

electronics today

APRIL 1978

INTERNATIONAL

45p

200 W AMPLIFIER PROJECT



— FREE TANDY CATALOGUE —

MOST BRITISH SALES ONLY

PET HOME COMPUTER WHITE LINE FOLLOWER CASINGS SURVEY



... NEWS ... PROJECTS ... MICROPROCESSORS ... AUDIO ...

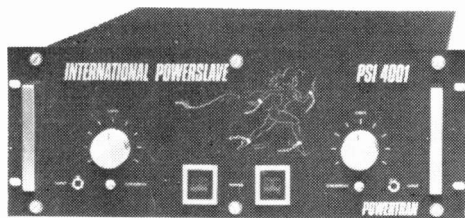
INTERNATIONAL POWERSLAVE 200 watt AMPLIFIER

POWERTRAN

COMPLETE KIT AS FEATURED IN THIS ISSUE OF E.T.I.

Super-Fi performance for studio / monitoring / hi-fi use with the inherent reliability and ruggedness for the most demanding group / disco applications.

- Features
- ★ over 200W rms continuous from each of 2 totally independent DC coupled amplifiers — over 800W peak power
 - ★ highly original fully complementary high linearity o/p stage utilizing the inherent symmetry of no less than 4 differential pairs!
 - ★ ultra low feedback (an incredibly low 14dB overall!) together with super high slewing rate (20 / μ S) banish ricochet effects and TID!
 - ★ distortion only 0.03% at FULL power 1KHz rising to only 0.07% at 10KHz (how many high power amplifier producers dare to quote at this frequency?)
 - ★ independent stabilized power supplies driven by custom designed TOROIDAL transformers
 - ★ inherent reliability — monster heat sinks for cool running at the hottest venues — electronic open and short circuit protection — 4 rugged power transistors/amplifier — each 250W rating
 - ★ professional quality — metal oxide resistors, cermet adjusters, fibre glass boards, sturdy 19" rack mounting cabinet complete with sleeve and feet for free standing work too
 - ★ easy to build — plenty of working space with ready access to all components, minimal wiring, extensive instructions suitable for both experienced constructors and newcomers to electronics — can be purchased one channel at a time
 - ★ value for money — quality and performance comparable with ready-built amplifiers costing over £600!



PSI4001 SLAVE MODEL

OVER 800W
PEAK POWER!



PSI4002 STUDIO MODEL

Pack	Price
1. Fibre glass printed circuit board for power amp	£4.20
2. Set of capacitors, metal oxide resistors, thermistor, cermet pre-sets for power amp	£6.40
3. Set of semiconductors for power amp with mounting hardware, cooling tabs	£27.60
4. Pair of monster black drilled heat sinks, transistor mounting bracket	£6.90
5. Toroidal transformer: Primary 0-117V-234V, Secondaries 42-0-42V, 0-15V, 0-15V, Electrostatic screen	£19.20
6. Set of all parts for stabilised power supply including fibre glass printed circuit board, mounting bracket, semiconductors, resistors, capacitors, etc.	£20.50
7A. Set of all parts for buffer/overdrive unit including fibre glass printed circuit board, semiconductors, resistors, capacitors, controls — required for PSI 4001 only	£3.80
7B. Set of parts for peak power meter including professional quality meter, fibre glass printed circuit board, components, control — required for PSI 4002 only	£11.50
8. Set of all miscellaneous parts including sockets, illum. mains switches, fuse holders, fuses, cut-outs, cable, etc.	£12.10
9. Cabinet including chassis, anodised silver on black panels, fixing parts, etc. Please state whether Slave of Studio model required	£27.50
10. Handbook £0.50 or free on request when ordering any of above packs. 2 each of packs 1-7 (A or B), 1 each 8, 9 and 10 are required for complete 200 + 200W professional amplifier.	
Total cost of individually purchased packs	PSI 4001 £216.80 PSI 4002 £232.20

Transistors used in this kit

2N5401	£0.40
2N5832	£0.40
2N6052	£2.80
2N6059	£2.40
BC182L	£0.10
BC212L	£0.12
BD419	£0.70
BD420	£0.75
BF460	£0.60
BF463	£0.65
BRF41	£0.30
BRF81	£0.30
MJ15003	£3.80
MJ15004	£4.10

SPECIAL OFFER PRICE for

Complete PSI4001 Kit
£205.00 + VAT

Complete PSI4002 Kit
£220.00 + VAT

MANY MORE KITS ALSO AVAILABLE — ASK FOR OUR FREE CATALOGUE

Amplifiers (20-200W), Tuners, Cassette Deck, Quadraphonics, etc., etc.



De Luxe Linsley-Hood 75w Amplifier

20 + 20w AMPLIFIER COMPLETE KIT ONLY

Based on P.W. TEXAN **£33.10 + VAT**

30w VERSION (T30+30) ONLY **£38.40 + VAT**

75 + 75w AMPLIFIER
COMPLETE KIT ONLY **£99.30 + VAT**

T20 + 20 AMPLIFIER



PRICE STABILITY: Order with confidence! Irrespective of any price changes we will honour all prices in this advertisement until May 30th, 1978 if ETI April, 1978 issue is mentioned with your order. Errors and VAT rate changes excluded.

U.K. ORDERS: Subject to 12½% surcharge for VAT (i.e. add ½ to the price). No charge is made for carriage, or at current rate if changed.

SECURICOR DELIVERY: For this optional service (U.K. mainland only), add £2.50 (VAT inclusive) per kit.

SALES COUNTER: If you prefer to collect your kit from the factory, call at Sales Counter (at rear of factory) Open 9 a.m. - 4.30 p.m. Monday - Thursday.

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

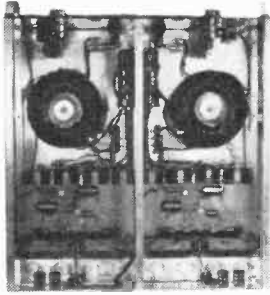
POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM

ANDOVER
(STD 0264) 64455

electronics today

APRIL 1978 VOL 7 NO 4 INTERNATIONAL



Powerful stuff P.43

FEATURES

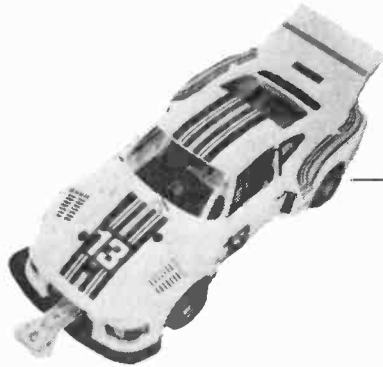
COMMODORE PET COMPUTER	13	How house-trained?
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Not a drop P.62

OFFERS

CBM 5R39	20	Count on this
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INTERNATIONAL EDITIONS

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GERMANY	Udo Wittig Editor



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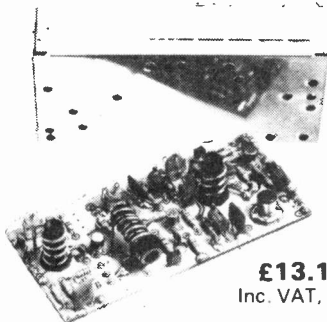
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THE MOST COMPREHENSIVE RANGE OF TUNER MODULES EVER DISPLAYED

HF 7948 FRONT END



£13.12
Inc. VAT, P&P

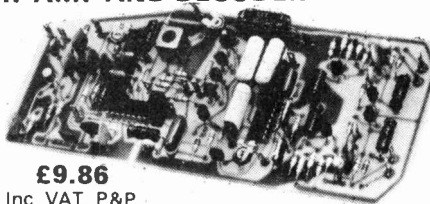
TECHNICAL CHARACTERISTICS:

Output terminal for digital frequency meter;
Antenna impedance - 75 to 300 Ohms;
Frequency ranges 87.5 to 104 MHz or to 108 MHz; Sensitivity - 0.9 μ V 26dB signal to noise ratio \pm 75 kHz deviation; Intermodulation 80dB Image rejection - 60dB; Tuning voltage - 1V to 11V; Total gain - 33dB; Intermediate frequency - 10.7 MHz; Power supply voltage +15V; Power consumption 15mA; Dimensions 104 x 50 mm.

TECHNOLOGY:

Double sided epoxy printed circuit board with plated through holes; Dual gate effect transistors; Silvered coils.

