fig. 3. Main timer board layout

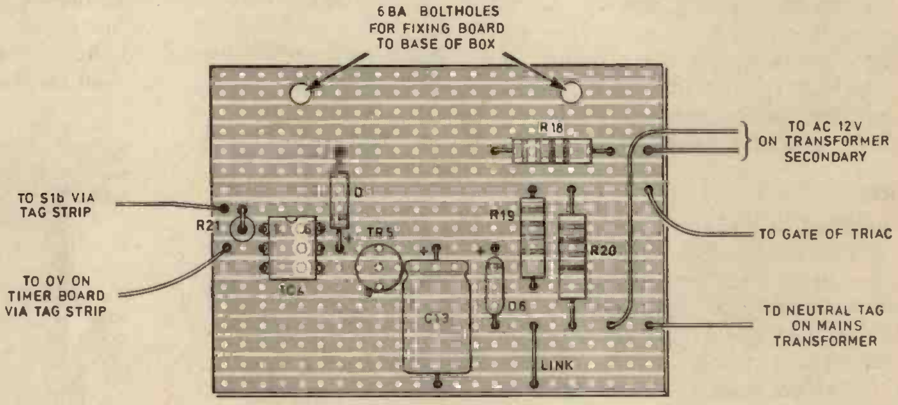


Fig. 4. Triac drive board layout

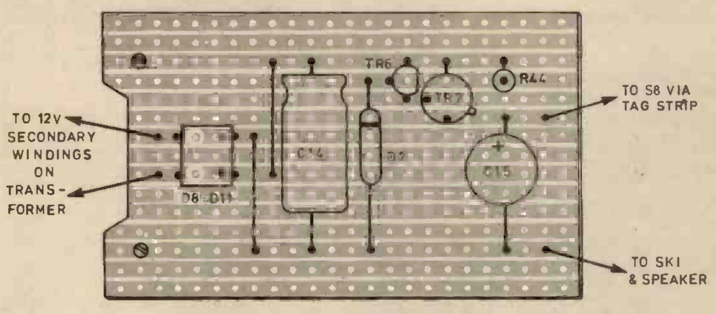


Fig. 5. Low voltage board layout

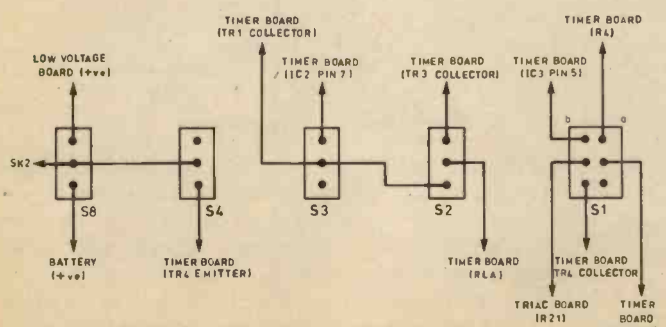


Fig. 6. Wiring of the front panel switches

COMPONENTS . . .

Resistors

R1, R15, R16, R21	390Ω (4 off)
R2	15kΩ
R3, R5	6·8kΩ (2 off)
R4	330kΩ
R6	10kΩ
R7	1kΩ
R8	470Ω
R9	270Ω
R10	1·5kΩ
R11	270kΩ
R12	47kΩ
R13	3·9kΩ
R14	33kΩ
R17	4·7kΩ
R18, R19	47Ω (2 off)
R20	3·3kΩ
R22–R32	22kΩ (11 off) ½W 2% metal oxide
R33–R43	270kΩ (11 off) ½W 2% metal oxide
R44	1kΩ ½W 10% carbon

All resistors ¼W 5% carbon except where stated

Potentiometers

VR1	220kΩ preset

Capacitors

C1	0·1μF polyester
C2, C12	1μF 25V tant. (2 off)
C3	22μF 25V tant.
C4	0·47μF 25V tant.
C5	100μF 25V tant.
C6	4·7μF polyester
C7	0·47μF polyester
C8	0·047μF polyester
C9, C10	1,000pF polystyrene (2 off)
C11	4·7μF 25V tant.
C13	220μF 25V elect.
C14, C15	100μF 25V elect. (2 off)

Semiconductors

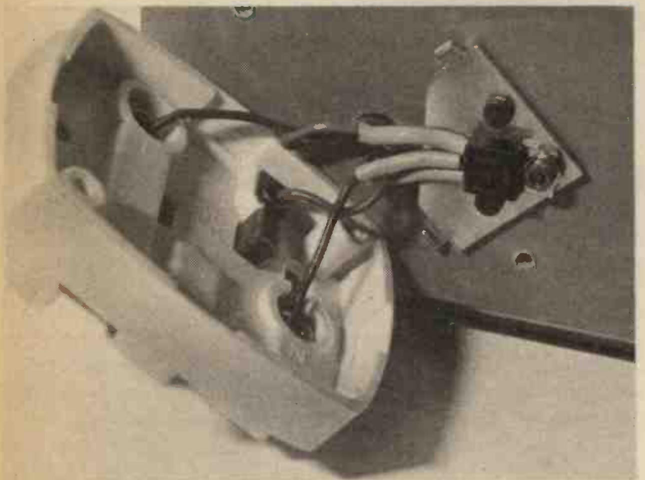
D1, D5	1N4001 (2 off)
D2, D4	TIL209 l.e.d. red (2 off)
D3	TIL209 l.e.d. green
D6	6·8V Zener (400mW)
D7	9·1V Zener (400mW)
D8, D9, D10, D11	Bridge rectifier 0·9A R.S. type 261–772
TR1	BC107
TR2, TR3, TR5	BC107 (3 off)
TR4	BC478
TR6	2N2926
TR7	2N3053
IC1	ZN1034E
IC2, IC3	556 (2 off)
IC4	IL74 Opto-isolator
CSR1	Triac 8A 400V R.S. type 261–801

Switches

S1	D.P.D.T. sub min toggle
S2, S3, S4, S8	S.P.D.T. sub min toggle (4 off)
S5, S6	12 way rotary type
S7	4 way rotary type
S9	D.P.D.T. 5A toggle

Miscellaneous

1 off	Moulded case 216×130×79mm
4 off	4mm socket
1 off	13A socket
1 off	Neon indicator
3 off	Pointer knobs
1 off	Relay 12V 185Ω
1 off	Mains 5A plug and socket (round type)
1 off	Transformer 12-0-12V 0·5A
1 off	Speaker 35Ω
1 off	PP6 battery
1 off	Chassis mounted fuse holder
1 off	Battery clip
	Veroboard
	6 way barrier strip
	Holders for i.c.s



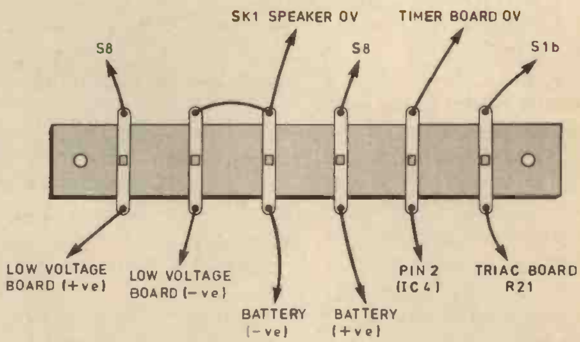


Fig. 7. Barrier strip wiring

A solder tag attached to one of the terminals of the speaker is used as a common low voltage negative connection. The wiring of the switches S1, S2, S3, S4 and S8 is shown in Fig. 6.

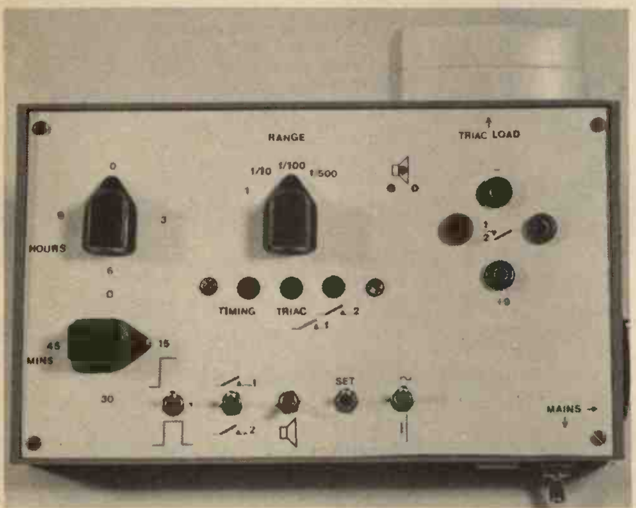
The triac drive board is bolted to the bottom of the box adjacent to the low voltage board. The component layouts in Figs. 5 and 6 show the external connections which are to be made to these two boards. These connections should not be made to the timer board until the latter has been tested.

The mains switch (S9) is mounted on the front of the box and isolates both live and neutral wires when off. Also, with the switching arrangements employed, the battery may be switched in by S8 to control timing functions and to provide triac drive whilst mains loads are switched via the triac.

The triac was mounted inside the base of the surface mounted 13A load socket on a small piece of aluminium which acted as a heat sink.

In order to facilitate the fitting and removal of the control panel, a six-way length of barrier strip was bolted to the side of the timer box adjacent to the transformer. In this way the wires from the control panel can be routed neatly to the power supply circuits and the triac control panel. The leads requiring connections to this barrier strip are shown in Fig. 7.

The mains connection to the unit should be made via a 3 pin non-reversible plug and socket. In the prototype the plug was fitted in the side of the case near the mains switch.



SETTING UP AND TESTING

When the timer board has been assembled and mounted on the control panel and before connections are made to the low voltage and triac drive boards, the timer circuit can be connected to the 9V battery and tested. Switch S8 should be in the "battery" position and the audio alarm switch S3 "on". Set switch S5 (the "hours" switch) to zero and S6 (the "minutes" switch) to 5 minutes—the first position clockwise.

The range divider switch S7 should be set to divide this 5 minute period by a factor of 100. Now operate the "set/reset" switch to provide power to the timer circuit and the green l.e.d. (D2) should light and go out after 5 minutes × 60/100 seconds or 3 seconds. Immediately the l.e.d. goes out indicating the end of the timing period, the audio alarm should sound and the red l.e.d. (D3) should light up for about 2·5 seconds before going out.

What happens after this sequence depends on the setting of S1. With S1 in the "repeat" mode, D2 will relight about 1 second after it has gone out at the end of the timing period, i.e. the timer has reset itself for another delay period; and the audio alarm stops. As soon as D2 relights, D4 lights briefly indicating that a solenoid can be operated to drive a camera button if S2 is in position 2.

This sequence of switching will repeat every 3 seconds but can be altered to any other delay period as described at the beginning of this article. With S1a in the "one shot" mode, D2 will go out and stay out, D3 will come on for 2·5 seconds and go out but D4 will not light.

Simultaneously with the above sequences, the low voltage relay will be heard to operate. With S2 in position 1 and S1a in the "repeat" position, the relay will energise as D2 goes out at the end of the delay period (closing the contacts of the relay) and de-energise as D2 comes on again: the relay energises for about one second at the end of every delay period.

With S2 in position 2 and S1a in the "repeat" mode, the relay energises for the time S3 is alight thus providing automatic switching for a camera shutter drive. With S1a in the "one shot" mode, and S2 in position 1 the relay will energise at the end of the time and remain energised.

If S2 is in position 2 the relay will not energise and TR2 will not be switched on since the monostable based on IC3a is not triggered. These sequences are summarised in Table 1.

The low voltage board should be checked to see the voltage available from the circuit is about 9·0V. If it is, the leads from this circuit board can be connected to the timer board

SWITCH S1a	SWITCH S2	RELAY RLA
"Repeat"	Position 1	"On" at end of delay period (D2 goes out) "Off" one second later as timer resets (D2 comes on)
"Repeat"	Position 2	"On" as D4 lights "Off" as D4 goes out
"One shot"	Position 1	"On" at end of delay period and stays on
"One shot"	Position 2	Does not energise

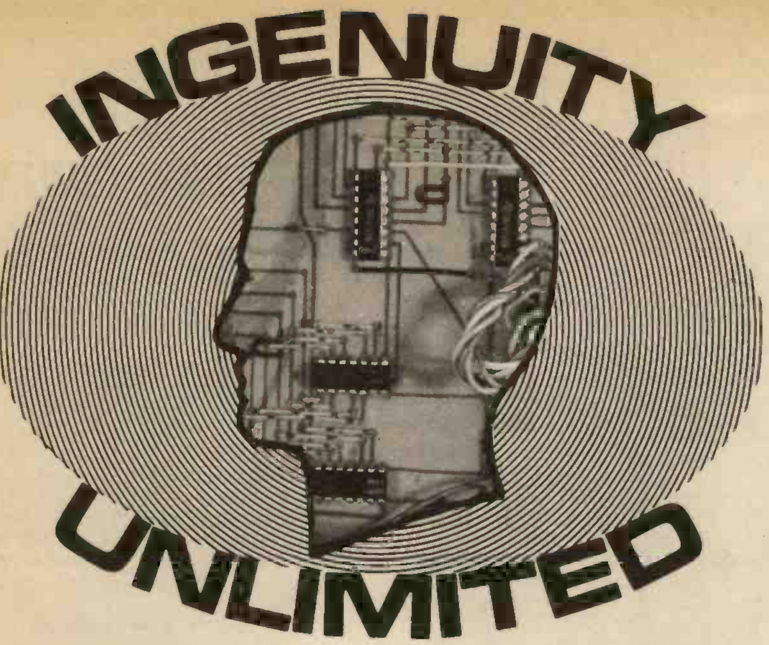
Table 1. Relay operation for the different switching sequences of S1a and S2

via the barrier strip, the negative lead to the solder tag on the speaker and positive lead via switch S8 to the timer board. The whole sequence of timing operations described in Table 1 can also now be checked for correct operation from the mains.

Finally the triac drive board should be tested. The lead from S1b should be connected to R21 on the triac drive board and the lead from pin 7 of IC1 on the main timer board to the 0V line and pin 2 of IC4 in the triac drive board also to the 0V line. With the timer being operated from the battery, check that the opto-isolator is working as follows. Set the timer to operate in the "repeat" mode every 9 seconds, say. Use a multimeter set to the "Ohms × 1k" range and connect the black lead to pin 5 of the IC4 and the red lead to pin 4 of the same i.c.

Now every time monostable IC3a is triggered and D3 lights the resistance between these two terminals will fall to a low value. This connection is actually across the collector-emitter connections of the internal phototransistor of the opto-isolator, and when the resistance between these connections falls it indicates that it is receiving light from the internal diode.

The energising of this phototransistor switches on TR5 and the triac when the triac drive board is connected to the mains. Now switch S1b to the "one shot" position and note that the resistance across pins 4 and 5 of IC4 falls at the end of the delay period and remains low. If all is well the triac drive board can be wired to the neutral and the 3 pin load socket. ★



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.

PROM PROGRAMMER

When working with digital systems, the designer often has need of a cheap TTL compatible PROM. One very interesting device released is the 256×4 bit DM8574 by National Semiconductors Ltd. This i.c., with the exception of certain drive requirements, is pin for pin compatible with the popular 16 pin d.i.l. 2112 256×4 bit RAM, whose R/W pin is replaced by a $\overline{\text{CE}}$ input on the PROM. It is therefore quite simple to design a general purpose memory board for most microprocessor systems which mixes RAM and ROM in any combination on the same printed circuit board.

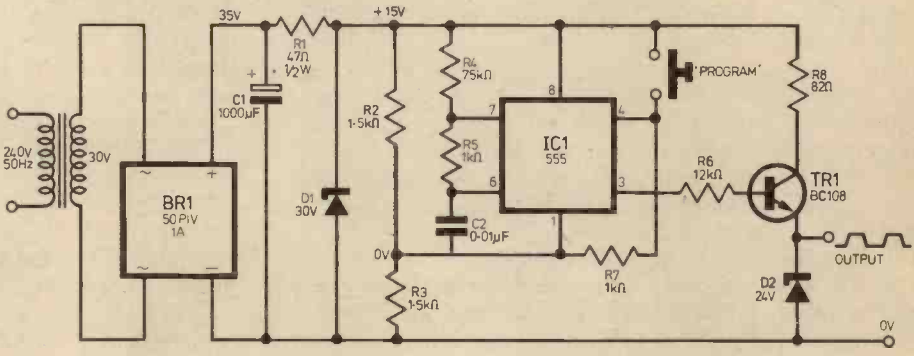
The only problem with the use of PROM is the need for a device programmer. Fortunately, the DM8574 is a "Field Programmable" device of the fusible link variety and a simple programmer can be constructed as shown.

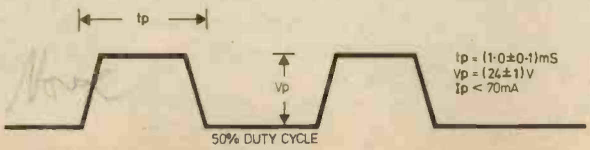
The PROM may be programmed by supplying a single 5V supply to the device and selecting the address of the 4 bit word which is to have some of its fusible links blown. (Blowing a link creates a logical zero at the bit address selected; leaving the link unblown leaves a logical one at that position). A logical one is then applied to both the enable inputs, and the programming pulse (see figure) is fed to the output where a low level is required. Verification that the bit has been programmed may be obtained by bringing the enable inputs low and checking the logical level at the appropriate output.

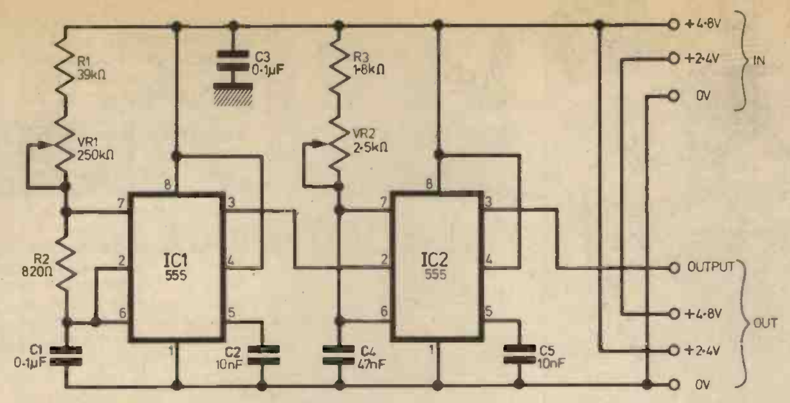
The programmer utilises a 555 timer working from a 15V supply derived from a split 30V supply so that when the 555 output goes high the base of the BC108, whose emitter potential is held at 24V, is driven hard on, causing some 70mA to flow from its output. The 555 is arranged to provide a 1kHz 50% duty cycle square wave at its output when pin 4 on this i.c. is brought high by pressing the "PROGRAM" push-button, this output then being used as explained to drive the BC108 when programming the PROM bit-by-bit as explained.

Microcomputer addicts might like to consider the possibility of automating the programming sequence in order to provide a quick and easy way of obtaining custom-programmed ROM chips suitable for inclusion in their system.

J. A. Murdie,
Darlington,
Durham.







RADIO CONTROL SERVO TESTER

THE servo mechanisms currently used in radio controlled models use a variable width pulse to convey the information concerning the required position. This pulse has been standardised as varying between 1–2ms and is nearly always positive going. Most receivers and decoders use 4·8V or 6V batteries and the amplitude of the pulse is almost equal to the supply voltage.