FI 2846 IF AMP AND DECODER



£9.86
Inc. VAT, P&P

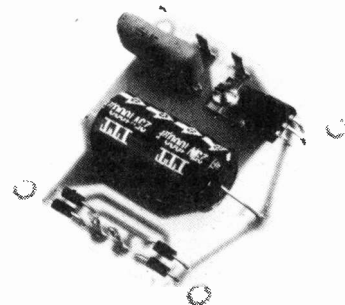
TECHNICAL CHARACTERISTICS:

Intermediate frequency - 10.7MHz; IF Bandwidth - 280kHz; Signal to noise ratio 70dB with 1mV input; Distortion - mono 0.1%, stereo 0.3%; Sensitivity - 30 μ V up to the 3dB limit; Channel separation - 40dB at 1kHz; Pass band - 20 to 15,000Hz; Rejection at 38 kHz greater than 55dB; Am rejection - 45dB; De-emphasis - 50 to 75 μ s. Pilot capture at 19kHz +4%; Channel matching within less than 0.3dB; Output impedance - 100 Ohms; Output voltage - 500mV; Phase locked loop stereo decoder; Output for LED VU-meter; Null indicator; Outputs for AGC AFC and inter-station muting; Consumption - 55mA LEDs extinguished, 100mA LEDs illuminated; Power supply - 15V; Dimensions 195 x 76mm.

CIRCUIT TECHNOLOGY:

Epoxy printed circuit board; Monolithic integrated circuits, ceramic filter.

ALS 1500 STABILISED POWER SUPPLY



£2.53
Inc. VAT, P&P

TECHNICAL CHARACTERISTICS:

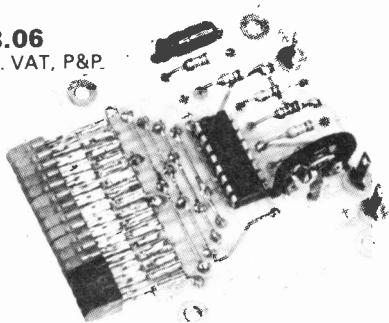
Output voltage - 15V; Max. output current - 500mA; Thermal coefficient less than 1mV/ $^{\circ}$ C; 15V power supply for modules HF 7948 and FI 2846; Supply protected against short circuit (power and current protection); Dimensions - 65 x 55mm.

TECHNOLOGY:

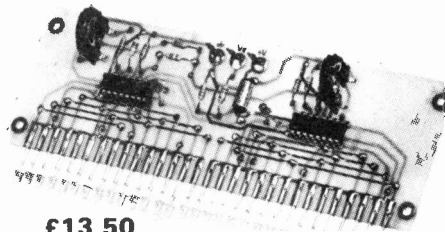
Double sided epoxy circuit board; Monolithic integrated circuit.

OPTOELECTRONIC OPTIONS

£8.06
Inc. VAT, P&P

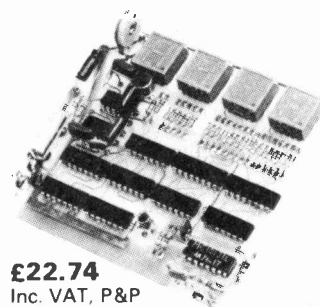


LED VU-METER
Station strength indicator



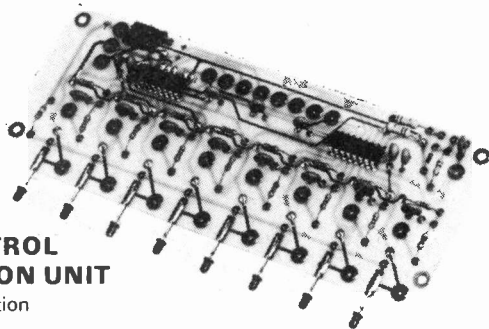
£13.50
Inc. VAT, P&P

ILLUMINATED POINTER
Station finder



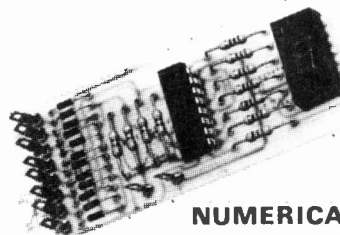
£22.74
Inc. VAT, P&P

FREQUENCY METER
Digital display of received station frequency



£8.77
Inc. VAT, P&P

**TOUCH CONTROL
PRE-SELECTION UNIT**
LED channel indication



£4.35
Inc. VAT, P&P

NUMERICAL DISPLAY
Pre-selected channel number

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NEW SEASON'S COMPONENTS

BRIDGE RECTIFIERS

SILICON 1 amp	Order No.	Price
Type	BR1/50	£0.20
50V RMS	BR1/100	£0.22
100V RMS	BR1/200	£0.25
200V RMS	BR1/400	£0.36
400V RMS		
SILICON 2 amp	Order No.	Price
Type	BR2/50	£0.45
50V RMS	BR2/100	£0.48
100V RMS	BR2/200	£0.52
200V RMS	BR2/400	£0.58
400V RMS	BR2/1000	£0.68
1000V RMS		

BOOKS BY BABANI

Purchase books to the value of £5.00 from the list below and choose any 60p pak from this page FREE.

BP2	Handbook of Radio, TV & Industrial & Transmitting Tube & Valve Equivalents	60p†
	Handbook of Tested Transistor Circuits	40p†
BP3	Engineers and Machinists Reference Tables	40p†
BP6	Radio & Electronic Colour Codes and Data Chart	
BP7		15p†
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BP24	52 Projects Using IC741 (or equivalents)	75p†
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BP32	How to Build Your Own Metal & Treasure Locators	85p†
BP34	Practical Repair & Renovation of Colour TVs	95p†
BP35	Handbook of IC Audio Pre-amplifier & Power Amplifier Construction	95p†
BP36	50 Circuits Using Germanium, Silicon & Zener Diodes	75p†
BP37	50 Projects Using Relays, SCR's and TRIACS	1.10†
BP39	50 (FET) Field Effect Transistor Projects	1.25†
129	Universal Gram-motor Speed Indicator	8p†
160	Coil Design and Construction Manual	75p†
161	Radio, TV and Electronics Data Book	60p†
196	AF-RF Reactance -- Frequency Chart for Constructors	
202	Handbook of Integrated Circuits (ICs) Equivalents and Substitutes	75p†
205	First Book of Hi-Fi Loudspeaker Enclosures	75p†
213	Electronic Circuits for Model Railways	85p†
214	Audio Enthusiasts Handbook	85p†
216	Electronic Gadgets and Games	85p†
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219	Solid State Novelty Projects	85p†
220	Build Your Own Solid State Hi-Fi and Audio Accessories	85p†
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223	50 Projects Using IC CA3130	95p†
224	50 CMOS IC Projects	95p†
225	A Practical Introduction to Digital IC's	95p†
226	How to Build Advanced Short Wave Receivers	1.20†
RCC	Resistor Colour Code Disc Calculator	10p†

BOOKS BY NEWNES

No. 229	Beginners Guide to Electronics	Price £2.25†
No. 230	Beginners Guide to Television	Price £2.25†
No. 231	Beginners Guide to Transistors	Price £2.25†
No. 233	Beginners Guide to Radio	Price £2.75†
No. 234	Beginners Guide to Colour Television	Price £2.25†
No. 235	Electronic Diagrams	Price £1.80†
No. 236	Electronic Components	Price £1.08†
No. 237	Printed Circuit Assembly	Price £1.08†
No. 238	Transistor Pocket Book	Price £3.90†
No. 225	110 Thyristor Projects Using SCRs & Triacs	Price £2.50†
No. 227	110 COS/MOS Digital IC Projects For the Home Constructor	Price £2.25†
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No. 242	Electronics Pocket Book	Price £3.75†
No. 239	30 Photoelectric Circuits & Systems	Price £1.80†

CASES

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

No.	Length	Width	Height	Price
159	5 1/4in	2 1/4in	1 1/2in	62p†
160	4in	4in	1 1/2in	62p†
161	4in	2 1/4in	1 1/2in	62p†
162	5 1/4in	4in	1 1/2in	74p†
163	4in	2 1/2in	2in	64p†
164	3in	2in	1in	44p†
165	7in	5in	2 1/2in	£1.04†
166	8in	6in	3in	£1.32†
167	6in	4in	2in	86p†

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

No.	Length	Width	Height	Price
155	8in	5 1/4in	2in	£1.40†
156	11in	6in	3in	£1.80†
157	6in	4 1/4in	1 3/4in	£1.25†
158	6in	5 1/4in	2 1/2in	£1.60†

SPECIAL OFFER!

AGFA CASSETTES

STEREOCROM

307 C60 RRP £2.03	Our price £1.60
308 C90 RRP £2.54	Our price £1.80
309 C120 RRP £3.49	Our price £2.60

SFD - Super Ferro Dynamic

310 C60 RRP £1.48	Our price £1.00
311 C90 RRP £1.89	Our price £1.50
312 C120 RRP £2.62	Our price £2.00

DIODES SIL G.P.