The information for each channel of a multi-channel system is transmitted sequentially, followed by a synchronising pulse to maintain lock between receiver and transmitter. Models using several channels are commonplace; aircraft often use six.

When setting up the control systems in a model, it is usual to have to use the transmitter and receiver together. This can be inconvenient especially at a flying field where spurious signals are most definitely not wanted! This servo tester overcomes the need for using all the gear just to test one function by simulating the decoder output for one channel only. It is simply connected between the battery and the required servo. The pulse width is adjustable over the full range, and the repetition rate may be set for any number of channels, although this is not really necessary and this adjustment may be omitted. (Servos work in equipment of one to seven channels without adjustment, and the variable rate function was built in when servos were being designed, purely to check this fact.)

The circuit consists of an NE555 wired as an astable pulse generator, producing narrow, negative going spikes at a repetition rate of between 3 and 20 ms. A good compromise, to eliminate one adjustment, would be 10 ms. This is achieved by replacing R1 and VR1 with 100kΩ. The narrow pulses produced trigger a second 555 wired as a monostable, the duration of which is adjustable between 1 and 2ms. The internal design of the 555 is such that varying battery voltages do not affect pulse width so that the circuit will work from 4 to 15V supplies.

The output pulse is almost as great as the supply voltage.

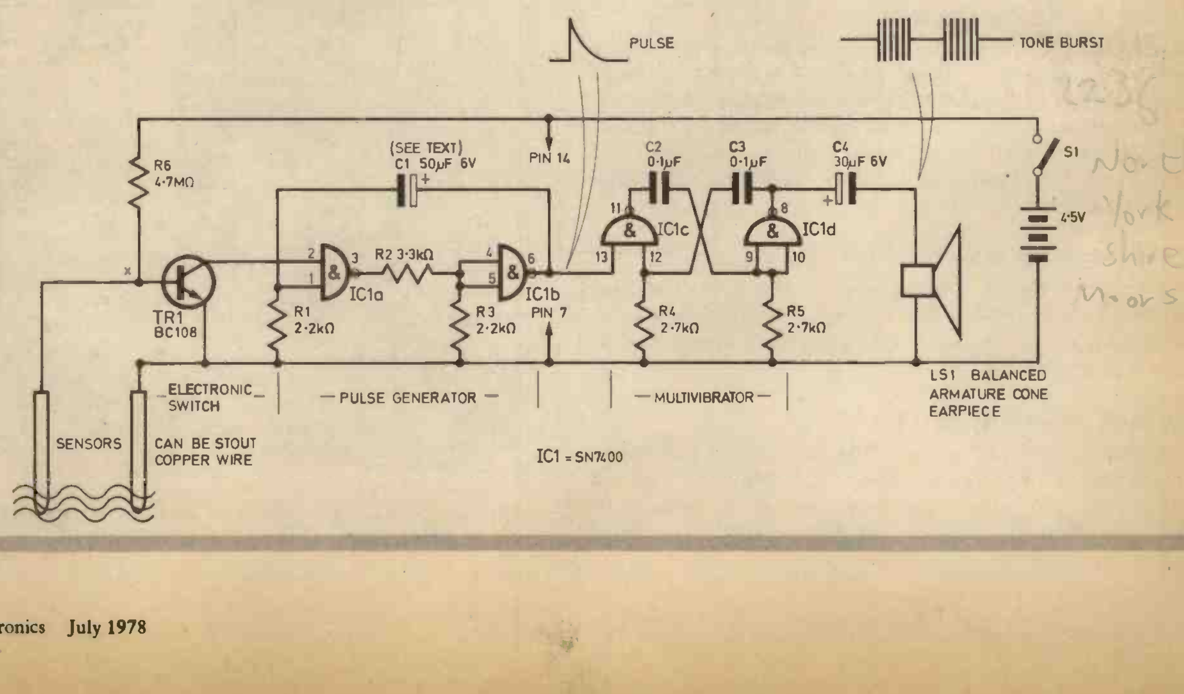
Both circuits are assembled on commercially available circuit boards. It is not necessary to calibrate the device, the central position of the width control potentiometer will be very close to 1·5ms, the mid-range value. It may be checked against a new servo; here the end positions should be at the limits of useable travel, usually ±45°. The centre tap from the battery is not necessary for the working of the device, and is included as some of the older servos require it.

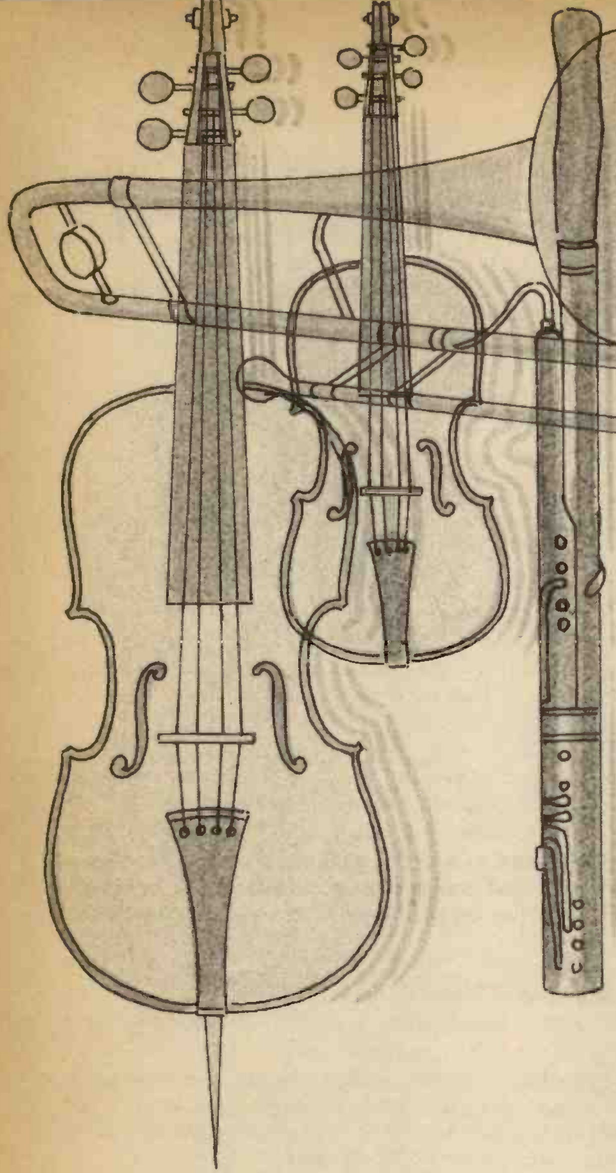
A. Langton,
Aberdeen.

OVERFLOW INDICATOR

GATES IC1a and IC1b form a pulse generator. C1 determines the frequency of the pulses, and the value of this should lie between 10µF and 50µF, the larger the value the longer the duration of tone. Gates IC1c and d together form a multivibrator to produce the required tone. The multivibrator is controlled by the pulse generator through pin 13, so when the generator is not producing pulses, no tone is heard from the transducer. TR1 forms the switch that is required to control the pulse generator. When water or any conductive liquid bridges the sensor probes, bleeps are heard from the earpiece.

V. J. Guillaumier, Malta.





PE STRING ENSEMBLE

A.J. BOOTHMAN B.Sc.

Part 5

THE final part of the series gives details of the cabinet construction, a number of component value changes for improved optimum results, and further interwiring information and clarification.

CABINET CONSTRUCTION

The component parts for the cabinet are given in the cutting list with assembly details shown in Fig. 5.2. Some variation in dimensions may be required to suit alternative keyboards, but the construction has been kept simple for ease of adaptability. Corner joints can be made from short lengths of ⅝ × ⅝in (15·875 × 15·875mm) timber, screwing from the inside of the cabinet.

IMPROVEMENTS ON PROTOTYPE

Since commencement of publication of this series the construction of further models has resulted in information from which certain component value changes are recommended to give the best results.

TONE GENERATOR/PSU

Connections from the p.c.b. to the front panel transposer switch and the tuning potentiometer are made with screened cable (see Fig 5.2), and the capacitance of the cable contributes to the capacitance C8 which determines the frequency of operation of the oscillator. This capacitance is variable dependent on the cable used and can be compensated for by changing the value of R3. It has now been found that 680 ohms is more consistently correct than the originally specified 470 ohms.

CHORUS GENERATOR

Further work has been carried out to maximise utilisation of the dynamic range available within the Chorus Generator, resulting in certain component value changes, and the addition of one resistor is used to improve the modulation characteristic of the v.c.o. based on IC31. The additional resistor R60a, should be inserted as shown in Fig. 5.1 which is a reproduction of Fig. 3.6.

The following component values should be used to replace those given in Part Three of the series.

R16—27kΩ	R22/36—6·8kΩ	R30/44—10kF
R59—15kΩ	R65/66—220Ω	C16—470pF
C46—680pF	R60a—39kΩ	

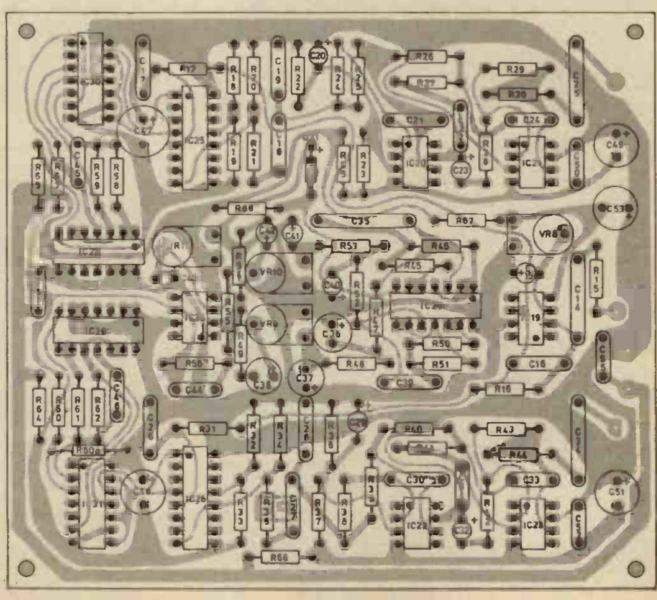
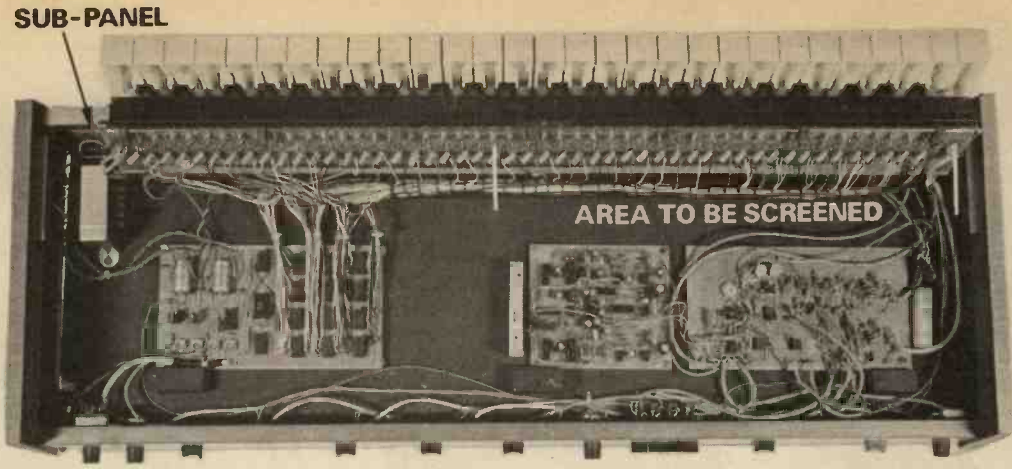


Fig. 5.1. Showing position of additional resistor on chorus p.c.b. Orientation of the i.c.s is also given



VOICE/PREAMP CIRCUITRY

Noise contribution from the Woodwind and Brass filters has been reduced to negligible proportions by replacing R107 and R116 with shorting links, removing C76 and C83 and connecting 1MΩ resistors across pins 2 and 6 of ICs 33 and 34.

The following components on this figure should also be changed as follows:

R124—150kΩ, R131—470kΩ, R135—68kΩ
C81—47nF, C88—47nF, C101—220pF

PSU/TONE GENERATOR INTERWIRING

Last month an interwiring diagram (Fig. 4.6) was given for the Chorus Generator and Voice/Preamplifier p.c.b., which included details of most of the front panel control connections. Fig. 5.2 shows the wiring for the remaining controls, which are connected to the P.S.U./Tone Generator p.c.b., and the mains input sub-panel.

The sub-panel is mounted at the rear of the cabinet, at the top left-hand end (see photo) and contains the mains switch, fuse and socket which are wired to the mains transformer as shown. Earth leads are also required both to the keyboard chassis and 0V pin on the Voice/Preamplifier p.c.b.

Low voltage a.c. connections are made in pairs between the transformer and the p.c.b. supplies +15V, 0V, and −15V are taken direct to the Voice Board, and can be routed behind the key bar to avoid entanglement with the Tone Generator output leads.

Connections to D13 on the front panel are shown, the polarity being indicated by the "flat" on the skirt of the l.e.d. The lead adjacent to the flat should be wired to the l.e.d. pin on the p.c.b. D13 is fitted adjacent to the pitch control. The 20V supply is wired to Attack and Sustain Controls as shown in the diagram and connections are made to the keyswitch rod and sustain line on the Diode Gate assembly from these controls.

TRANSPOSER/TUNING CONNECTIONS

A four core screened cable is used to connect the Tone Generator p.c.b. to the Transposer Switch, the screen is connected to the ground terminal on the p.c.b., but not to the switch. A single wire link should be connected between the switch and tuning potentiometer VR5, and a screened cable between the potentiometer and the p.c.b.

In this case the screen should be soldered to the p.c.b. at one end and the body of the potentiometer at the other end.

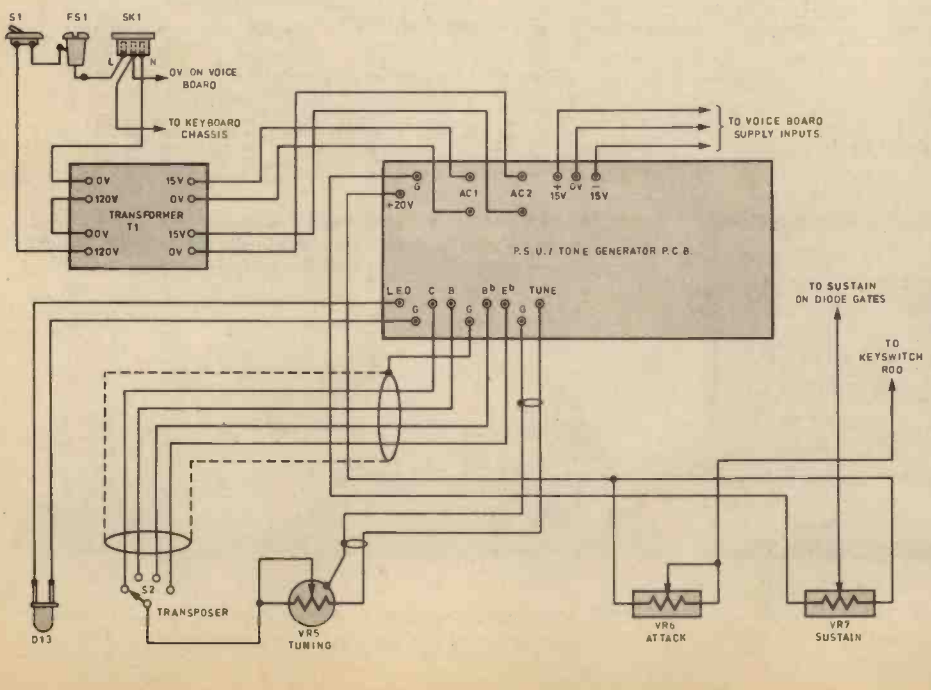


Fig. 5.2. Interwiring of P.S.U./Tone Generator to controls

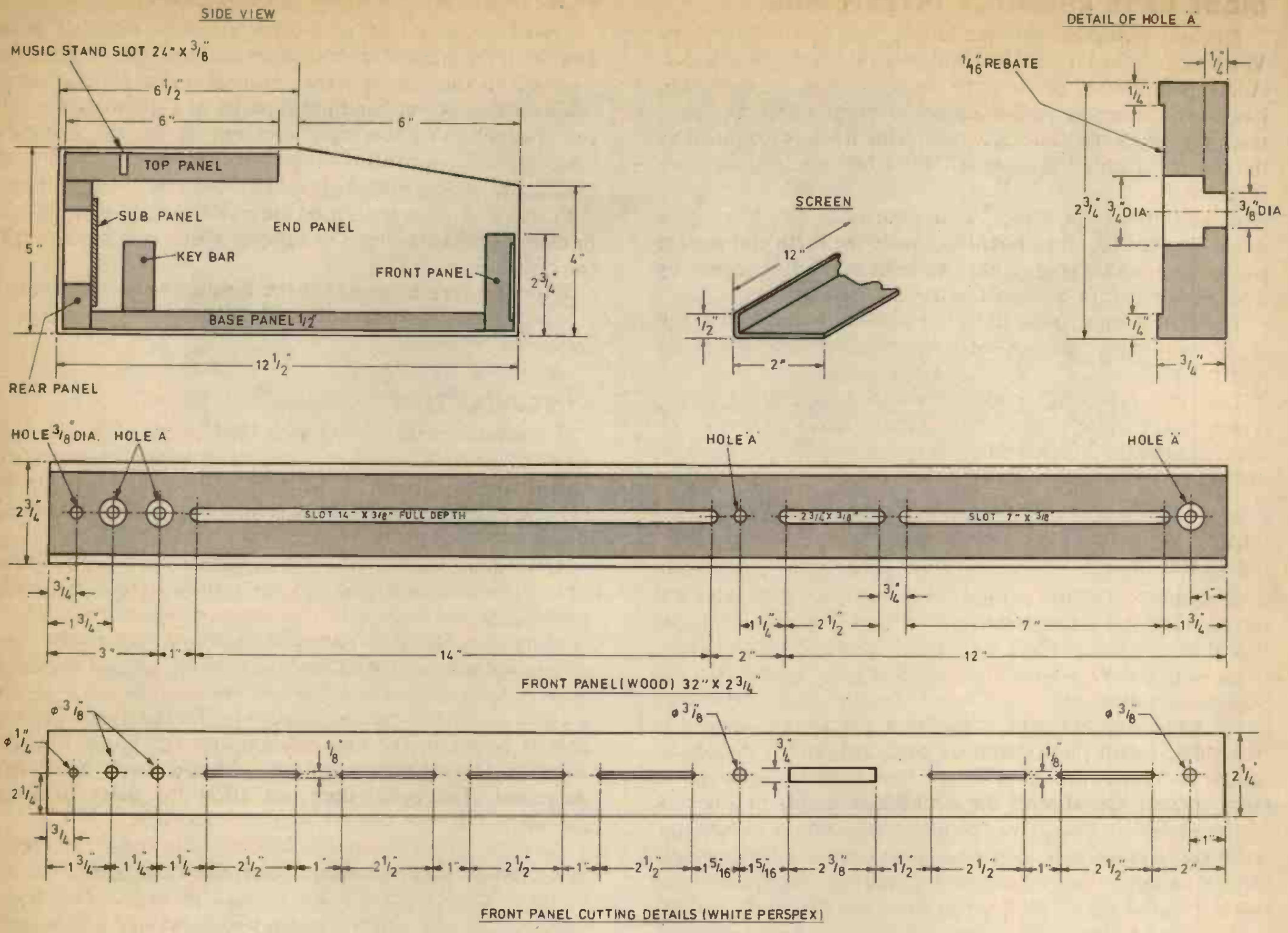
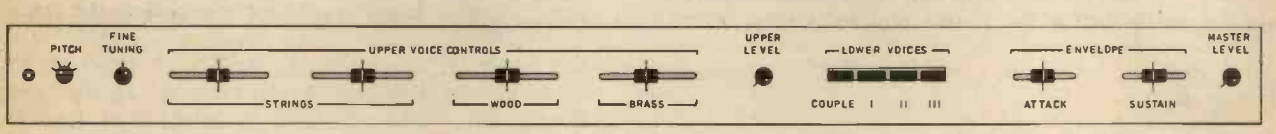


Fig. 5.3. Cutting details of casing and fascia

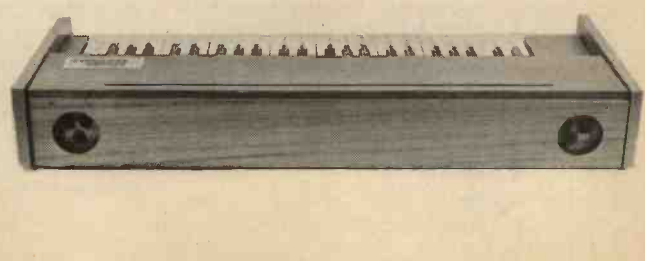


CUTTING LIST

End Panels	(2 off)	12½in × 5in × ¾in Veneered
Base Panel		32in × 10½in × ½in Chipboard
Rear Panel		32in × 3¾in × ¾in Veneered
Front Panel		32in × 2¾in × ¾in Veneered
Top Panel		32in × 6in × ¾in Veneered
Key Bar		22in × 1⅞in × ⅞in Timber
Sub-Panels	(2 off)	4in × 3in × ⅛in Plywood
Keyboard Ends	(2 off)	To suit Keyboard
Metal Screen		12in × 2½in Bent as shown in (Fig. 5.3)

Sub-Panels are mounted against 2in holes in Rear Panel

Fig. 5.4. (Above) Showing fascia legends. (Below) Showing rear panel and attached sub-panels. Right is for mains input and left for output sockets



DIODE GATE ASSEMBLY INTERWIRING

The interwiring between the Diode Gate assembly and the Voice Board, Sustain control and earth is shown in Fig. 5.2. A lead is connected between the point at which the earth lead has been connected to the keyboard chassis and the earth track on the Diode Gate assembly. This track is identified as the one to which all capacitors C13 (4·7μF electrolytics), are soldered.

In assembling the Diode Gate boards earlier, links were made between the three boards to make the earth and sustain tracks continuous (Fig. 2.6). The sustain track is joined by a single wire to the Sustain Control VR7.

The four output track links are made between PCB2 and PCB3 only since the keyboard split occurs between PCB1 and PCB2.

Low and high output groups are each connected to the Voice Board using a four-core screen cable. with the screen connected at the Voice Board end only. The low output cable should be routed behind the key bar.

GATE ASSEMBLY—TONE GENERATOR WIRING

The interconnection pattern for the Diode Gate p.c.b.s was given in Fig. 2.8 in the second part of the series. This illustrated the three p.c.b.s, making up a single assembly, with arrows indicating the 85 points at which leads are taken from the Diode Gate assembly to the Tone Generator board. The track leads associated with the connection points can be seen in the single board photograph on page 596, and if the photograph is turned through 180° the four rows of leads can be seen to correspond with the connection points in Fig. 2.8. As described in Part Two the interconnection is carried out with easily solderable insulated copper wire; a single length acting as both the interconnecting wire on the Diode Gate assembly and the flying lead to the Tone Generator board.

In Fig. 2.8 the numbers in circles (1–8) correspond with the numbers on the outputs of IC7–18 (1–8) on the Tone Generator p.c.b. shown in Fig. 1.7 in the First Part of the series.

Each arrow represents a lead back to the Tone Generator with the note identified by checking the vertical correlation with the letters below the arrows and the circled number under the row concerned. On the left-hand end the circled number changes for the last note in a row, as also occurs in the case of C5.

SCREENING

In the design of the String Ensemble great attention has been paid to ensuring that the instrument is free from beehive (background noise from the Tone Generation circuitry). This has been achieved in respect of blocking any direct beehive through the Diode Gates into the voice circuitry. However, it is important to ensure that this is not negated by pick up into the voice circuits from the Tone Generator harness. The use of screened leads where recommended will prevent this, and care should be taken not to strip the screening back too far, leaving unscreened lengths, particularly in connections to the Woodwind slider potentiometer.

An earthed metal screen is also required to isolate the Tone Generator harness from the Voice and Chorus boards when the keyboard is lowered, and whilst the original prototype incorporated a screen fixed above the boards on stand-offs from the baseboard (see photo on page 598), it has now been found more convenient to mount the screen onto the keyboard chassis with equal success. Dimensions for the screen are given in Fig 5.3.

PLAYING THE STRING ENSEMBLE

Prototypes have now been used on a wide range of power amplification systems in both domestic and stage settings. A normal hi-fi amplifier/speaker combination has given excellent results with a power handling capacity of approximately 15W per channel using the high level output for the Ensemble into the auxiliary channel of the amplifier. With a commonly used guitar combo-amplifier rated at 100W the "Bright Input" with treble lift, has been used successfully to give either solo or chordal backing effects in a group which includes an organ for general use.

With this type of amplifier the Ensemble low level output is recommended to prevent overloading of the first stage of the combo-amplifier.

LEVEL SETTING

The Upper Voice controls plus the Upper and Master Level controls give six variable signal levels which when coupled with the Lower Voice switches and the variation in the number of notes playing at any time results in a very wise signal range driving into the chorus delay lines.

For a good signal/noise performance it is important to set the instrument such that the delay lines have a reasonable signal level, but due to the wide range of signal available it is possible to overload the delay lines under extreme conditions.

The new component values given earlier for the Chorus and Voice boards give a good optimum condition where in normal playing circumstances the Upper and Master Level Controls should be set in the mid-position and the power amplifier adjusted for maximum output with the swell pedal fully depressed. The pedal does not affect the delay lines and should be used for normal volume adjustment.

A single Upper Voice can be used with the slider control at maximum. Two voices can be used with each slider control in the mid-position. Similar compensation can be made if more voices are mixed, but since an overload safety factor has been incorporated it will probably not be necessary.

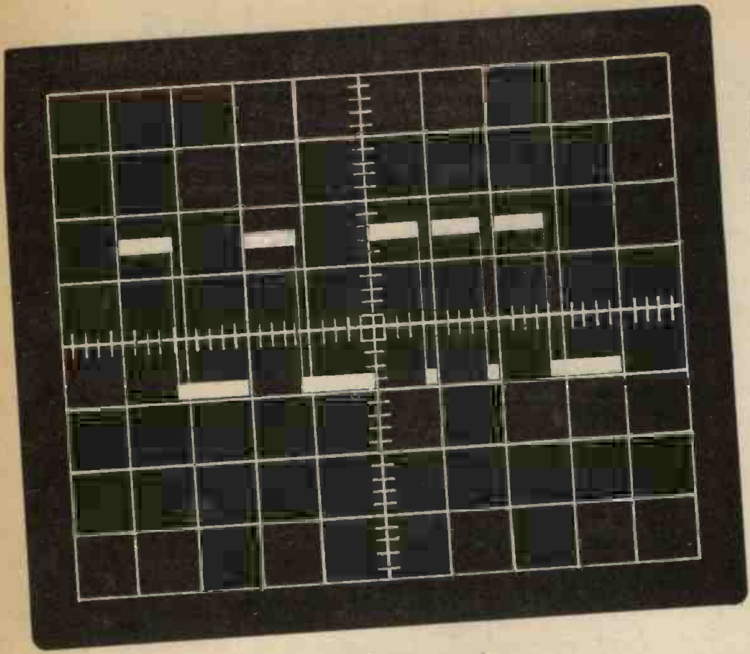
An alternative mode of operation when mixed voices are to be used regularly, organ simulation, is to turn the Upper Level control anticlockwise to, say, the one third position which will then allow all voices to be mixed additively with heavy chordal fingering without overloading the delay lines.

For solo playing on single voice the Upper Level control can be turned to maximum. The Master Level controls the entire keyboard and can be used to increase the lower keyboard level, whilst the upper keyboard level is reduced by the Upper Level control, or to further increase the upper keyboard level on single note solo playing.

OPTIMUM VOICING

The best effects are obtained with simple voice settings, that is with one voice control in use at any particular time. However, experimentation with the wide range of controls available can lead to the creation of other sounds which with subjective opinion can enhance the motives of an individual to construct the project. ★

Constructors who would like a cleaner copy of Fig. 3.5 should write in including a stamped addressed envelope.
In Fig. 4.3 and the Components List last month C81 and C82 should be 4,700pF and 47nF respectively.



C.R.O. LOGIC MONITOR GENERATOR

R. DERRY

THE device to be described uses two MSI TTL logic chips with a minimum of additional components to generate an analogue waveform which gives a histogram type of display when fed to an oscilloscope. In addition, marker pulses can be added to the display to add to its clarity. An eight channel version is described which can be built for about £5, assuming that an oscilloscope is already available.

Also described is a way of using the display to test logic displays which is particularly useful for general bench work with logic circuits. The basic design can be extended to cope with more than eight channels if required.

CIRCUIT DESCRIPTION

The heart of the circuit is a 74151 i.c. as seen in Fig. 1. This is an eight line to one line data multiplexer operated conventionally being addressed by a divide by eight counter (a 7490 counter wired to divide by eight). The counter is driven from an asymmetrical oscillator fed via a Schmitt trigger to give sharp transitions. The reasons for the asymmetrical output of the oscillator are described later in the section on the marker blips. The histogram display that results is particularly vivid which will indicate not only "0" and "1" states but also invalid voltage levels between these two states.

As the 'scope's spot begins its travel at the left of the screen, Channel 1 (input "0" of the 74151) is addressed and the spot will indicate either a nominal 0V or 5V. After it has traced out a line of one eighth of the display length, Channel 2 is addressed and the spot will either continue along the same line or switch to indicate the other value. This will continue until all eight channels have been displayed. As Channel 1 is about to be addressed again the syncronising pulse causes the spot to return to the left-hand side.

Provided that this happens fast enough a histogram display will result (although without marker blips). The rate of addressing is dependent entirely on the frequency of the oscillator. This is not critical but if the rate is too slow a disturbing flicker will mar the display: if too high, the quality of the image deteriorates due to pulse rounding and distortion due to stray capacitance in the connecting leads. While the display could be sharpened using a Schmitt trigger at the input to the 'scope or by using low capacitance connecting leads, there is really nothing to be gained by a very fast addressing rate. Bear in mind that harmonics of the order of twenty to thirty times the oscillator frequency are present on the output of the unit as it is giving a square wave output.

It was found that an oscillator frequency of the order of 1·5kHz gave a clean flicker free display using two feet of connecting lead from the board to the 'scope.

The lead used was ordinary connecting wire, the data, sync and earth lines being just simply twisted together.

SYNCHRONISATION

Obviously if the oscilloscope used the data stream from the board to operate its internal synchronisation circuits, the display would lock into a random position. A convenient source of a synchronising pulse is available from pin 8 of the counter. This goes negative as Channel 1 is about to be addressed. Provided the 'scope can be set to lock on a negative edge, Channel 1 will be on the extreme left.

If it is preferred to lock on a positive pulse the sync output can be inverted or the inputs renumbered so that what would have been Channel 5 is numbered Channel 1, Channel 6, Channel 2, etc.

COMPONENTS . . .

Resistors

R1	620Ω	R7	10kΩ
R2	10kΩ	R8	360Ω
R3	10kΩ		
R4	620Ω		
R5	360Ω		
R6	10kΩ		

Capacitors

C1	0·047μF
C2	0·1μF
C3, C4	10μF (2 off) 25V elect.
C5	0·1μF

Integrated Circuits

IC1	7413
IC2	7490
IC3	74151

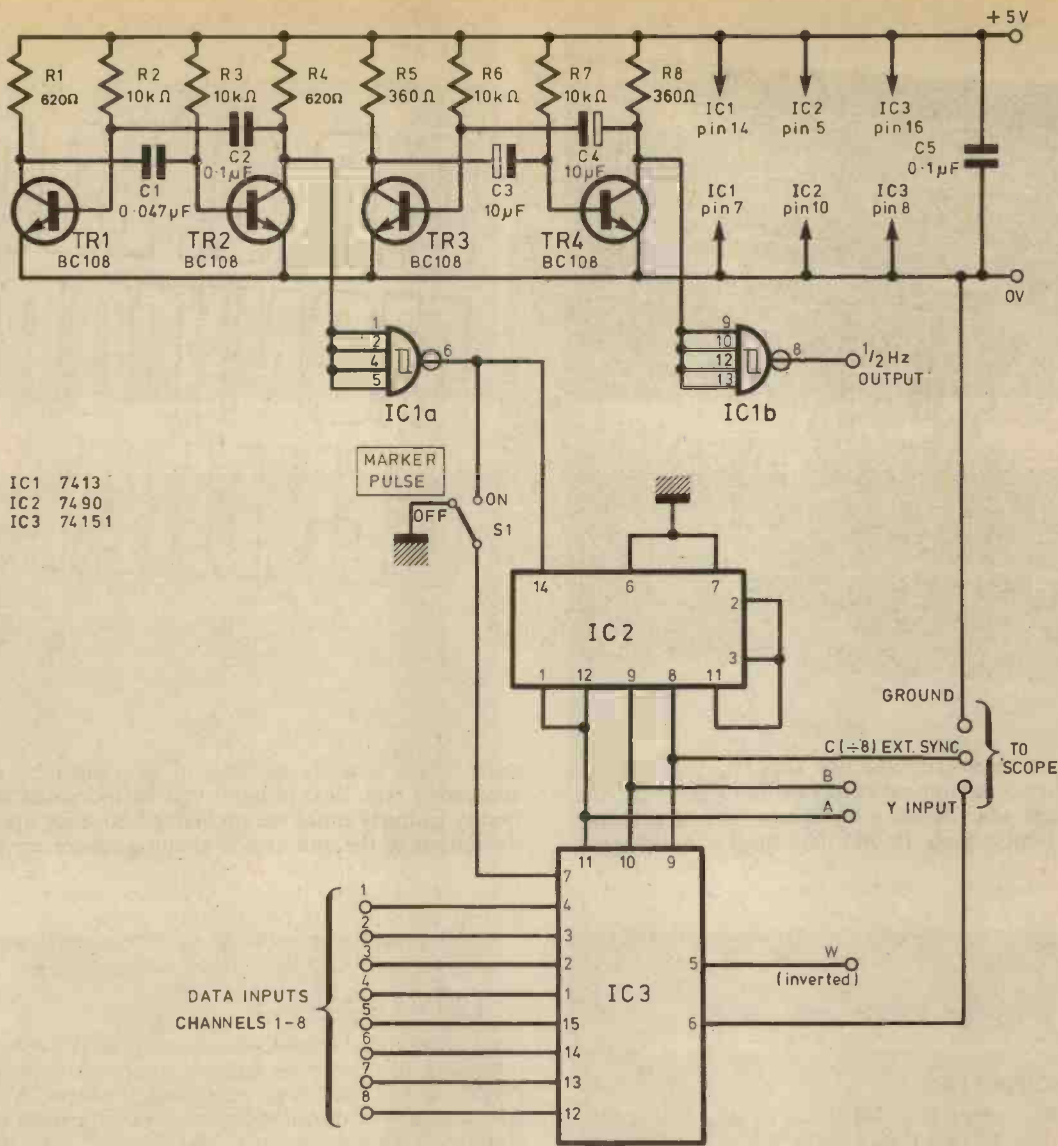


Fig. 1. Circuit of Logic Monitor

OPERATION

There are three 'scope connections: data output, sync output and common earth.

The 'scope should be set to give a reasonable size of display using an input sensitive down to d.c. as otherwise the display will keep moving around the screen. Unconnected inputs will give a "1" display so ground one input, say Channel 2 and adjust the 'scope timebase until the image locks. If the time base is running too slow more than one image of the display will appear side by side.

Increase the timebase rate until a single image appears. If the timebase is too fast the image will fold over on itself. Experiment with grounding various combinations to check that each input has been connected correctly.

A length of 10 way colour coded ribbon cable can be used, allocating colours to the channels following the resistor code. (Channel 1=brown, Channel 2=red, Channel 3=orange, etc).

The black and white wires are used to carry the 0V and 5V supply from the circuit under test to power the board. The connecting leads can be terminated in any convenient way.

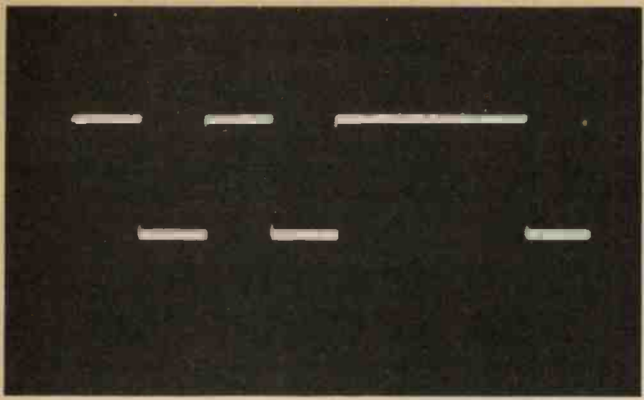
MARKER PULSES

As described so far the circuit is fairly conventional and gives a straight histogram display so that if all the inputs are at "1" or "0" a straight line results which can be less than clear as a display and some form of marker blip is desirable.

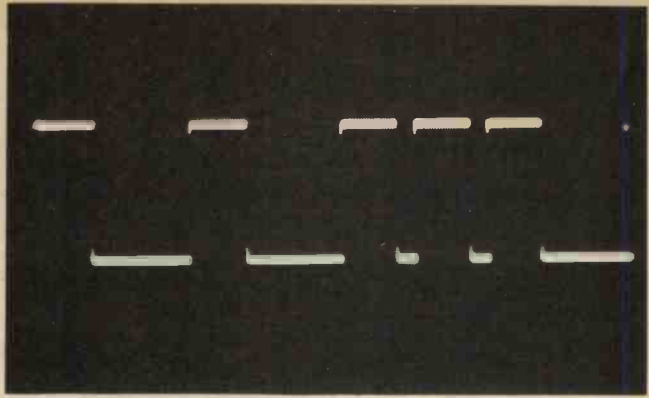
This can be achieved without additional components in two ways. The first makes use of the strobe input of the 74151. Unless this is grounded its output stays at 0V. If this input is fed with the output of the oscillator the output is returned to "0" for the duration of the positive half cycle and follows the condition of the selected input for the duration of the negative half cycle. This is why the oscillator is given an asymmetrical output.

By making the positive excursion about one sixth the length of the negative excursion, small blips are created on the zero line.