300mW 40 PIV (min) SUB-MIN FULLY TESTED

Ideal for Organ builders

30 for 50p, 100 for £1.50, 500 for £5, 1,000 for £9

INTEGRATED CIRCUITS

CMOS

Type	Price	Type	Price	Type	Price
CD4000	£0.15	CD4022	£0.90	CD4046	£1.30
CD4001	£0.18	CD4023	£0.20	CD4047	£1.10
CD4002	£0.18	CD4024	£0.80	CD4049	£0.55
CD4006	£0.98	CD4025	£0.20	CD4050	£0.55
CD4007	£0.18	CD4026	£1.70	CD4054	£1.10
CD4008	£0.98	CD4027	£0.60	CD4055	£1.40
CD4009	£0.58	CD4028	£0.98	CD4056	£1.35
CD4010	£0.58	CD4029	£1.15	CD4069	£0.40
CD4011	£0.20	CD4030	£0.55	CD4070	£0.40
CD4012	£0.20	CD4031	£2.20	CD4071	£0.23
CD4013	£0.52	CD4035	£1.30	CD4072	£0.23
CD4015	£0.98	CD4037	£0.90	CD4081	£0.20
CD4016	£0.50	CD4040	£0.95	CD4082	£0.23
CD4017	£0.98	CD4041	£0.82	CD4510	£1.30
CD4018	£1.00	CD4042	£0.82	CD4511	£1.60
CD4019	£0.55	CD4043	£0.98	CD4516	£1.40
CD4020	£1.10	CD4044	£0.94	CD4518	£1.25
CD4021	£0.98	CD4045	£1.40	CD4520	£1.25

LINEAR

Type	Price	Type	Price	Type	Price
CA3011	£1.05†	LM381	£1.85†	UA710C	£0.40†
CA3014	£1.70†	LM3900N	£0.65†	72710	£0.30†
CA3018	£0.75†	MC1303L	£1.48†	UA711C	£0.32†
CA3020	£1.70†	MC1304P	£0.95†	72711	£0.32†
CA3028	£1.02†	MC1310P	£0.95†	UA723C	£0.45†
CA3035	£1.70†	MC1312PQ	£1.20†	72723	£0.45†
CA3036	£1.35†			UA741C	£0.24†
CA3024	£1.50†	MC1330P	£1.90†	72741	£0.24†
CA3043	£1.85†	MC1350	£1.20†	741P	£0.20†
CA3046	£0.80†	MC1351P	£1.20†	UA747C	£0.70†
CA3052	£1.60†	MC1352P	£1.40†	72747	£0.79†
CA3054	£1.35†	MC1456B	£1.40†	UA748	£0.35†
CA3075	£1.50†	MC1466L	£4.50†	72748	£0.35†
CA3081	£1.50†	MC1469R	£2.95†	748P	£0.35†
CA3089	£2.10†	MC1496B	£0.98†	SN76013N	£1.75†
CA3090	£4.25†				
CA3123	£1.90†	NE536	£3.50†	SN76023N	£1.75†
CA3130	£0.93†	NE515A	£3.50†		
CA3140	£0.90†	NE540	£1.50†	SN76110	£1.50†
LM301	£0.39†	NE550	£0.95†	SN76115	£1.90†
LM304	£1.80†	NE555	£0.32†	SN76660	£0.75†
LM308	£1.40†	NE556	£0.82†	SL414A	£1.95†
LM309K	£1.50†	NE561	£3.95†	TAA550B	£0.35†
LM320-5v	£1.50†	NE562B	£3.95†	TAA621A	£2.00†
		NE565A	£1.75†	TAA661A	£1.85†
LM320-12v	£1.50†	NE566	£1.50†	TAD100	£1.30†
		NE567	£1.80†	TBA540Q	£2.20†
LM320-15v	£1.50†	UA702C	£0.46†	TBA541B	£2.25†
		72702	£0.46†	TBA500	£0.80†
LM320-24v	£1.50†	UA703A	£0.25†	TBA810S	£1.05†
		UA709C	£0.25†	TBA820	£0.80†
LM380-14v	£1.50†	72709	£0.46†	TBA920Q	£3.40†
		709P	£0.25†	TCA270S	£2.20†

PANEL METERS

4" RANGE			2 1/2" RANGE		
Value	No.	Price	Value	No.	Price
0-50U	1302	£6.70	0-50UA	1307	£5.50
0-100UA	1303	£6.70	0-100UA	1308	£5.50
0-500UA	1304	£6.70	0-500UA	1309	£5.50
0-1MA	1305	£8.40	0-1MA	1310	£5.50
0-50V	1306	£8.40	0-50V	1311	£5.50

MR2P TYPE			MIN. LEVEL METER		
Value	No.	Price	Value	No.	Price
0-50UA	1313	£5.40	Size 23 x 22 x 26mm		
0-1MA	1315	£5.40	Sensitivity 200UA		
			No.		
			1320		£2.80

BALANCE/TUNING			VU METER		
Value	No.	Price	Value	No.	Price
Size 45 x 22 x 34mm			Size 40 x 40 x 29mm		
Sensitivity 100/0/100UA			Sensitivity 130UA		
No.			No.		
1319		£2.00	1321		£2.00

MINIATURE BALANCE/TUNING METER			MINI MULTI-METER		
Value	No.	Price	Value	No.	Price
Size 23 x 22 x 26mm			Size 60 x 24 x 30mm		
Sensitivity 100/0/100MA			Sensitivity 1000 ohms/V		
No.			AC VOLTS 0-10, 50, 250, 1000		
1318		£1.95	DC VOLTS 0-10, 50, 250, 1000		
			DC CURRENT 0-1-100mA		
			Resistance 0-150K ohms		
			No.		
			1322		£7.50

TRANSFORMERS

MINIATURE MAINS Primary 240V			MINIATURE MAINS Primary 240V		
No.	Type	Price	No.	Secondary	Price
2024	MT280 0-6V, 0-6V RMS	£1.50†	2021	6V-0-6V 100mA	90p†
2025	MT150 0-12V, 0-12V RMS	£1.50†	2022	9V-0-9V 100mA	90p†
			2023	12V-0-12V 100mA	95p†

1 AMP MAINS Primary 240V			STANDARD MAINS Primary 240V		
No.	Secondary	Price	No.	Secondary	Price
2026	6V-0-6V 1 amp	£2.50	2027	9V-0-9V 1 amp	£2.00
2027	9V-0-9V 1 amp	£2.00	2028	12V-0-12V 1 amp	£2.60†
2028	12V-0-12V 1 amp	£2.60†	2029	15V-0-15V 1 amp	£2.75†
2029	15V-0-15V 1 amp	£2.75†	2030	30V-0-30V 1 amp	£3.45†
2030	30V-0-30V 1 amp	£3.45†			

G.P. SWITCHING TRANS.		
No.	Rating	Price
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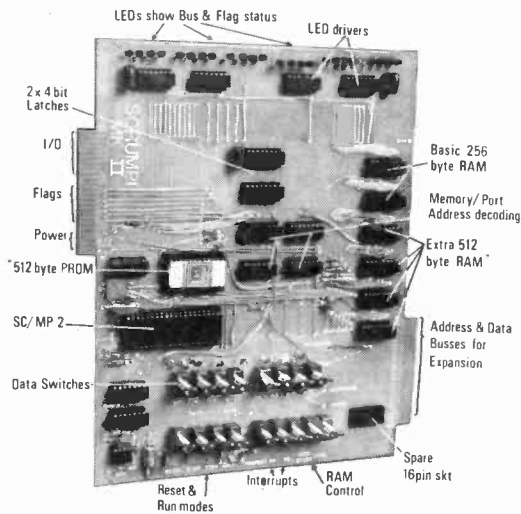
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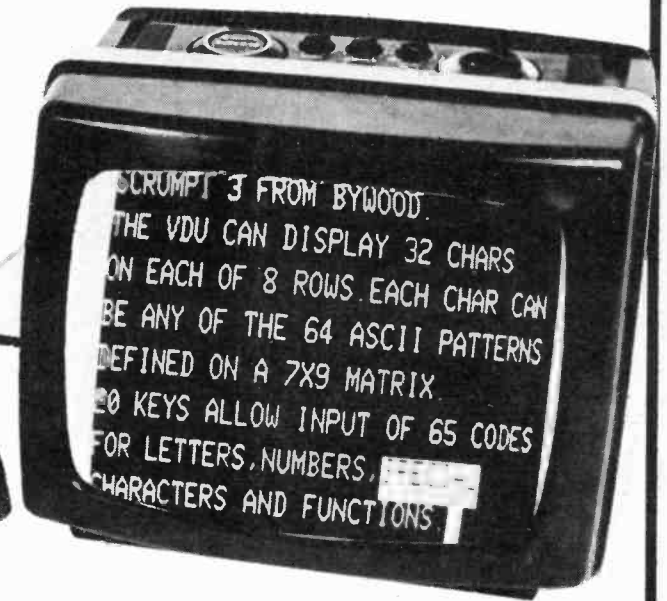
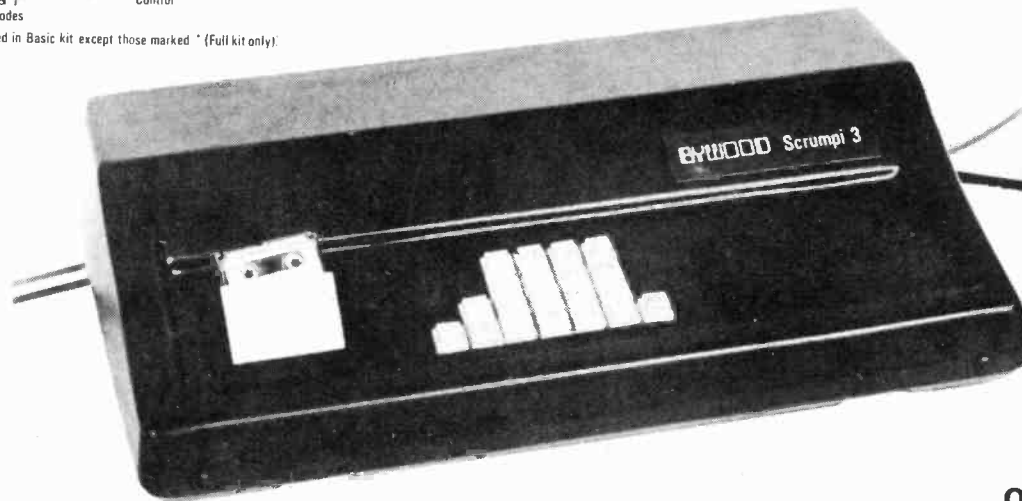
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2+3=?