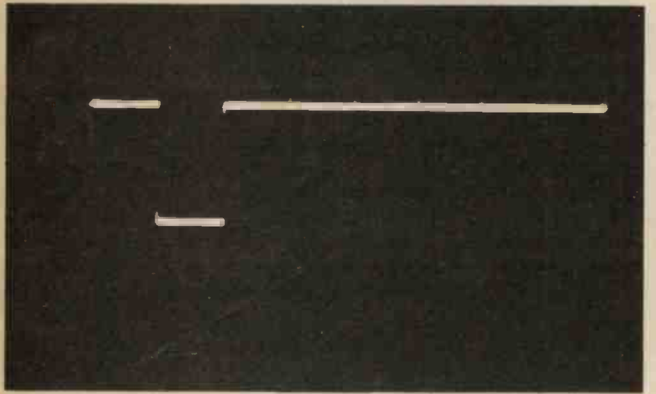
If you have an oscilloscope with a sensitive "Z-axis" modulation input the asymmetrical oscillator can be fed to this instead. The display will be blanked between each section of the display, giving discrete dashes.



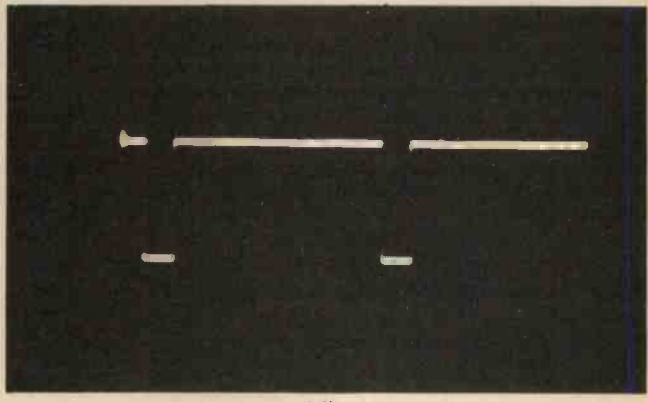
(a)



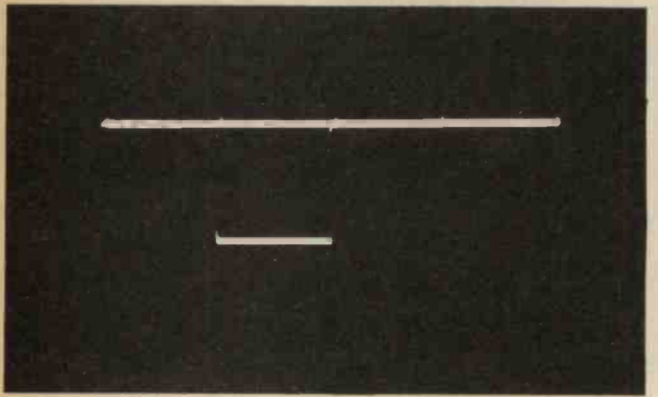
(b)



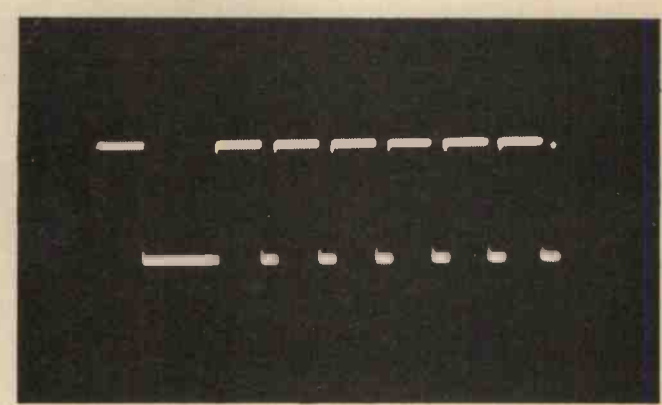
(c)



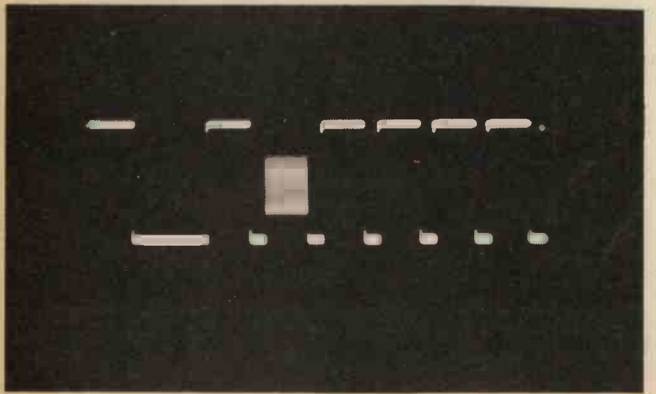
(d)



(e)



(f)



(g)

Fig. 2(a). Display without blips; (b) display with blips; (c) Test waveform correct appearance; (d) Test waveform—timebase too slow (half speed); (e) Test waveform—timebase too fast (double speed); (f) Test waveform—correct appearance; (g) Channel 5 invalid input voltage

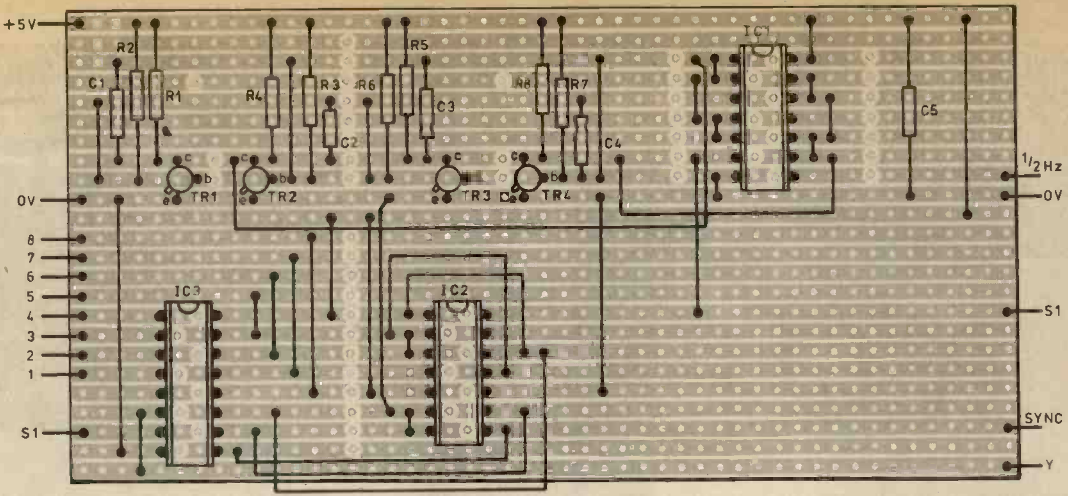


Fig. 3. Veroboard layout

PERMANENT INSTALLATION

If desired, the board can be permanently mounted in a box on the workbench. In this case it is convenient to provide a "Marker Blip" on/off switch.

This is a simple changeover switch that connects either an earth or the oscillator to the strobe input. A second switch could be added to switch the 'scope away from the logic monitor circuits to look at logic waveforms directly—care being taken to keep stray capacitance to a minimum. An additional convenience would be switches that would disconnect individual input channels and substitute an earth so that unconnected inputs will indicate "0".

It was found convenient to mount a 0·5Hz oscillator on the same board. This is useful for cycling circuits under test slowly for examination of their working.

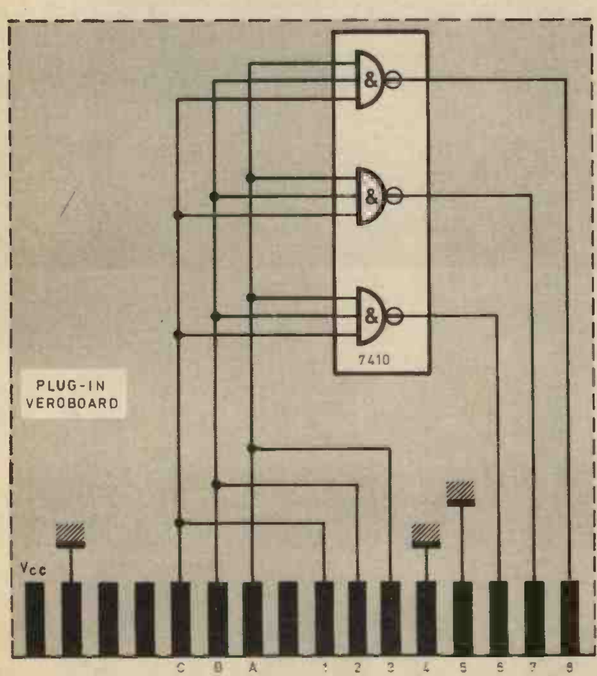


Fig. 4. Typical test set-up

TESTING INTEGRATED CIRCUITS

The testing of TTL i.c.s and i.c.s that are feared to have been damaged is speeded using the display. Using a μDec breadboard, a 7493 divide by sixteen counter is used to provide inputs to the gates under test. Both inputs and outputs are monitored. For example, to test a 7410 triple 3-input NAND gate i.c. the A, B and C outputs of the counter are connected to the three inputs of each gate and also Channels 1, 2 and 3 of the display. The gates can now be seen cycled through all eight possible input conditions as the counter is pulsed by the l.f. oscillator. Channels 4 and 5 are grounded for clarity of display and Channels 6, 7 and 8 connected to one each of the three outputs.

With a correctly operating i.c. all three outputs will go to zero simultaneously when three "1s" are at the inputs of the gates. A faulty gate will be seen to be behaving differently. By examining the display as the circuits are cycled it can soon be seen if the faulty gate can be used as a 2-input gate or as an inverter. Once the breadboard has been set up it is a quick and simple matter to unplug one i.c. and substitute another of the same kind.

If you regularly use "untested" i.c.s it might well be worth your while to wire up a series of plug-in pieces of Veroboard that would instantly set up the correct conditions of a range of commonly used i.c.s. Some of these boards might need subsidiary logic on the plug-in board but the necessary i.c. need only be plugged into a socket and can be borrowed from another logic circuit not in use at the time of testing. (see Fig. 4)

INCREASING THE CHANNELS

The number of channels can be increased to sixteen by replacing the 74151 with a 74150 sixteen to one line multiplexer driven by a 7493 divide by sixteen counter. A lesser number of inputs can be arranged by resetting the counter before it reaches sixteen.

The 74150 gives an inverted output and will give an "upside-down" display unless its output is fed through an inverter.

Theoretically the number of channels can be increased indefinitely by using additional data delectors and counters combined with additional analogue circuitry to give pseudo double, triple or quadruple beam displays. However, the more channels that are used the higher are the harmonic frequencies that have to be handled with the resulting difficulties of keeping a good pulse shape on the 'scope along with the screen becoming cluttered with too much data. In practice eight channels are more than adequate.

★

DIMWIT

M. J. CARTER

A sympathetic bedside light!

One of my vices is that I read in bed, and tend to fall asleep with the bedside light still on. Those similarly afflicted will confirm what this can mean in disturbed sleep, not to mention electricity costs. Moreover, those attempting to help me, by turning off the light when I am found asleep, only succeed in waking me up again; as much by the transition from light to dark as by any noise they might make.

APPLICATIONS

In its original role of "humane bedside light", the prototype Dimwit has given many months of appreciated service. It has also been found suitable for ordinary lamp-dimmer applications, and to have "entertainment value" when soft lighting is called for—with an inbuilt practical joke. Other applications include porch and corridor timed lights, and nightlights for reluctant progeny.

CIRCUIT DESCRIPTION

The lamp is controlled by a mains triac circuit based on Fig. 13 from "Power Control With Triacs" by W. Williamson, P.E., March 1971. Automatic control is achieved by putting a light dependent resistor in series with the potentiometer, and illuminating it by an l.e.d. This home-made opto-isolator is very much slower than the packaged sort, and requires a lightproof container, but its output is more amenable to this application.

The sequence is started by pressing the GO button S1 in Fig. 1, which applies mains power to the PSU via S1b and starts the Timer via S1a. The l.e.d. is then turned on, which causes the load lamp to be dimmed up. The relay RLA is also energised, thus bypassing S1b so that power is maintained when S1 is released. At the end of the timed period, D1 and hence the lamp, will dim out slowly. Then the current in RLA coil is also reduced until it drops out, which switches off the whole circuit. The sequence of events may be followed in more detail in Fig. 2. In addition, the timer is arranged to restart if S1 is pressed during the timing period, and to "time out" prematurely if the KILL button S2 is pressed.

Referring to the circuit diagram of Fig. 3, the timer is a standard 555 arranged as a monostable, whose timing is set by R1 and C1; the value of R1 was chosen empirically to give a period of about fifteen minutes. The values used give a theoretical time of:

T 1·1 C1 R1 453·75s ≃ 7½ minutes.

There are three reasons why the time achieved in practice is twice the calculated time.

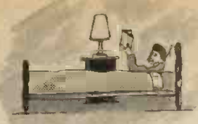
Firstly, the tolerance of high value electrolytic capacitors (typically −10%, 50%) often make the nominal value an underestimation.

Secondly, the threshold current drawn by IC1 (pin 6) shunts some of the charging current in C1, and this stretches the timing period. Using a low leakage tantalum capacitor, this effect was found to extend the period by some 20% over the calculated time.

Thirdly, charging current in C1 is reduced by its own leakage current, which, together with the threshold current, extends the period by just over 80%. Unfortunately, the leakage current of aluminium electrolytics tends to increase with storage time, due to deforming of the insulating layer in the absence of a polarising voltage. Although this leakage is small, it is enough for a previously unused capacitor in the C1 position to give extra long periods for the first few timings (up to an hour or more), and in some cases preventing triggering altogether. Before soldering C1 into place, therefore, it would be advisable to re-form it as completely as possible, by, for example, leaving it connected (the right way round!) across a PP3 for a day or two. An extended series of measurements with the prototype Dimwit showed that, once the leakage current had settled down, the period varied by no more than twenty seconds in sixteen minutes, which is well within the required accuracy. For those who wish to avoid this "running in" by using a tantalum timing capacitor, it should be noted that C1 would need to be increased to about 200μF to compensate the absence of

SPECIFICATION

(i) When started manually, by pressing the GO button, the bedside light comes on, and remains on for 15 minutes.
(ii) At the end of this period, the light is dimmed slowly to extinction, and the unit switches itself off.
(iii) When the sequence is started, the lamp "dims" up quickly (rather than be switched straight on), which reduces sudden dazzle, and increases the life of the lamp.
(iv) The maximum brightness of the lamp, during its "on" period, is under manual control.
(v) Pressing the GO button re-starts the sequence, *whenever* it may be pressed.
(vi) Pressing the KILL button prematurely ends the timing period in (i), and the unit proceeds to shut down as in (ii).



leakage-current. Increasing R1 is not advisable.

To trigger the 555 Timer, a value of 1kΩ was chosen for R2, giving a source resistance to S1a which is low enough to be immune to the triac switch-on spike. The more conventional value of around 12kΩ proved troublesome.

Diode D1 has been added to fulfil specification (v), and if S1 is pressed before IC1 "times out", C1 is discharged by D1 and S1a, thus restarting timing. Normally D1 is reverse biased, and takes no part in circuit action.

When IC1 turns on at the beginning of the sequence see Fig. 2 (a), C3 charges rapidly via D2, D3, and D4, then completes its charging via R4, see Fig. 2 (b). This is transmitted through the buffer stage TR1, TR2 to D1, which dims up rapidly *but not instantaneously*, see Fig. 2 (c). This is in order to fulfil specification (iii), and the resistance of R13 then falls. Fig. 2 (d) shows the inverse of this, so that the triac control circuit dims up the load lamp rapidly. R13, the ORP12 light dependent resistor, particularly at the low illumination levels used in this application, has a somewhat slow response, as indicated in Fig. 2 (d); the only effect this has on the completed Dimwit being however, that the mains lamp is a little more sluggish in dimming up after an hour's rest than after only a few minutes. Since the maximum peak voltage rating of the ORP12 is 110V, the potential divider comprising R11 and R12 has been included. This limits the maximum output power a little, but does extend the life of most tungsten lamps.

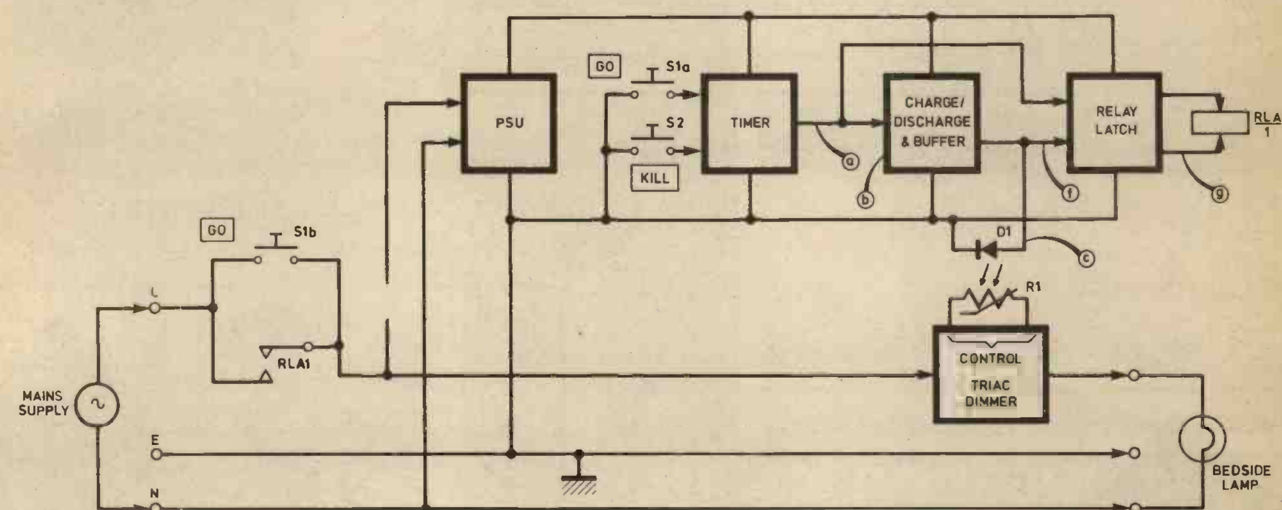


Fig. 1. Block diagram of Dimwit

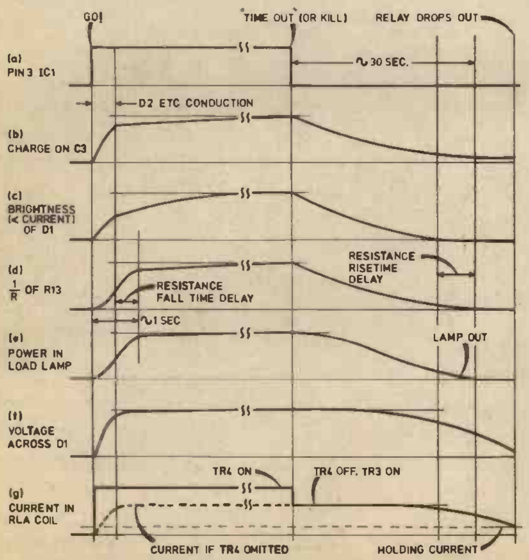


Fig. 2. Waveform timing diagram

RELAY DRIVE

The relay is energised by TR4, Fig. 2 (g), which is turned on by IC1 via R8. A handy miniature relay was used for convenience, and a possible type is the 6V miniature open relay from RS Components (part no. 349-125), for which there is enough space on the p.c.b., but which has different mounting arrangements. Since S1b carries the switch-on current surge for the lamp, which in any case is considerably reduced by the dimming-up process, see Fig. 2 (e), the relay contacts need only be rated for the continuous current of mains lamp and Dimwit. Moreover, as will be seen, the current broken by the relay at the end of the cycle is smaller still. Thus, if need be, a reed relay may be used.

Once IC1 has timed out (or when the KILL button S2 is pressed), C3 starts discharging slowly via R4, Fig. 2 (a), (b); thus the load lamp, Fig. 2 (c), (d), (e), starts dimming down

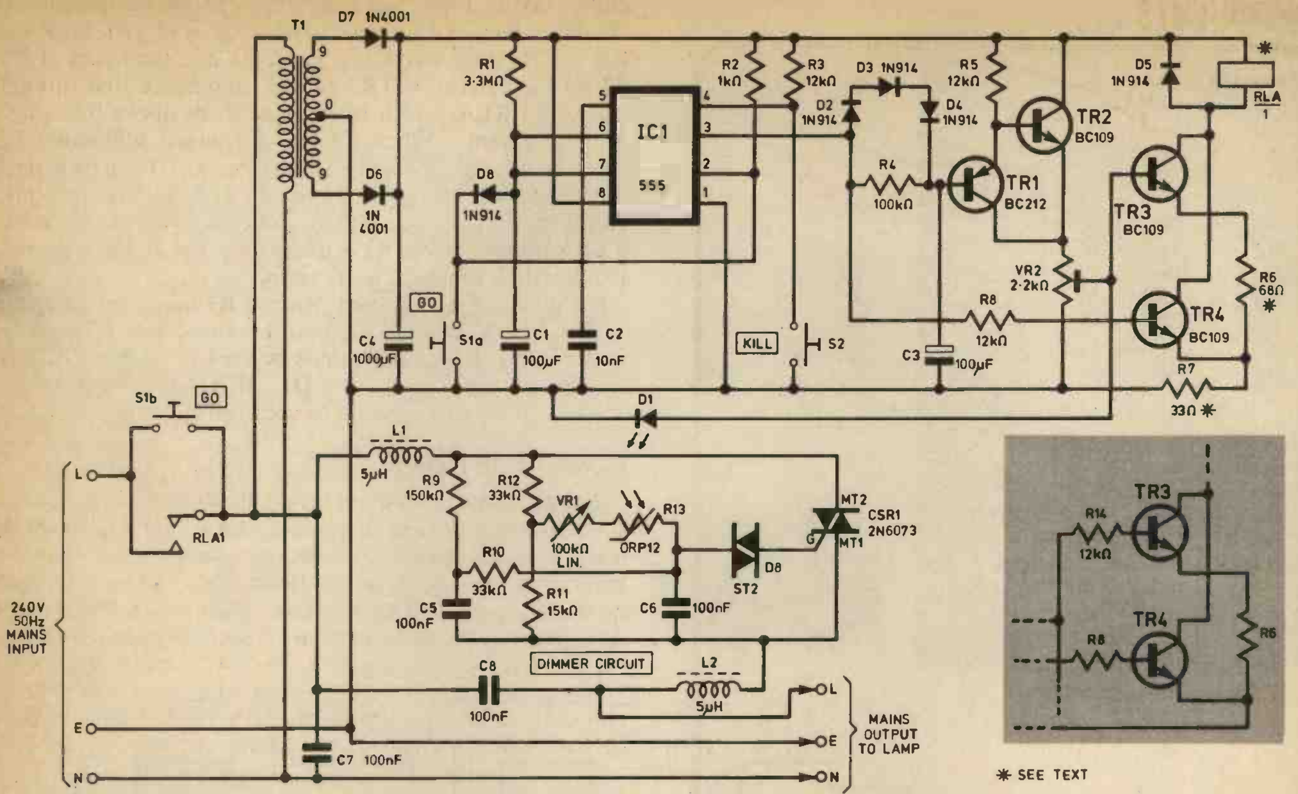


Fig. 3. Full Dimwit circuit. The shaded area shows the modification referred to in the text

Fig. 4. Printed circuit layout (actual size)

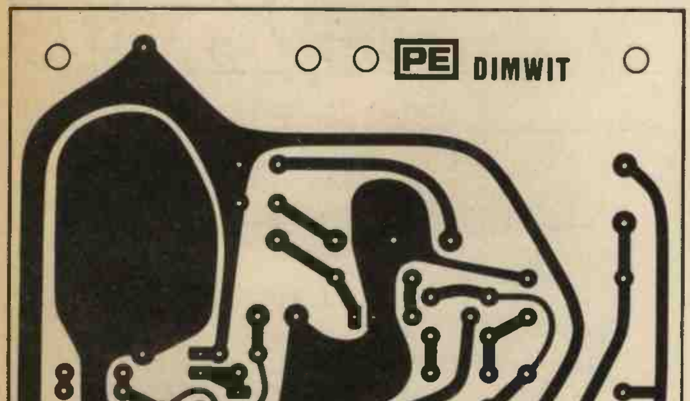
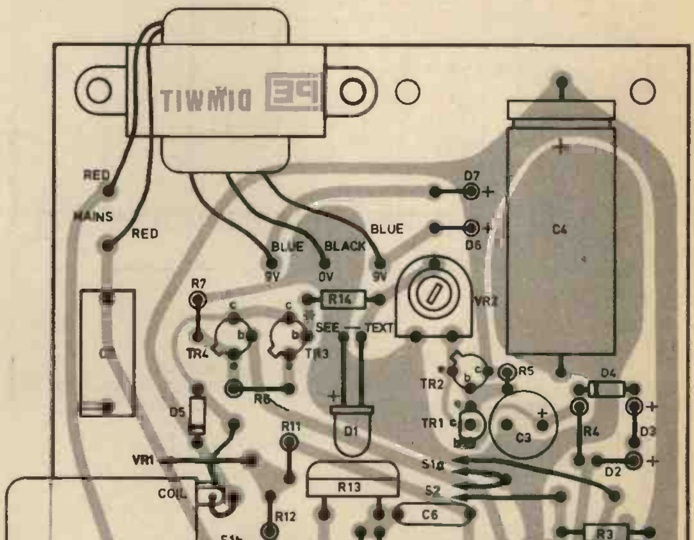


Fig. 5. Component layout



COMPONENTS . . .

Resistors

R1	3·3MΩ
R2	1kΩ
R3	12kΩ
R4	100kΩ
R5	12kΩ
R6	68Ω (see text)
R7	33Ω (see text)
R8	12kΩ
R9	150kΩ $\frac{1}{2}$W
R10	33kΩ $\frac{1}{2}$W
R11	15kΩ $\frac{1}{2}$W
R12	33kΩ 1W
R13	ORP12

All $\frac{1}{4}$W 5% unless otherwise stated

Potentiometers

VR1	100kΩ linear
VR2	2·2kΩ min horizontal

Capacitors

C1	100μF/16V electrolytic
C2	10nF
C3	100μF/16V electrolytic
C4	1000μF/25V electrolytic
C5	100nF/160V
C6	100nF/160V
C7	100nF/400V
C8	100nF/400V

Inductors etc

L1	5μH v.h.f. choke, 1A (RS: 238–255)
L2	5μH v.h.f. choke, 1A (RS: 238–255)
T1	Miniature mains to 9–0–9V transformer (Altai 909 or similar)
RLA	9V min 1-pole c/over relay: 280Ω coil, mains contacts

Semiconductors

D1	clear plastics red l.e.d. (5mm dia)
D2–D5	1N914 (or any surplus low-current silicon diode)
D6–D8	1N4001
D9	Diac ST2 (or similar)
CSR1	Mains triac, 3A minimum (2N6073 or similar)
TR1	BC 212
TR2	BC 109
TR3	BC 109
TR4	BC 109
IC1	555 Timer

Switches

S1	d.p. momentary make; 250V, $\frac{1}{2}$A (RS: 337–920)
S2	s.p. momentary make, low voltage

Miscellaneous

1 off	aluminium box, 152 × 101 × 51mm
2 off	self-tap screws (for above)
4 off	13mm 6BA countersunk screws
1 off	6mm 6BA countersunk screw
5 off	6BA nuts
5 off	6BA locking washers
1 off	solder tag
4 off	4mm × 6BA insulating pillars
2 off	mains cable grommets
1 off	potentiometer knob
2 off	25 mm No. 8 roundhead woodscrews, with matching Rawlplugs (for wall mounting)
80mm	double-sided foam-backed adhesive tape

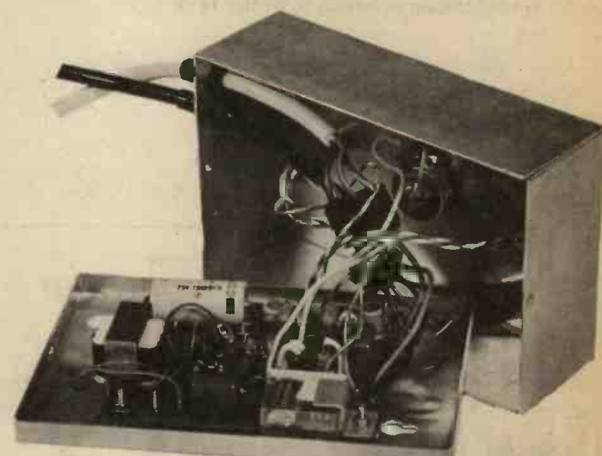
slowly, taking about half a minute to go out altogether. At the same time TR4 turns off, Fig. 2 (g), and TR3 turns on. The voltage drop across D1, Fig. 2 (f), and the values of R6, R7 set the current in TR3 emitter, and hence that through the coil of RLA, which is arranged to be above the relay's holding current. When C3 has discharged sufficiently for D1 to be off, Fig. 2 (c), the voltage across D1 begins to fall, and reduces the energising current in RLA until it drops out. This turns off the whole circuit, and thus completes the cycle. If S1 is pressed before RLA drops out, then IC1 is triggered, and the whole sequence starts again.

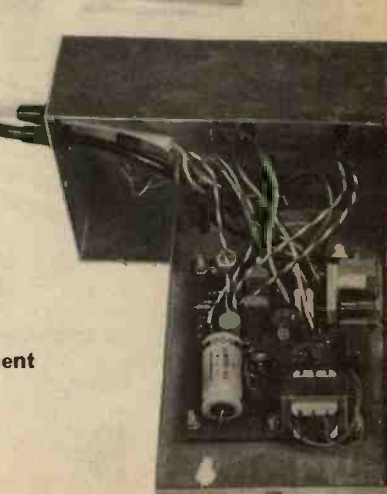
If a different relay is used, R6 and R7 may need adjusting to give correct action of RLA; if it is found that R7 must be omitted, then R14, Fig. 3, must be used to prevent TR3 base shunting all the current from D1. If R13 is not needed, its position on the p.c.b. should be occupied by a short circuit.

CONSTRUCTION

The p.c.b. and component layout are shown in Figs. 4 and 5. Construction is straightforward, as long as care is taken on the mains-voltage section to minimise the risk of flashover between tracks or to the (earthed) case. D1 and R13 are mounted as shown below. If the stiffness of the lead-out wires is not considered enough to keep them in place, they may be secured to the p.c.b. with a plastics filler. D1 should illuminate all of the active area of R13 and this may be checked visually in semi-darkness. RLA is mounted as shown below using double-sided foamback adhesive

A most chivalrous bedside light (internal view), showing the relay mounting arrangement





Opto coupling arrangement

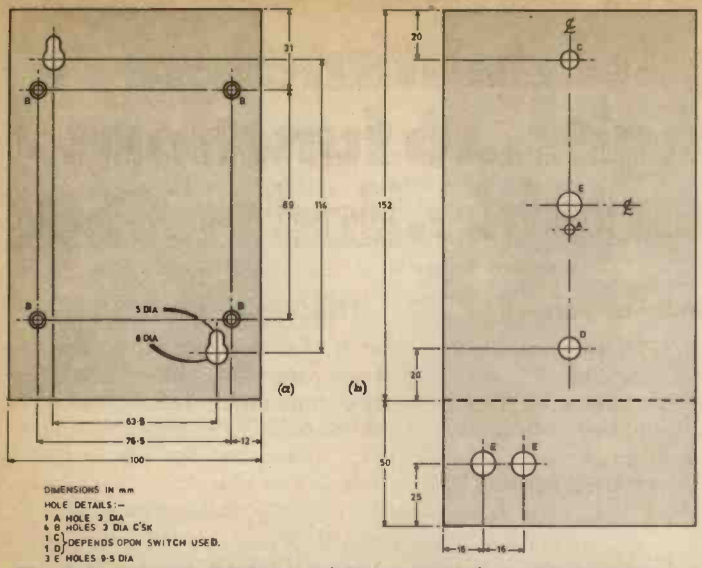


Fig. 6. Metalwork drillings. (a) Keyhole slots on backpanel, for wall mounting. (b) Front panel. Hole sizes will depend upon switch types used.

In the *old* days they managed with crude "ON/OFF" bedside lamps

tape. The tape is wrapped around the relay case, and the relay then stuck into place. For added security, the metal clamp shown may be added. The mains transformer is also secured at one end by a p.c.b. mounting screw, and at the other with a 6BA nut and screw. Connect to mains earth.

After assembling the p.c.b., and drilling the metal box as indicated in Fig. 6, mount the circuit board on the back panel using 6BA countersunk screws and insulating pillars. Set VR2 to mid-position, and VR1 fully clockwise. Close the case but leave it unscrewed.

By connecting to a load lamp of the same wattage as is intended to be used with the unit, and connecting to the mains, full operation of the completed Dimwit may be checked. VR2 can now be set to give the desired dimming performance; turning it anticlockwise increasing the dimming-up time and decreasing maximum brightness, while shortening the dimming-out sequence. (Remember to reassemble the case after each adjustment, if a lightproof assembly is not used for R13). When adjustment is complete, screw the case together and Dimwit is now ready for use.

The completed Dimwit is intended for wall mounting. The "saucepan" slots, which allow the unit to be hooked onto No. 8 roundhead woodscrews, are best made by drilling a 8mm hole and a 5mm hole, and joining them with the aid of a "rat tail" file. To mount Dimwit, drill and plug the wall, to accept the woodscrews, and screw them nearly home.

CONSIDERATIONS

The "dimming up" time which occurs at the beginning of the sequence may be increased by replacing D3 and/or D4 with a 1kΩ resistor, which slows the charging up of C3.

There is a faintly audible "clunk" when the relay drops out, which might be sufficiently loud to *reawaken* the more highly strung sleeper. If this becomes a problem, an electrically suitable type reed relay might provide an easier solution to further sound proofing, although fitting it into the available space may present problems.

It would take a number of years to recover the cost of the project, from saved electricity and enhanced bulb life, but its *true* value becomes apparent as you begin to take Dimwit for granted! ★

News Briefs

IERE CONFERENCE

The advances made in the field of radio receivers since the days of the cat's whisker crystal detector have been considerable. It is proposed to survey the subject at a conference on Radio Receivers and Associated Systems organised by the IERE which is to be held at the University of Southampton from July 11–14 1978.

Thirty seven papers will be delivered formally and a further twenty will be presented in poster booth sessions. An exhibition of relevant equipment and systems is to be organised by the Electrical Research Association.

Further information can be obtained from The Conference Secretariat, IERE, 99 Gower Street, London WC1.

SONY BETAMAX

In April Sony announced to the press the launch of its Betamax home video recorder. With over 500,000 people using Betamax on N.T.S.C. systems in the U.S.A. and Japan Sony believe the time is right to offer a PAL standard Betamax to Europe.

Mr Akio Morita, chairman and co-founder of Sony Corporation, heralded the coming of a "Video Age". He said that Sony were not looking to capture the home video market in a rush of sales. The Sony policy is to establish highly qualified outlets for Betamax and for the after sales service to be faultless.

On International Standards Mr Morita said he obviously hoped that video cassette manufacturers would together establish a common system, but the inference is that Sony think their system is the best and others may follow.

Costly and specialised machinery is used to manufacture the slanted azimuth video head. This equipment is in Japan and production is likely to be based in Japan for some time to come. Sony have a TV production line at Bridgend in Wales and although it is possible that assembly of some Betamax may happen at some time in the future it must be little comfort to the Mullard TV tube work force.

The new Sinclair DM 235 digital multimeter. 3½ digits...6 functions fully portable. Under £50!

The new Sinclair DM235 is yet another example of outstanding Sinclair value-engineering. Developed from the Sinclair DM2 and world-beating PDM35 (already outselling all other digitial multimeters), the DM235 provides full facilities for every application, including field servicing, testing and laboratory work. At a price no comparable digital meter can approach.

A new dimension in styling

Up till now, choosing a meter suitable for use on the bench *and* in the field hasn't been easy. Either you bought a bulky bench instrument (awkward to carry around) or a hand-held portable (difficult to use on the bench). The Sinclair concept is different. By keeping the thickness down to only a fraction over 1½ in, and the weight down to under 1½ lb, we've produced an instrument that has all the advantages of conventional bench meters, but that packs neatly into any tool kit or brief case.

A big, bright, unambiguous display

The DM235 has a full 3½ digit display reading to ±1999. Large, high-brightness 8 mm LEDs give clear, unambiguous readings with an ultra-wide angle of view. And an LED display means proven lifetime reliability.

Six functions in 26 ranges

DC Volts	1 mV to 1000 V
AC Volts	1 mV to 750 V
DC Current	1 μA to 1 A
AC Current	1 μA to 1 A
Resistance	1 Ω to 20 MΩ
Diode test	0.1 μA to 1 mA

10 MΩ input impedance

High accuracy

Basic accuracy of 0.5% (2 V DC range), other DC ranges and Resistance 1.0%, AC ranges 1.5% 30 Hz-10 kHz. Temperature coefficient <0.05 of applicable accuracy per °C.

Easy to use by anyone, anywhere

Automatic polarity operation, automatic placement of decimal point, and automatic out-of-range indication. Unambiguous reading of function and range selected from a single input terminal pair.

A rugged construction giving total portability

Very rugged mechanical construction using all solid-state components.

Protected against accidental overload.

Size only 10 in x 5.8 in x 1.6 in, weight less than 1½ lb.

Basic operation from four standard C size disposable cells, providing complete independence of AC supply.

Line operation available via optional AC adaptor/charger.

A full range of optional accessories

DM235 meter complete with test leads and prods	£49.80
Eveready carrying case with lead stowage compartment	£8.50
Rechargeable battery units	£8.00
AC adaptor/charger 240 V 50 Hz	£3.50
30 KV high voltage probe	£15.00

(All prices subject to 8% VAT)

The Sinclair credentials

Sinclair have pioneered a whole range of electronic world-firsts from programmable pocket calculators to miniature TVs – holding a world lead in innovative electronics. The DM235 embodies six years' experience in digital multimeter design, in which time Sinclair have become one of the world's largest producers.

Like every other Sinclair product, the DM235 comes to you with a full 12 month repair-or-replacement guarantee.

Find out more!

If you'd like full details of the DM235, its operation and its performance, and a complete distributor list, just send the coupon below. We'll send you all the facts by return.

The DM235 has all the performance you need – at around half the price of its competitors. Send the coupon for the full story.

Sinclair Radionics Ltd, St Ives, Huntingdon, Cambs, PE17 4HJ.

sinclair

World leaders in fingertip electronics

To: Sinclair Radionics Ltd, St Ives, Huntingdon, Cambs, PE17 4HJ.

Please send me full illustrated details of the new Sinclair DM235.