All component & sockets included in Basic kit except those marked * (Full kit only).

Both SCRUMPI 2 and SCRUMPI 3 are powerful MPU kits in their own rights . . . Together they make one of the most powerful MPU Hardware/Software development systems available. Please write for details of combined kit/upgrade offer.



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SCRUMPI 2B £55.56 + VAT

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SCRUMPI 3 Basic kit **£154.92**, with case & PSU **£189.75**.

BYWOOD

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news digest.

strike me

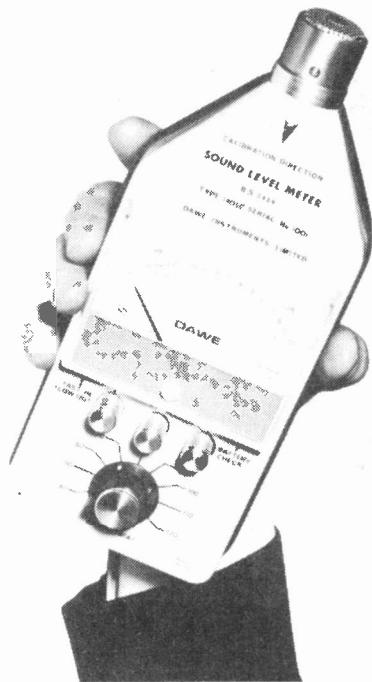
Straight out of Star Wars is a 'Strike Sight' computer from Ferranti.

The further away from the target a tactical aircraft can release a bomb load the greater chance the pilot has of returning safely. In particular, when releasing bombs equal to thousands of tons of TNT, unless the load can be released from an aircraft flying at very high altitudes (most tactical aircraft are not built for this), the only way is to release the load at some distance from the target.

The strike sight computer enables the pilot to do just that. The computer receives signals from and transmits signals to the range and doppler radars, the master reference gyro, and the altimeter. It guides the pilot on the approach to the target. At a specific time from the target the pilot selects whether to release the bomb or to abort the attack and pull out. At a precise interval thereafter, having selected to make the attack, the pull out begins and the computer takes over — the bomb is released automatically.

The only direct decision required by the pilot is whether or not to release the bomb. When he has made the selection the computer computes the release times and the pull-up process is initiated.

level out



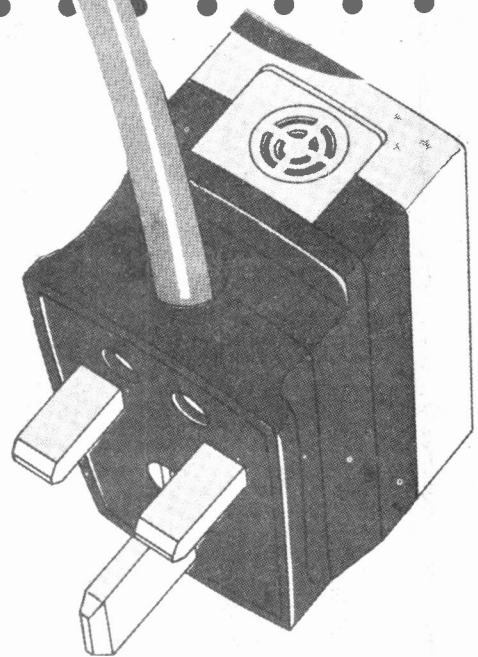
Pictured here is the Dawe Sound Level Meter 1405C. This device has a very wide dynamic range, from 34 to 130dB — from a whisper to well above the loudest shouting. Dawe Instruments Ltd, Concord Road, Western Avenue, London W3 05D.

getting a buzz

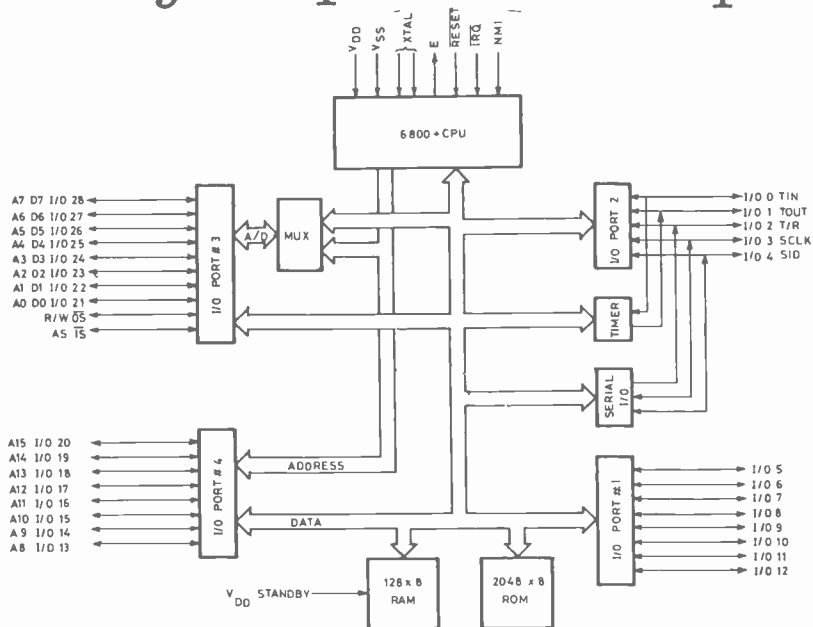
Wired like an ordinary plug and looking not much larger, the BUZZ PLUG may be fitted as a direct replacement for a standard plug.

The slightly thicker top actually contains some newly designed microcircuitry which continuously monitors the mains supply. In the event of a power failure (due to accidental switch-off, power cut, blown fuse) the plug produces a loud instantaneous warning which will persist until some action is taken.

The plug is powered by a single inexpensive battery which will give up to 60 hours warning. Typical applications include use with freezers, fridges, incubators and equipment which must run constantly or would require recalibration. Abbatal is the manufacturer, and further information is available from Ian Jones on Basingstoke (0256) 56417.



all yer mpus in one chip



Motorola, manufacturers of the 6800 MPU has announced the introduction of a new one chip microprocessor in May. The chip, the MC6801 includes 2K-bytes of ROM, 128 bytes of RAM, a 16-bit timer, clock, serial output and 31 input/output lines.

The MC6801 is not a cut-down low end microprocessor but a very large scale integration MPU with an equivalent of 40,000 devices on the chip. The 6801 implements the full 6800 instruction set with the execution time of many key instructions reduced.

right hook

In a historic ruling, the US Supreme Court has confirmed that private individuals have the right to buy or make their own telephone equipment and connect it to the US telephone network.

Under the ruling it will be legal to hook

up as many devices as the user wishes — computer controlled systems, 'phone diverters, memory diallers, picturephones etc, etc. The only restriction is that the various bits must meet the relevant FCC requirements.