Name ______________________

Position ______________________

Company ______________________

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Address ______________________

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PE/7

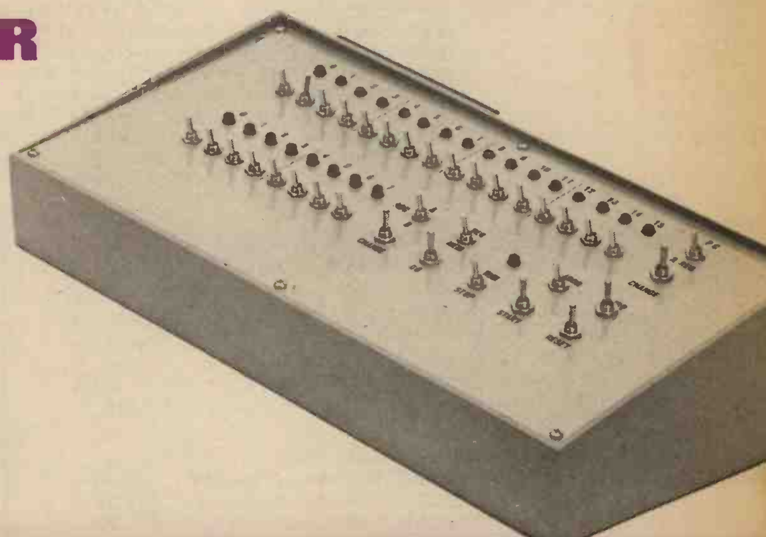
ALL IN OUR AUGUST ISSUE!

Digital Thermometer

Achieves a measurement range of −99·9°C to +99·9°C with a three digit seven segment display. Previously, analogue-to-digital conversion involved many discrete and integrated circuit devices. This unit dramatically reduces this problem by using a Siliconix LSI chip plus a few additional components.

CONSTANT DISPLAY FREQUENCY COUNTER

A straightforward unit to give frequency count capability in the range 1 to 99·999kHz with a 1Hz sampling rate. The readout does not count visibly or flicker due to display blanking. All components are readily available, and this would be an ideal project for the beginner.



AMI-COS MICROPROCESSOR KIT REVIEW

The home computer industry which has recently been booming has produced a bewildering number of "systems" for the amateur. We look at one particular kit in this review.

PRACTICAL
ELECTRONICS

OUR AUGUST ISSUE WILL BE ON SALE FRIDAY, 14 JULY, 1978

FREE ENTRY COMPETITION!

AN OPPORTUNITY FOR INVENTORS FINANCIAL BACKING and £490 worth of SCOPEX 'SCOPES TO BE WON

1st Prize A Scopex 4D10A dual beam oscilloscope worth over £200.

Runner up Prizes Two Scopex 4S6 single beam oscilloscopes each worth over £140.

Can you invent or design a novel project that could form a commercial product? We give you the chance to win the financial backing your ideas might deserve. Successful designs may be backed commercially by a Venture Capitalist to develop saleable products and you—as the designer—would receive financial benefit.

Even if your design is not deemed suitable for development you could still win yourself a piece of test gear worth over £200. Some designs may also be published in P.E. as constructional projects and payment will be made at the time of publication—so you could gain in any or all of three ways!

If you do come up with a winning design, who knows, you could soon be a partner in a going concern.

HOW TO ENTER

The contest is for practical items incorporating electronics as a major part of the overall system. There is no restriction on the application, e.g. it could be a video tape recorder or a door bell. It may be for domestic use or for Industry.

Entries must be written/drawn clearly on one side of plain paper with the entrant's full name and address at the top of every sheet. Each entry to comprise:

(a) a brief summary of the design (about 50 words);

(b) any such further descriptions, drawings, sketches, photographs and circuit diagrams, etc., you consider the judges may need to form the best appraisal of your design. **DO NOT SEND ACTUAL MODELS.**

Each entry must have a properly completed entry coupon cut from P.E. firmly affixed to the back of the summary. Entrants may be requested to supply prototypes for evaluation at later stages of the judging. All entries must be in English.

Readers may be assured by P.E. that ideas submitted will not be misused or transmitted to other parties by anyone concerned with the competition.

SEND YOUR ENTRY TO
Practical Electronics Inventors Competition
55 Ewer Street, London, SE99 6YP

FREE ENTRY COUPON

PRACTICAL ELECTRONICS INVENTORS COMPETITION

(Block letters please)

NAME (Mr/Mrs/Miss)..

....

ADDRESS..

....

....

....

TELEPHONE NUMBER if any..

I certify that

*** delete clause NOT applicable**

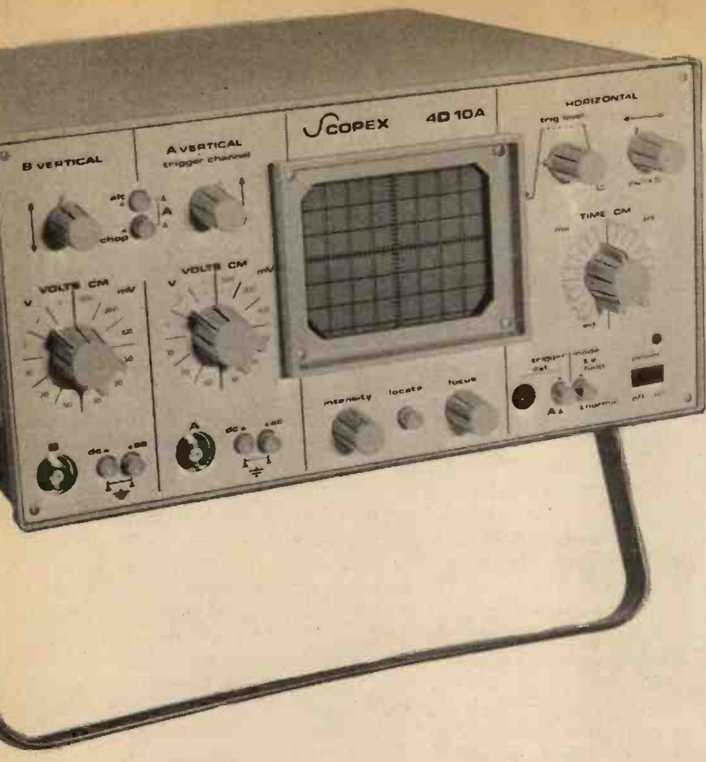
*** (a) This entry is my own original idea and has not been copied from any other source;**

*** (b) This entry has been made on behalf of the company/group members listed and is our own original idea not copied from any other source;**

(c) This idea has not been published or offered for publication elsewhere.

I/We agree to abide by the rules and conditions.

SIGNED..



The closing date is August 31st 1978.

RULES AND CONDITIONS

There is no entry fee nor limit to the number of entries a reader may submit but each entry must be accompanied by a proper printed entry coupon, cut from PRACTICAL ELECTRONICS, and must bear the entrant's own full name and address. Entries will also be accepted from groups or companies, in which case the entry must be submitted and represented by an individual and the other involvements declared on a separate sheet of paper attached to the back of the summary with the coupon.

All accepted entries will be examined by a panel of expert judges including the Editor of Practical Electronics, and assessed on (a) originality of the idea, (b) technical merit, (c) practicability, (d) economic viability, (e) market potential, (not necessarily in that order). The prizes will be awarded for the best entries in order of merit. In the event of the same idea being submitted by two or more entrants, presentation of the entry (clarity, best expression, etc.) will decide such winner(s) or winning order.

In the event that the judges consider there are not enough entries of a sufficiently high standard, the Editor reserves the right not to award any prize(s) at his discretion.

Entries arriving after closing date will not be considered, nor will any received that are illegible, not wholly understandable, are not accompanied by a properly completed entry coupon or in any other way do not comply exactly with the instructions and rules.

No responsibility can be accepted for entries lost or delayed in the post or otherwise; proof of posting will not be accepted as proof of receipt. No entries can be returned.

The competition sponsors reserve the right to adapt or amend any entry—after judging has been completed—for purposes of publication and/or commercial development. They also reserve the right to consider any other entries for commercial production. Where any idea is adapted or developed for commercial production payment and/or royalties and/or direct involvement in the company concerned will automatically be negotiated with the designer or person named on the entry coupon.

Winning entries will not necessarily be developed commercially, but Practical Electronics will pay the usual reproduction fee for any entries published.

Ideas already covered by a patent owned by the representer, but not already in or on offer for commercial production, may be submitted but this fact must be clearly stated together with the relevant patent number.

Decisions of the judges, and of the Editor in all other matters affecting the competition, will be final and legally binding. No correspondence will be entered into nor interviews granted.

Winners will be notified by post and brief details of winning entries published later in Practical Electronics.

The contest is open to all readers, but those outside the U.K. may be requested to provide a British address to which any prize may be sent. Development of any idea must take place within the U.K.

Employees and the families of employees of IPC Magazines Ltd., and the printers of Practical Electronics and anyone directly connected with the competition are not eligible to enter.

News Briefs

MICRO-MUSCLE THROUGH COMPILERS

As microprocessor based systems are doubtless going to be designed into ever more complex systems as time goes by, Zilog, with the introduction of high level Cobol and Fortran compilers, plan to have six languages for all of its microprocessors, including the familiar Z80. Business and scientific versions of Basic, and two members of Zilog's own high level family of systems orientated languages (called PLZ), have recently been announced. High level languages, it is felt, will be absolutely essential in the next few years. "If you don't offer them", declared Ralph K. Ungerman, who is the company's executive vice-president, "you'll be locked out of the market!"

Since software generally amounts to most of the cost in microcomputer systems, Zilog have established the PLZ family to meet three basic criteria: Although high level, the language has to be able to get into the architecture of the machine and deal with interrupts. It also has to generate efficient codes because of a microcomputer's limited address capability. And finally, the compiler must be simple to implement, since a micro system has limited memory.

The full power of the Z80 is made available to you using the PLZ/ASM assembly language, and the common syntax among the PLZ programs should be easy for someone familiar with any Algol-like language.

LASER RECORDER

For space photography, RCA has provided NASA with a laser beam recorder which generates images from all of the U.S. space agency's satellite sensors, resulting in higher quality and faster production of photographs.

Called the Operational Laser Beam Recorder (OLBR), it will be the primary photo production system at NASA's Goddard Space Flight Center. The OLBR can generate images requiring up to 20,000 picture elements per line.

NASA also has installed an RCA computerised preprocessing system to enhance the quality of the Return Beam Vidicon (RBV) camera signals from Landsat satellites which photograph the earth's resources. The OLBR and the preprocessing system allow rapid production of RBV colour composite photos that are of quality previously considered unattainable, according to RCA officials.

The OLBR is completely self-contained and self-calibrated, and is operated and maintained by a single operator. It controls, selects and accepts digital image data from high-density tape and transforms it into high resolution, geometrically and radiometrically correct, annotated latent images on 214mm strip film. The film then is developed and processed at Goddard to produce high resolution transparencies which are distributed to Landsat data subscribers throughout the world.

The film recorder subsystem accepts the timed and formatted digital words representing the picture elements and performs digital to analogue conversion and video signal processing. The processed video drives the modulation and scanning film transport subsystem which exposes the film with a shared spot, one scan at a time. All electro-mechanical adjustments and optical path film transport are of the highest possible precision to assure long-term repeatability and freedom from drifts which could affect image quality.

The preprocessor system is claimed to be unique because it provides both completely automatic and interactive handling of RBV data collected on tape at Landsat receiving sites in Alaska, California and at Goddard. Wideband video tapes are quickly analysed for quality with the locations of the images automatically noted and indexed. The output of the system is a high-density digital tape and a computer tape summary indicating the tape contents to the operator. The high-density digital tape is the primary input to NASA's master data processing which, in turn, drives the OLBR.

ACCURACY ON THE CARDS

Think of cards. Postcards, bingo cards, computer cards, carton blanks, book covers, in fact units of anything thicker than paper, and *that* could include labels, plastics sheet, film, you name it. Now supposing you need to count large quantities of these, in stacks. Counting by weight or measurement is quick, maybe, but inaccurate. By hand? Not even quick! If you're in business you might give 5 per cent over the top to be on the safe side. This eats into margins; but short measure loses customers.

You could go in for complicated machinery which separates the stack one at a time, and then counts, or you could go in for a static opto-electronic counting system. Such a machine exists, called the Optomat 520 Card Counter made by Vacuumatic Ltd., of Harwich, Essex. A beam of light is projected onto the edge of the stack to be counted, and sensing of the Lambertian reflected light to activate multiple photocells is utilised to differentiate between the light and dark transitions, caused by individual sheets and spaces. These spaces, by the way, are encouraged by the application of a compressed air stream. The photocell outputs are amplified and filtered to obtain distinct steps which then drive an electronic counter. So easy!

One of the sheets is taken at the outset, and put into a gauge so that the thickness dial can be set to control the optical scanner. A twelve inch stack is then placed against the backplate, and with the press of a foot pedal and a two second wait, hey presto, the total count appears. It is claimed that a count of 25,000 can be made in one minute with 100 per cent accuracy, and the machine will work over a caliper range of 0·005 inches to 0·02 inches at the same speed. So, humans and weighing machines collect your cards.

BLIND AUTOMATION

Most human beings *look forward* to the sun coming out, but a new compact control system, the Junior 10, has been developed for use with sun blinds mounted on the outside of buildings by Solar Protection Equipment Ltd., a Hampshire-based company which specialises in the design and manufacture of equipment and systems to protect buildings from the effects of the sun. The new system was field tested in a range of applications where accurate, reliable automatic control of blinds, awnings and solar screens is needed.

The package consists of a light cell, anemometer, control unit, and features include a light level selector, a wind override, and adjustable delays to control the "in" and "out" response so that instant reaction to short duration cloud patterns is avoided. There are l.e.d.s to indicate when the selected wind and light levels have been reached.

The light intensity range is approximately 3,000 to 30,000 lux, and wind speed range from 2 to 40m/sec (Force 2 to 12). Time delays on the solar bands may be set from 30 seconds to 10 minutes for the "out" mode, and between 1 and 20 minutes for the "in" position. The response delay from when the wind threshold value is exceeded to activation of the raise mechanism is permanently set at 15 seconds. Actuation of the downward movement corresponds to the delay selected on the "out" mode of the solar band. There is a manual override facility for the solar function of the unit, but which, for safety reasons, does not by-pass anemometer-controlled functions.

The Junior 10 will provide automatic operation for any number of blinds or screens on a single façade of a building. Other Solar Protection Equipment units are available to automate blinds fitted on two or more façades. The system can be used with any type of existing or new installation where the blinds are powered by electric motors.

IMPROVING BRITISH STANDARDS

BSI has published two further parts of BS 5428 *Methods for specifying and measuring the characteristics of sound system equipment*, a series of specifications covering the various major elements of audio equipment.

The first of the new publications is Part 3 *Microphones* which specifies the characteristics and methods of measurement for microphones used both in professional and domestic applications, notably wide band microphones, close-talking microphones and those used for normal speech.

Similar data is given in the second document, Part 11 *Loudspeakers*, which relates to systems comprising one or more loudspeaker elements and such relevant devices as built-in-cross-over filters, transformers and any other passive elements.

Both specifications are identical with the corresponding parts of the International Standard, IEC 268. Additional British Standards, now in course of preparation, will deal with *Performance specifications for high-fidelity audio equipment*.

BS 5428 Part 3 (Price £7·80) and Part 11 (Price £5·60), may be obtained from BSI Sales Department, 101 Pentonville Road, London N1 9ND.

IMPROVING WORLD STANDARDS

STAND to attention, you are about to be standardised still further, this time by the International Electrotechnical Commission (IEC), the organisation responsible for the preparation of worldwide standards in the electrical and electronic fields. They have just issued IEC Publication 268, Part Nine—*Sound System Equipment: Artificial Reverberation, Time Delay and Frequency Shift Equipment*—applicable to equipment commonly used for obtaining special effects on sound recording, broadcasting and public-address systems.

The latest standard now provides engineers with the list of characteristics to be specified for artificial reverberation equipment, broadly described as amplifiers designed for special purposes. In addition this publication includes not only reverberation times, frequency responses, ambient acoustical noise levels and echo and delay times, but also describes relevant methods of measurements. IEC standards for other amplifier characteristics are outlined in IEC Publication 268: *Sound System Equipment—Part Three: Sound System Amplifiers*.

readout

... a selection from our postbag

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

Word Cost

Sir—It seems to be a common misconception that the cost of a microprocessor increases with the size of the word.

The reverse is probably true if one's aim is to run useful programs rather than merely play with a toy.

A minimal useful system is a Central Processor Unit (CPU) plus a hex keyboard and a 4 digit hex display. For 4, 8 or 16 bit systems the cost difference is not likely to be very great. The real expense comes in buying a memory of useful size. For a given end result this last cost is likely to be least with the 16 bit system.

Program storage is approximately the same, at about 2 bytes for each instruction, for the 3 word sizes, but increased word size gives vast improvements in program efficiency. A single 2 byte instruction in the 16 bit system may equal as many as 20 instructions in 4 bits and somewhere in between for 8 bits. Programming is thus much simpler with less chance of errors and the saving in memory is immense.

Evaluation studies have shown that the National Pace 16 bit CPU offers the most to the beginner with aims for the future. It costs under £20, can work with both 8 and 16 bit data and, if necessary, will address up to 128 kilobytes of memory. One does not have to buy it all at once, as some writers have suggested with other CPUs, but can start with as little as 256 words, at about £10, and add as required to any limit. A special feature of the Pace chip is the instruction set which seems especially designed for easy programming with hex machine code, permitting easy relocation of sub routines even in complex programs. It certainly seems easier to program than the various, much lauded, 8 bit CPUs.

R. G. Silson,
Tring, Herts.

Any readers with differing ideas?—Ed.

Cover Blown

Sir—As professional engineers of some standing, we are, to put it mildly, somewhat amused to see the May cover of P.E. The advertised article is for a TTL logic tester, yet on the cover photograph the tester is shown in "action" on a circuit containing CMOS logic.

This anomaly unfortunately confirms a few suspicions held by the writers regarding the integrated circuit industry; namely that CMOS is really TTL with a self-destruct facility.

Yours explosively,
Messrs. Maclean and Stanbury,
Brentwood.

Well done lads. You may endorse our photographic licence as it was not thought that the numbering on the CMOS devices would show up so clearly. Full marks for our photographer.

Readers familiar with the Linear Capacitance Meter p.c.b. may have realised that the test clip was held over a blank area of board.—Ed.

TV Radiation

Sir—I note with interest the comments made in the May issue of Practical Electronics regarding the difficulties of establishing a Citizens Band service in the U.K.

Previously, I was indifferent to the proposal, but after reading the point raised in Industry Notebook, I am now wholeheartedly in favour!

It was stated that T.V. viewers in the U.S.A. were being subjected to interference from CB sets, and that Texas Instruments, in conjunction with the FCC were developing a high performance T.V. receiver less susceptible to such interference.

Speaking as a short wave listener, I would welcome any proposal to reduce interference *from* T.V. sets, and clear the airwaves of the pollution they produce. Everywhere you look, it is emphasised that no disruption of T.V. viewing is to be caused by any electrical or electronic equipment, but the problem of radiation *from* T.V. receivers is never mentioned. It is the age-old dual standard rearing its ugly head again, one law for the powerful, and another for the weak. To be blunt, I would rather allow C.B.'ers a couple of MHz airspace than be deprived, as I am at present, of *five* MHz which is totally submerged beneath a sea of T.V. radiation, and I am sure there are thousands like me.

Steve Price,
Doncaster, Yorks.

Tomorrow's Broadcasting

THE TECHNICAL POSSIBILITIES

DR. BORIS TOWNSEND, Head of the IBA's Engineering Information Service, gave the first of this year's IBA Lectures at the Authority's headquarters in February of this year; this feature is based on his lecture.

ONE sees clearly the road a few yards ahead, makes out the shape of the cross-roads shortly to be reached, and even discerns the outlines of the hills in the distance. So whereabouts on our journey through time are we now? From where does our future begin?

We nightly bring into the majority of our homes pictures and sound which are beautiful to the eye and a delight to the ear, and often to the intellect, at a price which most of us could once afford. I think our broadcasting is great! We roam the earth at will—not at our will, of course, but at the will of the programme director.

But it has to be said categorically that, in the same way as America has the largest backlog of antiquated technology of any country in history, so we are stuck with old-fashioned television transmissions which are a hybrid rag-bag of improvisation and almost incompatible technologies, which carry a quite unnecessary amount of repetitive data yet still reproduce inadequate detail, inadequate contrast, inadequate colour gamut, and pictures which lack most of the attributes of real life. It is a system which gives the viewer and listener little choice and to which any graduate tea-boy engineer could now suggest improvement.

What are we going to do about it? In the next few years—not much. We did something about our equally out-moded radio transmissions, and duplicated our use of precious wavelengths with our stero f.m. transmissions using circular polarisation. These transmissions are glorious. What happened? Nothing! The public ignored them. Everyone still listens on antiquated amplitude modulation receivers—statistically, so to speak. But engineers are not easily discouraged.

SMALL IS BEAUTIFUL—AND CHEAP

As an expatriate Londoner perhaps you will forgive me if I quote my favourite piece of London graffito: "God is not dead—he is alive and well and working on a less ambitious project!" The same goes for engineers.

The other end of the television system from the home and hearth is, to engineers, more amenable to radical change. And radical the change is going to be.

Engineers are making a two-pronged thrust forward. One is a miniaturisation of the analogue techniques which have been used in our studios since Savoy Place and Alexandra Palace, while the other is based not on smooth, continuous signal waveforms but on abrupt discontinuities, or digits. Both advances are dependent on the new technology of micro-electronics.

It is not possible to live in a developed country in 1978 and be unaware of the incredible reduction in the size of electronic circuits which has been made in the last decade. Gone are the separate valves, resistors, condensers and wires of yesteryear. Today's large-scale integrated semi-conductor micro-circuit can house thousands of individual electronic components on a small chip of silicon the size of a screw head.

With small size comes a reduction in the cost of materials, a reduction in weight, usually a reduction in power consumption and a reduction in operating time, since the signals moving through the circuits have less distance to travel. The failure rate also falls since the number of mechanical or soldered joints and the opportunities for operator mistakes are alike reduced. The cost of making an integrated circuit is proportional to its area and is more or less independent of its circuit complexity. The reduction in cost is staggering. An integrated circuit now costs about the same as an apple. As a result it is now practicable on the one hand to undertake electrical processes and functions of great complexity, and on the other hand to mass-produce cheaply for the home, devices which were once only to be found in capital-intensive studios.

Will this trend continue? It can. The latest microcircuits are approaching size-reduction limits imposed on the photo-etching process by the wavelength of light—that is to say, individual parts of the circuit are not more than a few wavelengths of light in size. Further reductions require radiations of shorter wavelengths than light, and laboratories are currently utilising ultra-violet, X-rays, and electron-beam pattern-generation machines to continue this reduction in size. It is an industry which is aiming at a dimensional precision two orders better than that to which mechanical engineering machine shops can work.

MECHANISMS INTO MICROCIRCUITS

Which brings me to a point of fundamental importance in our forecasting. The more recent history of manufacturing industry is that, despite the advantages of large-scale production and the replacement of labour by automatic machines, mechanisms grow more and more expensive to produce, while electronics become cheaper and cheaper.

Compare the £70 monochrome television receiver, of dubious performance, which sold in 1938, with its contemporary £100 small motor-car: and then take today's large, bright, reliable monochrome television receiver, still at £70, and its contemporary £2,000 mini. So whenever we can replace mechanisms by electronics we shall. Whenever we can transfer a problem from the mechanical domain into the electronic domain, we shall—and indeed already do.

These tiny microcircuits already make broadcasting equipment portable in a sense little dreamt of by the early pioneers. Every swinging teenager has the ability to make an audio broadcast tape of better quality than the phone-in programmes we permit. Sophisticated editing is possible in anyone's back-room, while multitrack tape-recording and its subsequent re-processing can restore a semblance of professionalism to any amateur pop group. All this opens up new avenues of exploration to enterprising programme directors. And a parallel development is going to take place in television. Yet there are still surprising weaknesses in the equipment available for radio reporting, as will be testified by roving radio news crews attempting to establish a link back to base, or even to aim a microphone at an American President.

ENG

In television, the evolutionary reduction in size and weight of television equipment has produced a revolutionary change in the medium, for as Valéry said, rephrasing Engels—similar figures exist only in pure geometry. Small, electronic, colour-cameras of low power-consumption are now in production and are giving immediate world coverage of important news events. These Electronic News Gathering developments will spread to the field production of drama and even to light entertainment programmes. If we wanted so to do, we could now operate a television service without much in the way of television studio complexes.

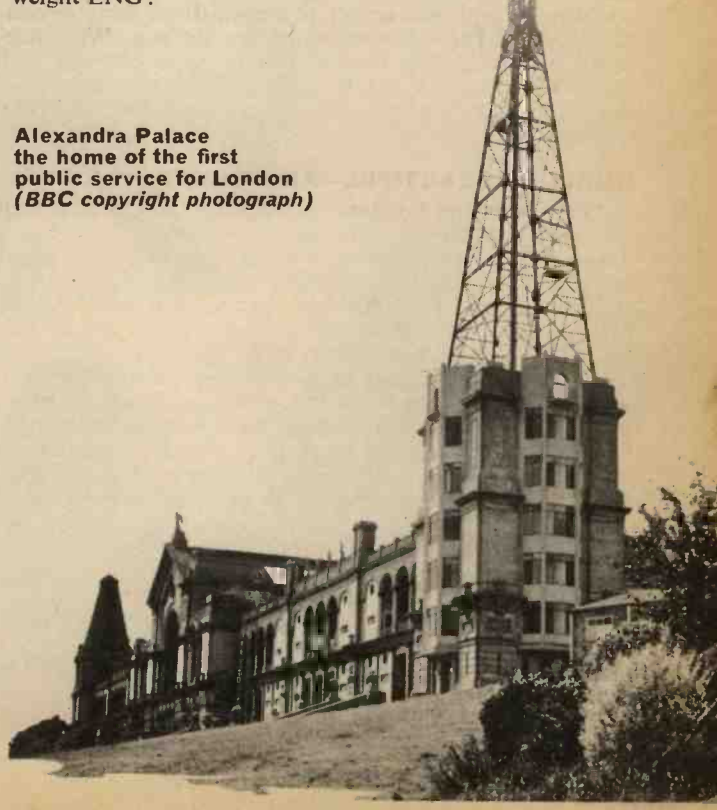
An essential ingredient of this light-weight facility is a portable battery-operated colour video-tape-recorder. Now to make satisfactory replays of colour video-tape-recordings the machine has to work to a timing accuracy of around one thousandth part of one millionth of a second. It is not possible to pull a magentic tape through a VTR with this precision, even on a massive and expensive studio machine and certainly not on a small portable recorder subject to the gyroscopic effects of being carried or even of being used on a motor-cycle.

The technological solution has been to transcend the problem by abandoning the attempt to make such a precision mechanism. Instead, we make a small, cheap tape-transport mechanism and then correct all the recorded and replay timing-errors electronically, and subsequently, back at base—a typical example of our foresaking mechanisms for microcircuits. The ability to carry out this electronic correction in a Time Base Corrector depends not only on a high complexity of microcircuits but also on the digital techniques of the second prong of our forward development thrust—of which more in a moment.

ENG equipment is now sufficiently automatic to be used by any sensible person—providing maintenance back-up is available. Thus, last year, when NBC was suffering a technicians' strike, the manager of one station gave two of his girl secretaries half-an-hour's instruction in the use of the ENG equipment and then sent them out to cover a story—which was later transmitted. This is not so much a cautionary tale for strikers and strike-breakers but more an encouragement to all actual and budding directors. Television programme-making is no longer necessarily capital intensive. Television directors need no longer rant about there being 20 engineers between them and their actors, while programme-makers are no longer dependent on the owners of expensive studio complexes for permission to ply their trade.

FILM

Whilst I am still talking about analogue television I should not ignore film. CBS, of course, would say "Why not?—film has gone from television!" As a forecast rather than a contemporary fact, CBS may have it right. But I cannot refrain from observing that the period of greatest innovation in the history of the sailing boat was in the 50 years following the invention of the steamship. We have not heard the last of film. I have held in the palm of one hand a working prototype of a professional 16mm film camera which is so much smaller than any 3-tube electronic camera that the uncommitted observer is bound to say, why all the fuss about light-weight ENG?



Alexandra Palace the home of the first public service for London *(BBC copyright photograph)*

Certainly, live ENG is more immediate than film—but most ENG is not live. Film processing times are already shorter than the average time between ENG recording and ENG transmission, whilst Dr Land has demonstrated more or less instant-processing polaroid colour cine film using an additive colour process.

It may be that electronics, rather than killing off film, will save it; for as our electronic picture processing becomes more sophisticated, so we can rescue film from its own defects of colour mistracking, variable colour grading, frame bounce, spots, even grain—but we may not wish to do so.

DIGITS

But I keep straying, inevitably, in this review of where our technology is at the moment, into the second prong of our forward development thrust, which is based on computer technology. From continuously varying analogue signals in the studio and network we are about to change over to trains of constant amplitude pulses—to digital radio and digital television, using components developed for defence and for computers. Why?—you may ask. Are our pictures going to be sharper, or more colourful, or bigger, or be stereoscopic? Is our sound going to encompass a wider frequency range or have more attack? The honest answer is NO.

Certainly digital signals will travel long distances better than analogue signals; that is to say, with less distortion and without picking up noise *en route*. Certainly digital—or television-by-numbers—equipment can eliminate the line-up time of studio equipment and can reduce maintenance routines; however, for most of our present-day studio processes, digits do not yet offer any cost saving. Certainly they permit us to undertake an incredible range of picture processing and correction and special effects.

DICE

Digits enabled us to put into everyday operation, some five years ago, an all-electronic colour-picture standards-convertor to change programmes from the American System to the British System, and conversely, using electronic arithmetic. This convertor, named DICE, needed the equivalent of some five million valves, packed into a space about the size of a wardrobe. In Venice last April we demonstrated to the Technical Committee of the European Broadcasting Union most of the components of an all-digital television studio; and we are now negotiating licences for the manufacture of digital video-tape-recorders to our IBA patents.

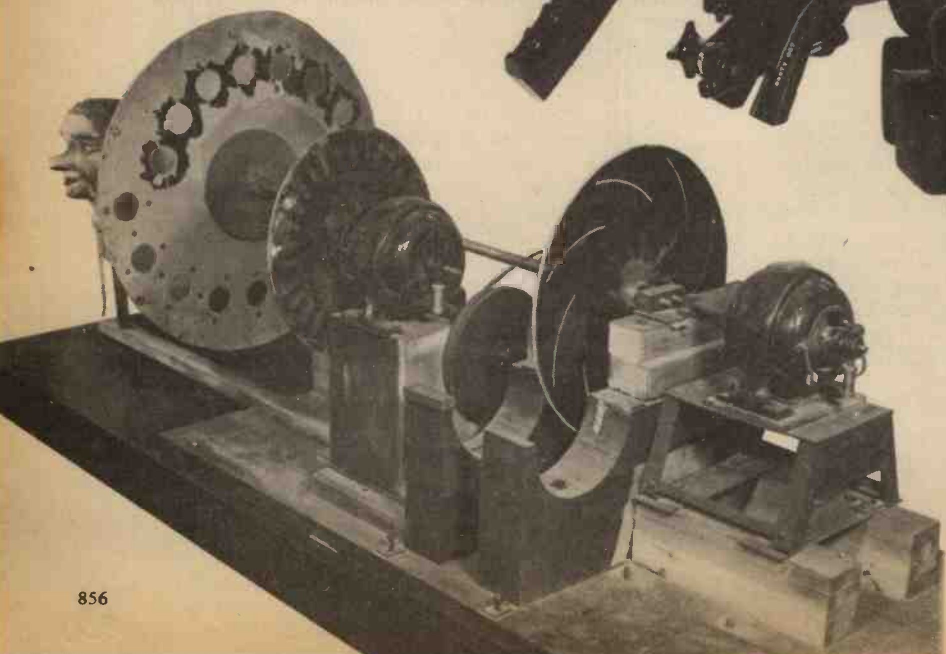
Almost anything goes in the field of special effects, including compressing and inserting one camera picture into part of another, flipping the picture about an axis, reprocessing ENG signals to remove noise, and most of the other defects due to simple cameras, and lots of other processes which engineers had long regarded as impracticable. And, unlike film special effects, the results are available immediately.

Digital pulses also enable us to add services to our existing broadcasts. By placing a string or two of fast pulse trains in the upper blank margin of our television pictures, engineers have given us a new information service—our ORACLE Teletext service, complete with simple computer graphics as well as typefaces. It uses a great deal of computer technology both at the studio and in the home receiver. Although the receiver ORACLE circuits are much more complex than all the rest of the colour set put together, the additional cost of the ORACLE decoder is going to fall well below the cost of the colour receiver alone.

MICROPROCESSED NETWORKS

Computer technology can make decisive inroads into television operations as well as into television signals. The microprocessor, which is the central brain of computers, is now controlling many routine functions in television as well as in industry at large. It is this kind of innovative technology,

The Philips LDK14 ENG/EFP Camera and battery belt



A replica of the TV camera with which John Logie Baird first demonstrated his system in 1926. From the IBA Broadcasting Gallery. Compare this with the ENG camera above

and the management which is needed with it, that enables us to operate and maintain 400 transmitters with the same number of staff as we needed for only 40 transmitters some dozen or so years ago.

The automation of our network continues at an increasing pace. In the next few years we shall reduce the control rooms for our country-wide transmitter network from fourteen to four. Our new Regional Operations Centre, or ROC, at Croydon is controlling and monitoring some sixteen main stations with their nineteen relay transmitters stretching from the Channel Islands to the Wash.

Microprocessors measure the signals pouring out from our transmitters and then display on our central television monitors, which are now more like computer-type visual display screens, not only data on the state of our transmissions, but coloured computer graphics of the circuits of any faulty transmitter, the fault diagnosis, the action which the transmitter may have already taken to cure its own problem, or the recommended repair procedure if human intervention is called for. This is all daily, routine, run-of-the-mill operations for us. This is our IBA present, the base from which I shall be leaping into the future. Of course, it will be a radio future as well as a television future.

In radio, engineers are experimenting with surround sound systems as the next step forward from stereophonic sound—or perhaps I should describe it as a step backwards from two loudspeakers in front to two more behind you. Our ILR companies have already made several successful quadraphonic broadcasts.

NEW STUDIOS

In television studios the 2 inch quadruplex video-tape-recorder is now clearly in its death throes, and will shortly be delegated to archival replay only. The 1 inch analogue helical scan recorders offer reductions in capital and running costs but will not have time to replace the 2 inch quadruplex machines before the 1 inch digital recorders get into large-scale production.

Digital telecine machines with one-line readouts and simple mechanical transports with zero line-up time will appear. The studio camera pedestal can give way to the stabilised hand-held camera, and studio floors can develop ridges if they like, while developments in fade-reduction techniques for radio-microphones, together with a marked reduction in their size, will eliminate, at long last, the boom shadow.

Real background scenery will be unnecessary, although super-stars will probably insist on having it. Toy scenery and chroma-key techniques will do, with computer control of the scenery camera, which looks into the miniature stage through a periscope, keeping the perspective of the background correct as the foreground camera is crabbed. After a few years, even the toy scenery will disappear. The scenery camera will look at flatly lit photographs of the required background and the graphics computer will adjust the perspective and the shadows of the transmitted image as required.

Post-production editing will increase and clever microprocessor control systems will speed-up editing for both film and tape. The acceptance of more natural-looking lighting in television pictures will combine with continuous and simultaneous tape recording of the action as seen by each of several electronic cameras, with all cutting, mixing and editing taking place in the calm atmosphere of the post-production suite.

The technical need for special lighting for television will disappear. Already the Lincoln Centre in New York televises its theatre productions of the Metropolitan Opera on the simple basis that the cameras must not intrude on the audience, and that the lighting and stage production will be exactly those which the stage director wants for his theatre audience; that is to say, many scenes have a huge contrast range and the mean lighting level between scenes ranges from deep gloom to high intensity. The severe technical constraints thus placed on the television crew are giving rise to novel signal-processing ideas of wide application. By 1984, cameras

Internal view of the LDK14 camera

will automatically produce suitable television pictures almost regardless of the scene lighting.

Microprocessors and computers can play a major role in studios as well as in networks. Several broadcasters have already built very large studio complexes in which the technical facilities are assigned between studios by computer. It is technically feasible to operate the whole television system from VTR and telecine replay, through the continuity suite and master control, to network switching and transmitter, under the immediate control of computers rather than operators. The day's transmission schedule can be compiled in the computer memory over the preceding fortnight or so, item by item, as convenient. On the day itself, the computer will give a running commentary to the presentation controller on what it is doing, and on what it is going to do, and on the optimum way of slotting-in last minute re-arrangements.

International discussions are going on about standardising the coded data which should be placed on the leader of every recorded programme to ensure correct transmission from automatic studios anywhere in the world, once the machine-minders have loaded the reel onto a replay machine—any replay machine. If the machine-minders put it on the wrong machine, the computer will merely change the machine assignments. If they don't put it on any machine, then the computer will ring alarms in the rest room as transmission time approaches, and will indicate the immediate action which it requires of the humans.

DESIGNING ENGINEERS OUT

The design engineers will engineer the operational engineers *out* of television. The design engineers will also engineer the scenery makers and the graphic designers out of television, with chroma-key, Magicam, electronic captions and even more sophisticated electronic graphics-generators. It will be possible to quadruple the output of a graphics designer by giving him an electronic drawing board. By moving his electronic pen over his action area he will instruct a computer to store his design and/or display it on television monitors. The designer will be able to ask the machine to do it again in a different colour, to draw it larger or smaller, to replicate the design twenty times around the edge of the frame, or to add the company logo, or to overlay any other design which he already has in the machine store, or to show it from a different perspective, or with different lighting.

Design engineers are also designing maintenance engineers out of television. One large television equipment manufacturer with a world-wide market is considering building into its products a self-diagnostic fault-analysis routine so that if one of its video-tape machines, say in the remoter parts of the Upper Volta, is too sophisticated for the local operator to handle, then the factory computer can interrogate the Upper Volta VTR via a satellite. The factory computer will then either adjust the remote television machine or will instruct the overseas human operator on which module to replace. The faulty module will then be airmailed back to the factory for repair.

π IN THE SKY?

Satellites, of course, are going to play an increasingly important role in television, despite the fact that the geostationary orbit already has some 400 man-made objects in its rather narrow equatorial annulus. We are only two years or so away from our ENG crews being able to send their news pictures straight into the sky, to a satellite, for immediate world-wide distribution, rather than going through the slow and tedious procedures of arranging terrestrial links with their PTTs.