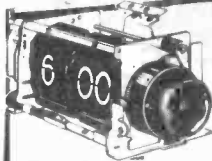
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OSMOR change over reed relay with 12V coil. Approx. 20mA operating current. 59x17x13mm 50p. 10 for £4. 100 for £30.

Small mains transformers with 240V pri. 12V @ 100mA 60x40x42mm 95p. 10 for £7.50. 100 for £85. Valve type 40. 1 Output TX 61x15x42mm 75p. 10 for £6. Output TX EL64 80x53x34mm 95p. 10 for £8.

Clocking oscillator: PYE DYNAMICS thick film 1MHz 5V supply 19x25x6mm 85p. 10 for £7.

FAIRCHILD FND 10 0.15" 7 segment display. Common Cathode 50p. 10 for £4.50. 100 for £30.

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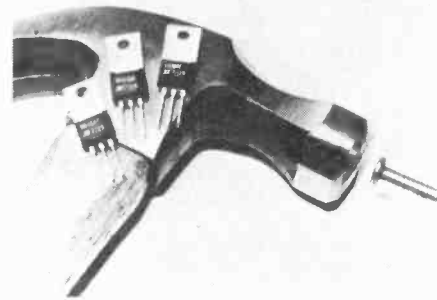
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LONDON W2, 404 6 Edgware Road, Tel: 01-723 1008

news

hammer fet-ish



A new range of low cost VMOS power FETs in plastic have been introduced by Siliconix. These devices are aimed at replacing conventional bipolar transistors in a great many applications. This development in VMOS technology has cut the price of such devices by a third enabling them to compete directly with bipolar devices.

The direct interfacing with most logic families makes VMOS ideal for use in computer peripherals, micro- and mini-computer

systems, process control, etc. In addition to the many existing applications, VMOS should open up many new areas in telephone switching, analogue switching, and unlike conventional FETs or bipolar devices, VMOS transistors are inherently linear and ideally suited to use in linear power amplifiers from audio right through to VHF.

Siliconix Ltd.,
 Llanllienwen Close
 Morriston,
 SWANSEA SA6 6NE

digital dialling

Unilever have recently had a new computer controlled telephone system installed in their Rotterdam headquarters. The system comprises a Philips computer controlled exchange with electronic switching and the latest pushbutton keyphones installed throughout the building. Now each phone has its own 'switchboard' capability and supports many new facilities such as short code dialling, automatic call back and 3-way conversations.

The new system should make telephoning quicker, easier and more effective (in 1976 the phone bill came to over £200,000 — more than £200 per person!).

A similar system will be installed in their London offices in the future.

bbc get it taped

The BBC and 3M have collaborated to develop a new tape recording system claimed to provide 90 dB noise figure. The system will accommodate 32 tracks on one-inch tape at an undisclosed tape speed.

digest...

lcd giving a hand

A Scottish company, Murrell Dynamics, has designed an LCD watch with an analogue-type 'dial'. The main problem which Murrell has overcome is reducing the number of connections required to address the segments which comprise the 'hands'.

The 100 mm diameter prototype (which Murrell claims can readily be reduced to 25 mm) utilises two concentric rings of 60 radial lines — the inner ones are addressed uniquely for the hours indication, the two rings together for minutes, and the outer one for seconds.

hp in the day

Hewlett-Packard have announced red and yellow seven-segment displays which can be viewed in direct sunlight or in ambient lighting as bright as 10,000 foot-candles.

planer sailing

Planer instruments have introduced a new hand-held digital voltmeter using a 3½ digit display with 11mm high digits. The device has an input

sensitivity of 10M and four ranges from 0.1999 volts to 199.9 volts. Price is around £50. Planer Products Ltd, Windmill Road, Sunbury-on-Thames, Middlesex.



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In case you have missed out on ETIPRINTS thus far, they are a complete PCB pattern already to rub down in seconds. The patterns are produced from our original artwork so that the results they produce are nice and sharp.

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- 002 With patterns for the burglar alarm from Jan 78 plus clock board B and the rev monitor from Dec 77.
- 003 With patterns for hammer throw and race track from Jan 78 plus the freezer alarm from Dec 77.
- 004 With patterns for the ultrasonic transmitter-receiver, metronome, 1B metal locator and porch light from Feb. '78 plus 51 w stereo amplifier Mk. 2 from Jan. '77.
- 005 March 77 issue projects, including howlround suppressor, RMS voltmeter, LCD panel meter

Readers please note that in earlier ads the contents of 002 and 003 were reversed. Would you please indicate when ordering from which issue the patterns you require were taken.

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gambling on

By Gerald Chevin
Videocraft Ltd.

WINTER CONSUMER ELECTRONICS
SHOW 5th-8th January 1978

The WCES at its new Las Vegas home, utilised 350 000 square feet and boasted over 550 exhibitors, with products ranging from Television through to Automobile sound. The new East Hall at the Las Vegas Convention Centre housed 350 exhibitors, the remaining 200 occupied the Pavilion Exhibition Hall and Grand Ballroom of the adjacent Las Vegas Hilton.

On the American VCR/VTR front, we have an alignment of manufacturers, opting for either the Sony Betamax or the V.H.S. (video home systems) format.

The sales forecasts estimated for 1977 by RCA is approximately 250 000 Video machines. This gives some indication of the kind of market penetration that the Video revolution is beginning to generate.

A number of Television large screen projectors are also on show, judging by the number of enthusiastic onlookers a very attractive unit the "Network 2000" from Magna-Vision, selling for less than £1,200 and including such features as Digital TV Channel read-out and cordless remote control, could be an indication of a new trend in large screen TV.

New Video games were not introduced at this winter show, but plenty of new programme cartridges, some with strange sounding onomatopiac titles like "Zzz ap," "Scribbling," "Acey-Deucey," "Bingo Math," "Indy 500" and "Draw Poker" to name a few were introduced by Atari, Bally and Coleco. Fairchild have introduced five more Video Carts.

These will interest anybody with a Videoplay TV Game, as the Video Carts, are totally compatible with the European version of the Fairchild game.

Microprocessor orientated games, included the GAMMONMASTER II Backgammon Computer (which is now available in the U.K.). COMPU-CHESS, at £100. A hand held game with six different levels of skill. One and Two are utilised for teaching purposes. Players familiar with the game, use levels three to five, but due to the number of algorithms, at level five, it could take the game nearly seven hours to reply to your move, and at level six, could take nearly two days!! For only £190, "BORIS" is available, whose features include programmable starting position, handicapping, autoqueening, en passant, editing, castling, timer and an eight digit alphanumeric read-out that flashes "congratulations" should you defeat it.

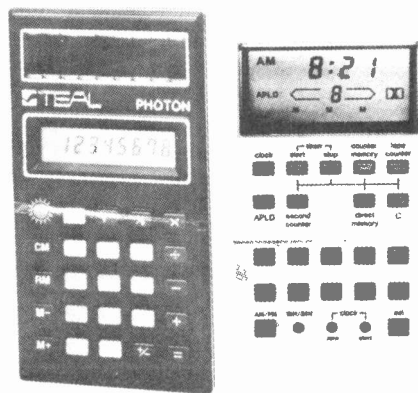
Parker Bros (who brought us Monopoly) are now micro-orientated with their code name sector. Two opponents command destroyers, trying to destroy a computer controlled submarine, which may be at any of the 4800 locations. Digital read-out of speed, depth, headings, and range are included. Collisions may throw the players off course, and if one misses the submarine, it then adopts a secret course.

Apart from most of the now familiar statistical scientific and programmable calculators, calculator alarms and calculator watches, the main interest in this sec-

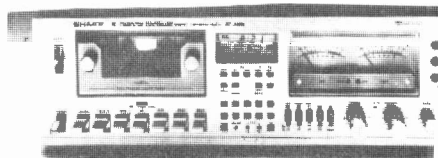
digest...

new development

tion was the photon by teal. It's features do not include an on-off switch, batteries, or a charger unit. It operates on pure Solar power, even under "LLL" low light levels.



Audio-wise, we saw a nice combination between the Micro processor and cassette deck by Sharp/Optonica. Some of it's features include *auto programme locate* which



can skip ahead or backwards, up to 19 songs, and automatically play your choice. *Counter memory* will stop or play at your own number selection on the counter. An LCD display indicates the function in use, or real time, which may also be used to turn the machine on and off. Approximate price £250.

Fisher offer on their model CR 4025 a cordless pause control with accompanying LED indicator on the deck. Price approximately \$250.

Blank tape is also a potential money spinning market. Not just the audio cassette field, but the video boom means a prime market place for both types of video cassette formats. One Company who likes to show its products to the full intermagnetics, emphasise their mechanical qualities by utilising transparent housings.

Radio sets has taken a turn for the better. With improved audio (maybe even soon stereo A.M.!) and arrays of digital read-outs for almost everything. Even "Star Wars" R2 D2 and CP30 are now available as radios.