Networked programmes can be fed to our earthbound television and radio transmitters from a satellite in space, which could be cheaper than paying Post Office charges for terrestrial links. It is clear that direct broadcasting from satellites straight into everyone's home will become practicable in the 1980s. The service is already planned. Five television channels in the 12GHz frequency band have been allocated to each European country. The heavy-platform satellite will be launched in 1981, carrying sufficient power generation to lay down adequately strong signals in European homes, and a year later it will begin to do precisely that, with television programmes.

TELEVISION SET FOR TELEVISION?

By the 1980s we can also expect the domestic television receiver to be as much a computer visual display unit as it is a television set and television will face even more competition than does radio. Microprocessors and LSIs will turn this colour VDU into an indoor games centre, covering everything from chess to clay pigeon shooting; children could do their homework on it and perhaps hand-in a magnetic printout to their teacher next day, eliminating complaints about illegible hand-writing, and permitting machine checking of the answers. It could be that the television set will be in continual use—but rarely for television, for domestic video recorders and domestic video disc players will be commonplace. I forecast further improvements in receiver safety and reliability, and that we shall have no hesitation in leaving our home equipment running all night.

All transmissions will carry coded pulses identifying themselves and their programme classification. It will be practicable to instruct the home recorder to record automatically our own selection of programmes or any programmes bearing a specified teletext code, to be stored ready for viewing, as convenient.

Thus the recorder could play back to us over breakfast our own telenewspaper with a make-up previously decided by ourselves, such as only news items concerned with football or the international price of tin, or the Middle East situation. Our transmitters and studios could run all night churning out recorded, labelled, programmes mixed with live news reports, while our domestic recorder compiled our own minority-taste programmes. Of course, one of the ORACLE Teletext pages will be providing captions to the programmes for the benefit of the hard of hearing.

I am saying that we could now take broadcasting out of real time, with a more convenient service to everyone, better utilisation of our capital investment in transmitters and receivers, and a better service to minority viewers and listeners. It seems to me that our development engineers may do more to save the Welsh language by keeping our transmitters on-air throughout the night, than do those who put them off-air in the evening.

WANTED

What of things which we may not have in the 1980s? At the moment I see no signs of a large, bright, practical, flat semi-conductor colour television display screen. We are waiting for the unpredictable breakthrough in material technology, which I expect to come in the middle of the next decade.

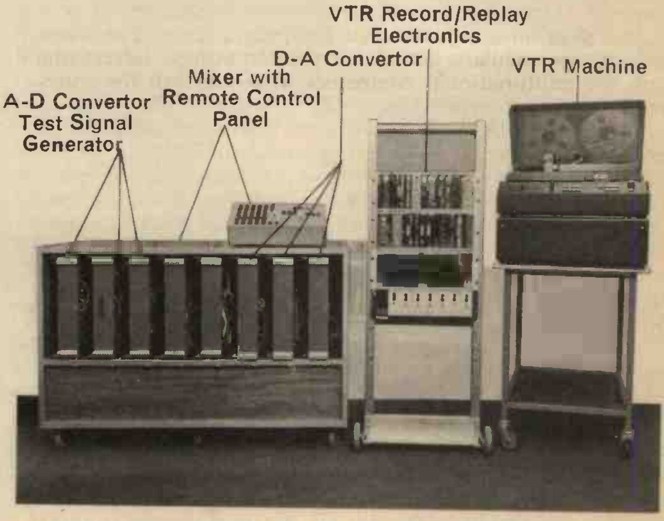
I see no indication that anyone is anxious to have 3-D television, although it is practicable with small screens if the viewer will wear polaroid spectacles, while the more dreamy-eyed physicists can visualise moving colour pictures in depth using holography.

An improved light valve, and practical methods of scanning laster beams, are still awaited; but perhaps the race for a better television display will be won by a fast-acting colour liquid-crystal display. Very fast, but dim, light modulators are already in use as sending-transducers in fibre-optic communication channels.

The cheapness of such glass telecommunication cables will make it economical to provide a wideband communication channel into every home, perhaps with a two-way interactive connection back to the local exchange. But I see no effective use of such a system until we have small, very high-density, electronic memories with multiple simultaneous access, so that central television programme libraries become practicable. Considerable research is in progress into such memories, for both defence and the computer industry, but I do not see it happening until the 1990s. When it does, we may need to redefine the terms "wireless" and "broadcasting".

RADIORACLE

Our radio transmissions will carry additional pulses to indicate on the receiver tuning display the name and frequency of the station we are tuned to—further pulses will be relayed from the radio to our visual display unit—sorry, part-time television set—to give us sleeve notes on the music being played, or the developing synopsis of the radio drama for the benefit of those listeners who missed the beginning of the story; that is to say, a form of RADIORACLE.



Experimental digital video recording systems developed by the IBA

I expect to see further development of our medium-wave radio. It is possible to extend the top note response of medium-wave radio reception in an artificial but adequate manner, and it is also possible to transmit stereo on medium-wave.

It will be possible to provide out-of-city radio to motorists from a broadcasting radio satellite, but further advances in receiver aerial design are needed and will take a few years to develop. However, this could be the cheapest way of providing multi-channel radio services designed for motorists.

SMALL IS DEMOCRATIC

The television technical developments which I am forecasting carry with them their specific logic for their own exploitation, and I see two quite different forms of television service emerging.

Firstly, any local community will be able to produce its own television news and local affairs programmes, and intersperse them with old films or even dramas shot in the neighbouring National Trust Property. The small light-weight equipment, backed-up by magic black-boxes of electronics which remove all the picture defects of the tiny cameras and recorders, will be combined with cassette video recorders and video disc players to give us community television, using transmission frequencies in, or just above, our current u.h.f. bands.

Such community-television studios will be modelled on our successful Independent Local Radio stations, for it will be technically feasible to operate a television company with not much more equipment than one of our present-day ILR stations. The IBA Quality Control engineer will call to carry out regular tests on the magic black-box picture processor to ensure that the station output meets our engineering Code of Practice. The sales staff will carry ENG equipment in their cars, and between calls on advertisers will cover the local action, such as it may be. Small, in television, will be beautiful, local, democratic and very profitable.

EUROPEAN PROGRAMME COMPLEX

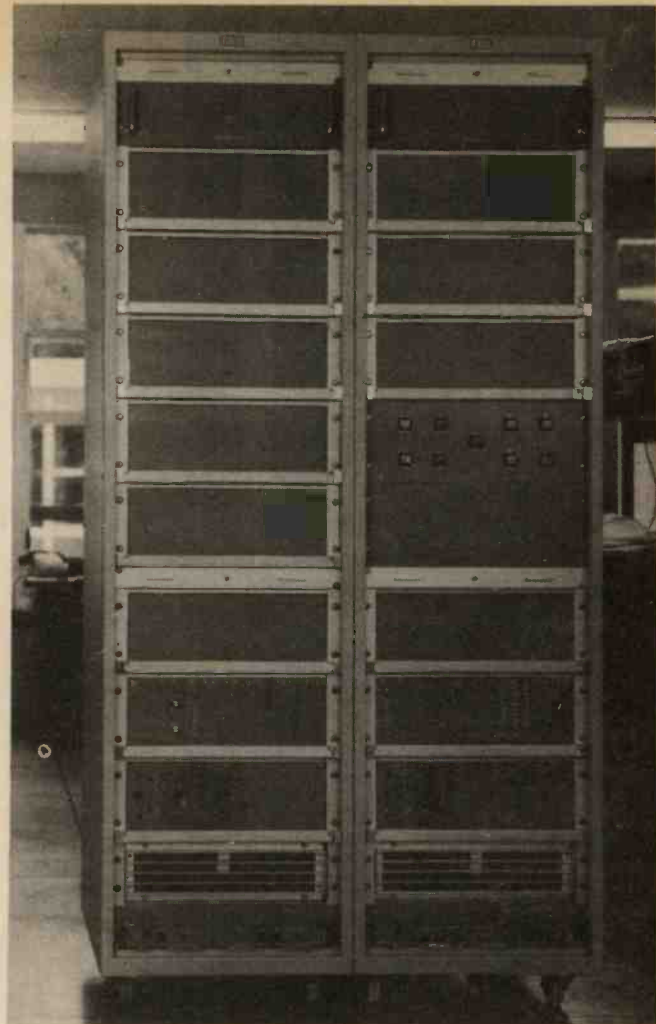
The second option which I see unfolding before us is very different, but is also based on the inexorable logic of the new technologies. A geostationary broadcasting satellite, positioned over Uganda with a reasonable northward-facing aerial, can see at least half-a-billion viewers. This size of ad-mass is worthy of a moment's thoughtful contemplation. Half a billion. There is no technical difficulty in associating numerous sound channels with each of the vision programmes, and each sound channel can be in a different language.

The size of such an audience warrants spending prodigious sums on international spectaculars, which I expect to see produced in a massive computer-run television complex equipped with every technical refinement, including security against electronic hi-jacking of the programmes. The international spectaculars would carry international advertising from the multi-national companies. It would call for entrepreneurs of stature, but then we have them in ITV.

Although I have only strayed into the middle of the next decade in my forecasting, I am already into a "Gee Whiz" situation, and I have ignored the two or three unpredictable breakthroughs in basic science and materials engineering which we can reasonably and statistically expect in this period. One could assert that there will be nothing remarkable in the 1980s, because almost anything we wish to do with our technology will be feasible. We shall have lost our ability to impress ourselves.

1984

But one of the things we may have to do by 1984 is to replan our then obsolete v.h.f. 405-line monochrome transmissions. I expect that we shall lose the use of these frequencies for television, which will be a pity, for Band III has excellent propagation characteristics for our purposes. Nevertheless, I expect the engineers to put up a case for a new television service in the band using the latest technologies—that is to say, they will propose a type of service which is an advance in engineering terms; for example, better definition, more scanning lines, larger pictures, tone gradation scales tailored to human physiology (and I hope a certain technical flexibility to make television more helpful in teaching the handicapped child with abnormal physiology).



The DICE colour picture standards converter

1989

Our technology has reached a rather exciting stage—a very democratic stage—an open stage. Television research engineers have some powerful technologies at their disposal, and organisational methods which enable them to move fast in meeting a demand. The question is no longer "What is possible?" We have to decide between a bewildering array of possibilities. Almost anything materialistic is now technically plausible. The problem for us is of a distinctly different character from the problem facing Nipkow. And it seems to me that it is not a problem which should be left to engineers.

It is no longer a question of what can the engineers do? It is a case of what will the programme makers of the 1980s want? What will the governments of the 1980s permit? What will the public of the 1980s pay for? Who will tell us? Or is everyone saying with Thurber "Progress is all very well, but it has gone on long enough!"?

My own inclination is to tell the engineers to press on and take their own foolhardy decisions, for I believe with Francis Bacon that truth comes out of error more readily than out of confusion. But at least you should know that engineers are listening for an answer. ★

Semiconductor UPDATE...

FEATURING : ICH 8510/20/30 NE590/591

R. W. Coles

HORSEPOWER DRIVER

The ready availability of pre-packaged analogue circuit blocks (for example the 741 operational amplifier) has made it possible for anyone who can read a data sheet to become a designer in what used to be a difficult and complex field. The new found ability to carry out system level design has done a lot to make our hobby more rewarding, and so any extension of the "building-block" principle into new areas is always welcome.

The trouble is that the system design approach has its limitations. There are always problems turning up which cannot be solved with off-the-shelf integrated circuits, and at this point we can sometimes feel our design knowledge wearing a bit thin!

Consider the problem of building an operational amplifier which can source and sink not the few milliamps of the 741, but let's say a couple of amps to drive a d.c. servo motor. You could of course hang a couple of Darlington transistors on the output of a 741 and perhaps even build in some fancy current limiting circultry to stop the thing exploding when the motor stalls, but this would mean quite a lot of work, even if you knew how!

Well this is one particular problem which need not stump you anymore thanks to Intersil who have brought out a sort of hairy-chested 741 which, in one of its three versions, can deliver 2·7 amps with a 48 volt output swing. Coded **ICH 8510/20/30**, the new circuits are mounted in eight lead TO3 power transistor packages and feature full short circuit protection so that they can be used to drive up to 0·1 horsepower motors as well as solenoids, actuators and what-have-you.

Inside the can is not a single monolithic chip but a standard 741 chip married with a special driver chip on a beryllium oxide substrate to form what is termed a hybrid circuit.

DIGITALLY PROGRAMMABLE P.S.U.

One particular application example in the data sheet attracted my attention; an ICH 8530 was shown connected to a digital to analogue converter (DAC) to provide a precision variable regulated d.c. power supply which could be programmed with an eight bit word over an output voltage range of minus 25 volts to plus 25 volts with a 3 amp output current rating. Using a binary coded decimal type DAC would enable thumbwheel switches to be used to set the output voltage, and with three decades, a 0·1 volt resolution could be achieved (Fig. 1).

If power supplies and motors are not your line, well these versatile building blocks make useful audio power amplifiers too!

CHEAPER PORTS

When you start to get ambitious with your pet microprocessor, you will want to wire it up to all the switches, lamps, and lawn sprinklers which live in the outside world, and that means that you will want ports.

You will no doubt be tempted to use the all-powerful, programmable LSI parallel interface chips such as the Intel 8255A, which offers 24 I/O lines which can be programmed in groups of eight into any of three modes (Input-Output-Bidirectional).

If you need flexibility and relatively few I/O lines, this is the best choice, but if you need lots of inputs and outputs which are defined in advance, the job can be done much cheaper with standard TTL, *if* you know how!

TTL is best when you can justify around 64 input lines and 64 output lines as sixteen eight bit ports, and obviously not all applications need this sort of capability. For the inputs use eight SN74251 three-state-output, eight input, data selectors. Each input to a particular chip will form one line at a particular port address, the eight chips give the eight lines per port needed by most micros, and no additional address decoding will be needed.

Outputs have posed more of a problem until recently, because output information is only available on the bus for a short period, and therefore needs to be latched by the output port itself. Signetics have now introduced an ideal TTL solution to the output problem in the shape of their **NE590** and **NE591** eight bit addressable, latched, peripheral drivers which not only have the correct logical formulation but also the benefit of sturdy Darlington output stages which can sink (NE590) or source (NE591) up to 300 miliamps each.

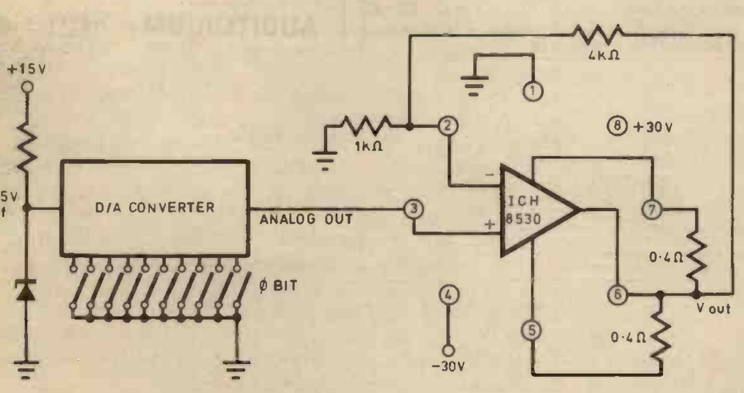
The 590 comes in cheap sixteen pin d.i.l. form, like the SN74251, while the 591 uses an eighteen pin d.i.p. to allow the output stages to operate from a "higher-than V_{cc}" supply.

CHIP CONNECTIONS

To use these chips, connect the three least significant bits of the address bus to the address inputs and use the appropriate control signal to drive CE which latches the data into the ports. As with the input scheme, each chip latches one bit for each port, and again no extra decoders are needed.

To ensure no random states at power on time, these new devices have a built in power-on-clear, and to keep your buses healthy, the inputs are of the low power type.

You should be able to get 64 in and 64 out for less than £15; compare that to the cost of LSI chips!



2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7	Ø Bit	Vout
1	1	1	1	1	1	1	1	1	+25V
1	1	1	1	1	1	1	1	0	-25V
0	1	0	1	1	0	0	1	1	+15V
0	1	0	1	1	0	0	1	0	-15V
1	0	0	0	0	0	0	0	1	+0·098V
1	0	0	0	0	0	0	0	0	-0·098V

Etc.

The power supply can be set to ±0.1V d.c.

Fig. 1. A circuit which provides a precision power supply voltage. The switch program is shown in part on the right

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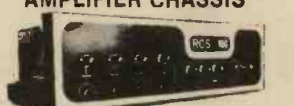

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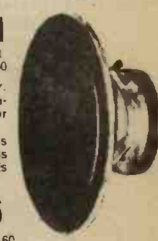

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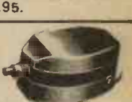

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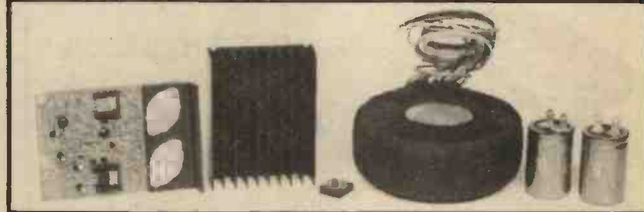

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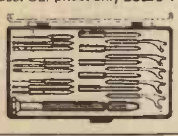

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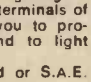

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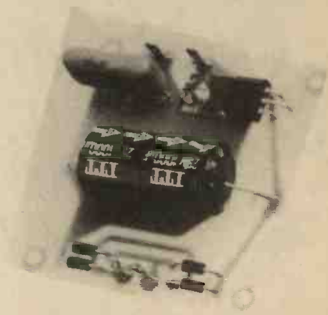

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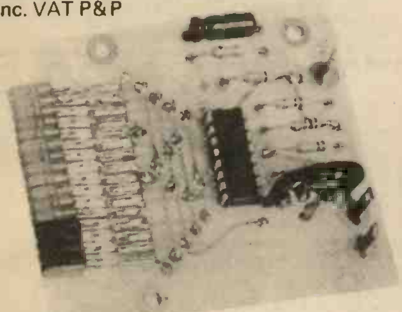

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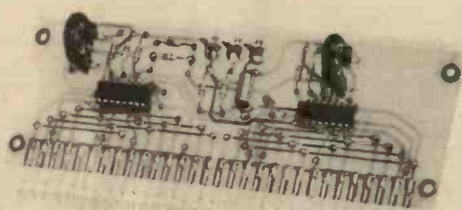

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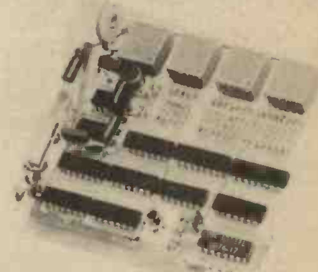

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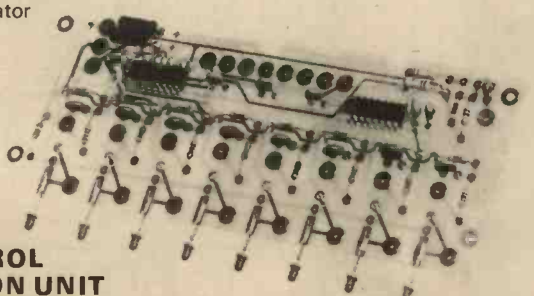

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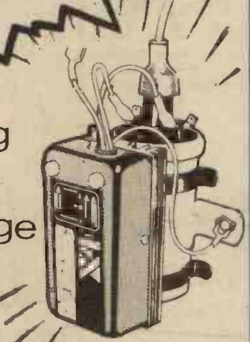

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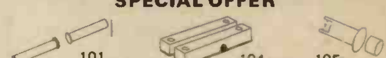

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