Finally a brief look at the up and coming Autosound industry, which is expected to top the billion dollar mark in '78.

We now have a 150 watt per channel power amplifier from AUDIOMOBILE INC. A seven channel stereo graphic equaliser from PYRAMID INDUSTRIES coupled with a multitude of goodies like digital read-outs, ultra small, heavy sounding loudspeakers and a claim most manufacturers make that performance levels are comparable to home audio systems.

The best quote from the show by Nolan Bushnell, the Chairman of Atari TV Games; "Only after you've experienced the sheer joy of slaughtering your best friend, will you know the true meaning of fun."



Gaps?



38 555 CIRCUITS



Gaps?

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2N708	0.28	2N3709	0.15	40408	0.75	8C170	0.18	80138	0.38	8F892	0.30	TA621	1.15
2N709	0.50	2N3710	0.16	40409	0.75	8C171	0.16	80139	0.40	8F893	0.34	TA661A	1.50
2N710	0.27	2N3711	0.16	40410	0.75	8C172	0.14	80140	0.40	8F894	1.20	TA661B	1.50
2N718A	0.50	2N3712	1.20	40411	2.85	8C177	0.20	80239	0.40	8F895	0.50	TA670	3.91
2N720A	0.80	2N3713	2.30	40594	0.80	8C178	0.20	80240	0.45	8F896	0.25	TA680A	1.50
2N914	0.35	2N3714	2.45	40595	0.90	8C179	0.23	80241	0.45	8F897	0.32	TA680B	1.50
2N918	0.30	2N3715	2.55	40673	0.75	8C182	0.11	80242	0.50	8F898	1.40	TA690	1.95
2N919	0.38	2N3716	3.00	40126	0.45	8C182L	0.14	80243	0.60	8F899	1.80	TA695	1.60
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2N930	0.26	2N3722	2.00	40128	0.45	8C183L	0.14	80245	0.65	8F901	1.52	TA7400	2.21
2N113L	0.30	2N3773	2.90	40151V	0.40	8C184	0.12	80246	0.66	8F902	1.15	TA7400A	2.30
2N1132	0.37	2N3789	2.80	40152U	0.50	8C184L	0.14	80529	0.45	8F903	1.88	TA7400B	2.30
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2N2102	0.98	2N3794	0.62	8F124	0.65	8C212L	0.17	8F121	0.35	8F907	1.85	TA7400F	2.30
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2N2220	0.35	2N3906	0.22	4F106	0.55	8C237	0.14	8F159	0.35	8F912	0.45	TA7400K	2.30
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2N2221A	0.26	2N4037	0.55	4F124	0.65	8C239	0.15	8F161	0.30	8F914	0.85	TA7400M	2.30
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2N3055	0.70	2N4829C	0.40	8C132	0.30	8C547	0.12	8F245	0.40	8F935	0.55	TA7400AH	2.30
2N3390	0.20	2N4847	0.15	8C135	0.20	8C548	0.12	8F246	0.75	8F936	0.75	TA7400AI	2.30
2N3391	0.20	2N4848	0.15	8C135	0.20	8C549	0.13	8F254	0.24	8F937	0.25	TA7400AJ	2.30
2N3391A	0.20	2N4849	0.19	8C136	0.19	8C530	1.00	8F255	0.24	8F938A	1.10	TA7400AK	2.30
2N3392	0.16	2N4857	0.32	8C137	0.20	8C531	1.00	8F257	0.37	8F939	0.90	TA7400AL	2.30
2N3393	0.15	2N4858	0.33	8C140	0.35	8C532	1.00	8F258	0.45	8F940A	1.20	TA7400AM	2.30
2N3394	0.15	2N4859	0.29	8C141	0.40	8C533	1.00	8F259	0.49	8F941C	2.50	TA7400AN	2.30
2N3439	0.84	2N4864	0.34	8C142	0.30	8C534	1.00	8F259A	0.50	8F942A	2.80	TA7400AO	2.30
2N3440	0.84	2N4866	0.38	8C143	0.30	8C535	1.00	8F261	0.60	8F943A	2.60	TA7400AP	2.30
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2N3702	0.13	2N6123	0.43	8C158	0.14	80115	0.80	8F284	0.35	8F950	0.35	TA7400AW	2.30

INTEGRATED CIRCUITS

CA3020	2.00	LM748-8	0.55	TA521	1.00
CA3020A	2.29	LM748A	0.55	TA522	1.00
CA3028B	1.29	LM1800	1.76	TA550	0.60
CA3028A	1.01	LM1808	1.92	TA560	1.75
CA3030	2.42	LM330	1.00	TA570	2.30
CA3030A	2.00	LM330N	0.85	TA6118	1.85
CA3045	1.40	LM3302N	1.40	TA621	1.15
CA3046	0.89	LM3401	0.70	TA661A	1.50
CA3048	2.23	LM3900	0.75	TA661B	1.50
CA3049	1.80	LM3905	1.60	TA670	3.91
CA3050	2.42	LM3930	1.50	TA680A	1.50
CA3053	1.62	MC1003	1.75	TA680B	1.50
CA3080	0.75	MC1303	1.03	TA690	1.95
CA3080A	1.88	MC1304	1.40	TA695	1.60
CA3086	0.60	MC1305	1.40	TA695A	1.75
CA3088	1.70	MC1310	1.91	TA7400	2.30
CA3090	2.52	MC1327	1.54	TA7400A	2.30
CA3090	4.00	MC1330	1.00	TA7400B	2.30
CA3093	0.98	MC1350	0.90	TA7400C	2.30
LM301A	0.67	MC1351	1.20	TA7400D	2.30
LM301A	0.40	MC1352	1.10	TA7400E	2.30
LM304	2.45	MC1458	0.91	TA7400F	2.30
LM308	0.65	MC555	1.10	TA7400G	2.30
LM308A	1.82	MC555	1.10	TA7400H	2.30
LM308B	0.85	MC565	1.30	TA7400I	2.30
LM308C	1.85	MC565	1.65	TA7400J	2.30
LM317K	3.00	MC567	1.80	TA7400K	2.30
LM318	2.26	SA550	2.50	TA7400L	2.30
LM319	6.48	SA570	2.50	TA7400M	2.30
LM322K	1.40	SA929	1.25	TA7400N	2.30
LM348N	1.50	76001N	3.30	TA7400O	2.30
LM360N	2.75	76003N	2.20		

THE CBM PET ~ IS IT HOUSE TRAINED?

Gary Evans, in conjunction with Graham Wideman and Mark Czerwinski of our Canadian offices, takes a look inside the machine that might do for 1978 what the TV game did for 1977.

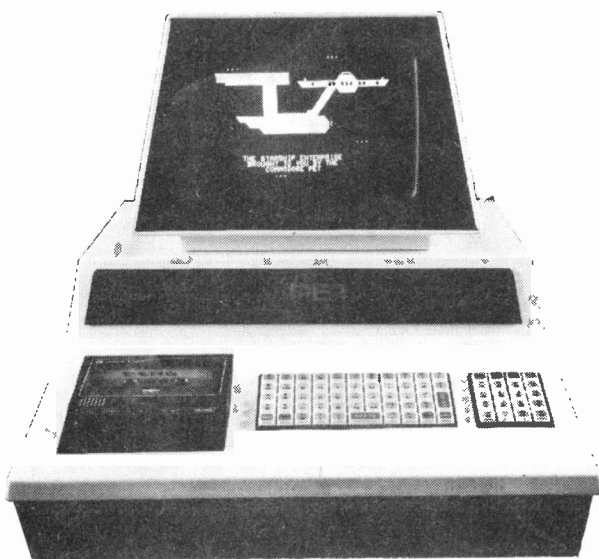


Fig. 1. The version of PET that is as far as we know the version that will be available in the UK.

WE FIRST SAW the Commodore PET as long ago as last April and reported on the fact in the July 1977 Microfile. It's taken until now for the final prototype we saw then to be translated into a production model, investments in production facilities completed and at last we have seen the official UK launch of the long awaited machine.

We have been dying to get our hands on a PET for some time and between our Canadian and British offices have now managed to put in some time on various PETS. Before getting down to a detailed description of the hardware just a few words about what will be available, at what price, when and from whom.

Commodore have set up a new division specifically to market PET and associated products (notably KIM 1 A 6502 development kit). Commodore Systems plan to mount a direct marketing operation to retail PET. They hope to locate suitable London showrooms very shortly.

The model available in Britain will initially be assembled in Germany and will feature 8K or user RAM (the 4K version sold in the States is not to be made available in the UK) and will retail for £695 (inclusive).

At the launch in early February Commodore Systems were quoting delivery times of about thirty days but expected these to lengthen to perhaps sixty days as demand increased. It might be worth mentioning however that the backlog of orders in the states has meant waits of up to one hundred and twenty days. The thirty or even sixty days quoted by Commodore Systems might be a little optimistic until production reaches target levels. ▶

The Machine Itself

The machine shown in Fig. 1. is as close to the final production version as makes no odds.

What you get for your money is what you see (CRT, cassette mechanism, calculator style keyboard) all packaged in a neatly styled case, plus the inards (6502 MPU, 12K or REM containing all that is necessary to operate the hardware plus a fast BASIC interpreter, 8K or RAM plus other assorted bits shown in Fig. 2.)

How did we like it

There is no doubt that this package of micro-pieces is well thought out, and designed with the idea that the user needs to know very little about computers to get "into" the PET. Remember the increased popularity of tape recording when cassettes came out? Make it simpler to use, easier for the human being. Same philosophy at work here, and that is what will sell it. Needless to say in spite of the fact we had very little documentation, we were highly impressed.

First of all there is no wiring up to do. When you plug in and switch on the PET, after only a couple of seconds it's ready for action. No BASIC to load from tape, it's already in there. This is one great headache reliever if the program you've written bombs out and writes all over memory in selected vital (of course) locations. No waiting for a 20 minute BASIC reload. 14K of built-in software is worth ten times its weight in silicon.

So after "power up" you can start programming, (more about that under SOFTWARE) or load from a cassette the software you want. Presumably in the future, tapes for various useful software packages will be widely available, so you will infrequently *need* to write your own, but it's lots of fun so you'll actually want to.

Taped

Upon entering the LOAD instruction, the machine tells you to stick the tape in and press the "PLAY" button. Here's where a compromise has been made. Although the PET can switch the transport motor on and off, it tells you to do the muscle work. Commodore have saved money by using a standard (cheap) cassette recorder, which is sensible for the consumer market they are aiming at.

The cassette feature worked quite well, although a couple of demonstration tapes did not load properly (we suspect over-worn tapes due to heavy use). One feature we would have liked, (which could not have been included without a large extra cost) would be a fast forward search. Without it the machine took a long time to find a program if the tape was started at the beginning and the program happened to be near the end. For this reason it seems most economical (time wise) to only use C30 cassettes (these are thicker and stronger anyway) and then record only one or two programs near the start of each side, unless programs are recorded in some long sequence in which they are to be used, or for storage of little used data etc.

BASIC

Commodore claims that their full floating point BASIC is the fastest yet implemented on a microcomputer. Here are the statements and features included.

Standard Dartmouth BASIC Statements: LET, READ, PRINT, DATA, IF, THEN, FOR, NEXT, DIM, END, GOTO

Extended BASIC Statements: RESTORE, REM, GET, GOSUB, DEF, RETURN, STOP, STEP, INPUT, FN, ON . . . GOTO, ON . . . GOSUB

Scientific Functions: .SGN, INT, ABS, SQR, RND, SIN, COS, TAN, ATN, LOG, EXP, PI

Logical Operators: AND, OR, NOT

Operation Commands: RUN, NEW, CLR, LIST, CONT, FRE

Formatting Functions: TAB, POS, SPC

Machine Level Statements: PEEK, POKE; Allow the user to examine and store at specific memory locations. USR, SYS; Link BASIC to machine language subroutines with parameter passing or developmental subsystems. WAIT; Monitors status of a memory location such as an I/O port until specified bits are set.

String Functions: LEFT\$, RIGHT\$, MID\$; Returns substrings (of specified length and position) of string acted upon. CHR\$, ASC; CHR\$ returns a character, given a numeric code. ASC returns a numeric code corresponding to a character. LEN; Returns the length of a string. VAL, STR\$; Convert decimal values to numeric strings and vice-versa.

Extended I/O Statements: OPEN, CLOSE; Control association of a logical file number to a physical device and, optionally, a file name on the device. SAVE, LOAD, VERIFY; Store and retrieve a program, with optional file name, on a physical device. Load allows for program overlay, VERIFY compares contents of memory to stored program. PRINT#, INPUT#, GET#; Allow communication with logical device numbers other than keyboard or screen. GET# inputs one character. CMD; Permits communication with multiple devices simultaneously.

Variables

TYPES: Real, Integer (%), String (\$)
NAMES: Variable names are uniquely given as a letter or a letter followed by a letter or digit.

Special Variables

TI, TI\$: Time of day. ST: Status word for I/O operations.

Key features

Another cost saver is the keyboard, being of calculator type construction and feel. All our reviewers disliked the feel (no feedback, you have to look at the screen to see your entry). On the other hand these reviewers were all

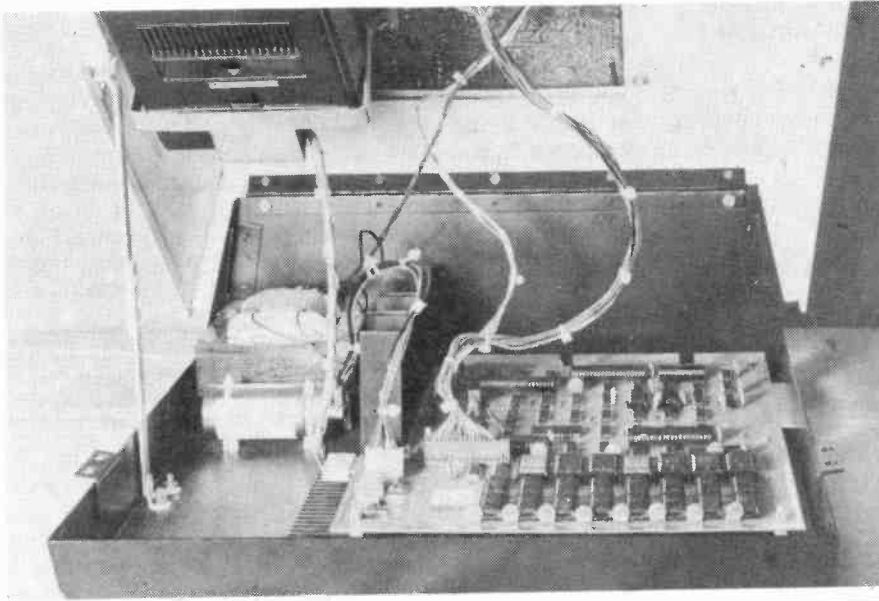


Fig. 2. Our first sight of the insides. It's a real pleasure to open up and discover a "prop" already in place to hold up the top. Notice neat cabling and connecting plugs, making for cheap efficient assembly and service.

Fig. 3. Here we've detached some of the parts from their mountings so we didn't have to draw a block diagram. Video monitor board is above.

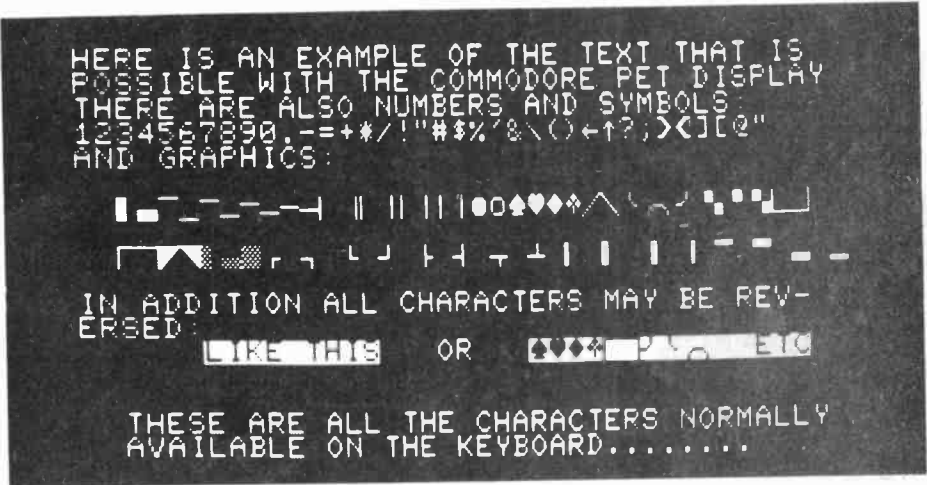
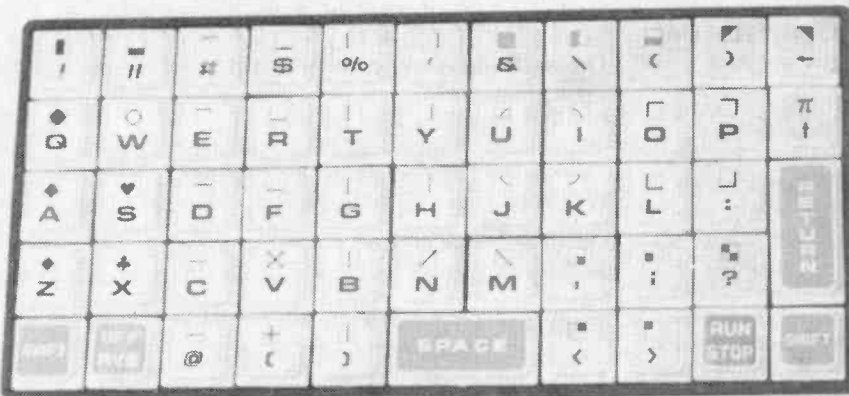


Fig. 4. The two PET keyboards. We found it quite handy to have a separate numeric pad.



unfair.

The keyboard arrangement has all the rows of keys lined up instead of offset as in a normal keyboard, which would appear to be a big disadvantage to experienced typists. However, one is unlikely to enter vast quantities

of text, and this turned out to be less annoying than anticipated.

To solve all these problems, it would be a simple matter to replace the main keyboard with a "proper" one. Since there are electronics inside, it would simply

be a question of configuring the switches the same way. How long will it be until some one comes out with a PET soup-up kit, come on, we've started counting . . .!

The video monitor appears to be quite standard, Fig. 4 is a view in the back. The 9 inch CRT provided is with high resolution for the twenty-five lines of forty characters. A brightness control is located at the rear.

Electronics

For the electronics enthusiasts (well, you're reading this magazine aren't you?) we've got Fig. 2. Most of the important features are shown on this photo, from which a basic idea of the system configuration can be gleaned. All the big chips are plugged into sockets, something nice to see, especially for ROMs. (When's APL coming???)

The keyboard is accessed via a sixteen line Peripheral Interface Adapter (6520 like a 6820 for Motorola fans) which we expect uses eight outputs and eight inputs for decoding sixty-four keys, and then also a couple of the PIA "handshaking" lines for the rest of the work. In other words most of the keyboard decoding is done by software.

The cassette recorder as previously mentioned is a customised standard one, with a new PCB inside full of electronics suitable for data recording. In fact two cassette interfaces are included (second cassette recorder available later) with input, output, and motor on/off lines. This uses six lines of the sixteen on the second 6520 PIA (we assume) leaving ten lines, eight for parallel I/O and two serial, at TTL levels. Both cassettes record at 1 000 baud, but using built in software any program is recorded twice in series for reliability, cutting the effective rate of 500 baud. Thus an 8K program takes about two and a half minutes to load.

In addition, the PET is probably the first popular micro-computer to use the IEEE 488 bus for instrumentation communications, making it compatible with many existing and future digital instruments, printers etc.

A final note of the hardware. Unlike some of the early hobby computer equipment the inside of this machine looks like it's built for business, and for the manufacturer to stay in business. Constructed with quality electronics, and chassis and PCB arrangement for easy assembly and service.

Software

As stated before, one of the beauties of the PET is its built in ROM — full of software. The 14K includes 8K BASIC, 4K Operating System, 1K Machine Language and 1K Diagnostic routine, according to Commodore's literature.

First there's 8K of "extended" BASIC. The correct term is "BASIC interpreter". In simple terms an interpreter is a machine language program which takes your BASIC program as data, "translates" it to machine language subroutines and then executes it. This process actually occurs in a line-by-line translate-execute manner. The term "extended" refers to the fact that many statements are included that are omitted in some versions of BASIC. Using BASIC means that programming can be conducted in a civilized manner, using statements that are almost readable in English, with base ten numbers. The machine does the work of converting to machine language and eight bit binary arithmetic. As

encouragement to skeptics we've included a description of the language and how (easy it is) to use it.

Commodore claim that their BASIC is significantly faster than anybody else's which we cannot attest to, but for general use the PET performed admirably as compared to the reasonably typical IBM 360 and 370 interactive, multi-user systems that the reviewers were familiar with. (But we do like APL 1/2).

The cassette I/O, keyboard, video, and other functions are handled by the 8K operating system. These together with the BASIC are provided in seven 2K x 8 ROMs.

Lacking documentation, we can only guess at the other two ROM items provided. The diagnostic routine we assume verifies the operation of the hardware, and uses a LED mounted on the main board as an indicator for this task.

The 1K machine language we guess refers to an assembly language ("machine language" is what the MPU uses, "assembler" is one step higher, using mnemonics for each instruction, and is generally more readable and useable). There is also a mention of next year's "assembler device", to be plugged into the expansion port for "machine language" (?) programming. The advantage of machine or assembler language programming is increased efficiency of programs over those "interpreted" from BASIC. This could be critical in case of a routine which runs several thousands times in a loop, or for a frequently used function.

Basic Basic (interactive)

One can think of the PET as operating in one of two modes: "calculator mode" in which the operator asks the machine to execute and give the results of one statement; and "programmed mode" in which the programmer enters a series of statements, then has the machine execute the entire set at one go. The second mode requires a little more structure for "administrative" purposes.

Calculator Mode

Known by this name because it is the process of getting a quick answer from a small formula, (similar to calculators), or telling the machine to do one thing.

Example: PRINT 3+4

The machine works out 3+4 and "prints" the result on the screen.

Another example: LOAD FRED

This causes the machine to obtain a program called "FRED" from the cassette, including giving you instructions about what buttons to push on the recorder.

Program mode

Problem: Figure out the sum of the integers zero to ten.

Program: 10 J% = 0
20 FOR 1% = 1 TO 10
30 J% = J% + 1%
40 NEXT
50 PRINT J%
60 END

The numbers down the side are line numbers which can be any integers, and they keep the lines in order. We have chosen multiples of ten as it makes for easy editing at a later date by inserting line numbers in between if necessary. The variables are J% and 1%. The % signs identify them as integers.

Graphics

We suspect some pretty creative, intelligent people sat down and worked out the graphics character set on this machine. Figure 4 shows the keyboard and all the characters you can key in.

The display system is based upon 8x8 dot units, which may contain 5x7 dot upper case letters, or assorted symbols which are so designed to provide very versatile diagram and graphing capabilities. Because the 8x8 blocks fit together both horizontally and vertically, it means that adjacent lines of text look a little crammed together, but this can be avoided by judicious line spacing if necessary.

The "cursor" is a flashing "element" or character that can be moved about the screen, and it normally indicates the next space to be typed in. After typing in that space the cursor moves to the next adjacent spot and so forth. "RETURN" causes the cursor to move to the first position on the next line, just as a carriage return does on a typewriter. Additional cursor control is provided to move it quickly up, down or sideways. The cursor is useful also for editing and correcting programs already written on screen, with the facility for inserting and deleting characters. When the cursor attempts to move below the bottom of the "page", the screen "scrolls up". That is to say each line moves up one, with the top line disappearing.

In addition to the normal characters, each may be "reversed", that is appear as black on white, which can be used to advantage on some occasions.

Finally, here's our big surprise! If you're been counting keyboard characters, there are a lot less than the 256 possible with the character generator used in PET. Quite by accident we found a whole set of lower case letters! Very interesting. We're not quite sure what does it but check the pictures for yourself. That still doesn't add up to 256 characters, so there may be yet more we don't know about. In fact keyboards on early prototypes showed a set of graphic symbols that included assorted Greek letters, could they be inside as well? We don't know, but it all depends on what's in the character generator. We wonder if Commodore has lower case letters planned as a future "add-on option?" For that matter you could always burn your own PROM . . .

Add-ons

Well that's the basic PET Commodore Systems to introduce a number of peripherals specifically designed for PET during this year. These include a 24K memory unit (thought to be dynamic) with its own power supply, a printer and floppy. The fact that PET has the IEE-488 bus and ready access to other data lines means that, with luck, we should see a wide range of add ons at reasonable prices from a wide variety of sources. Many pets (lower case for the furry kind) are bought in an initial burst of enthusiasm but are soon abandoned as some new copy comes along. More recently this fate has befallen many a TV game.

This phenomena is far less likely to apply to a versatile beast like PET but the User's Club Commodore Systems are to set up should go a long way to keeping interest in PET alive well beyond the initial purchase.

The club open to users and, for want of a better phrase, non-users, alike for an annual fee of ten pounds.

The club will produce a newsletter and provide a means of exchanging news, information and software on PET type subjects on an international scale.

Commodore Systems, although themselves running, the club, hope that the driving force will be the many PET users throughout the world.

What more can we say?

It looks like computers are starting their march into the homes of the masses, which sounds very science-fiction and scary to some. We hope that the familiarity with computers this may bring to the man/woman/child in the street will reverse the widespread fear of THE COMPUTER as an enemy. Perhaps man will once again feel master over objects. There was after all a time when the automobile was regarded as an evil fire breathing monster, until everybody got one.

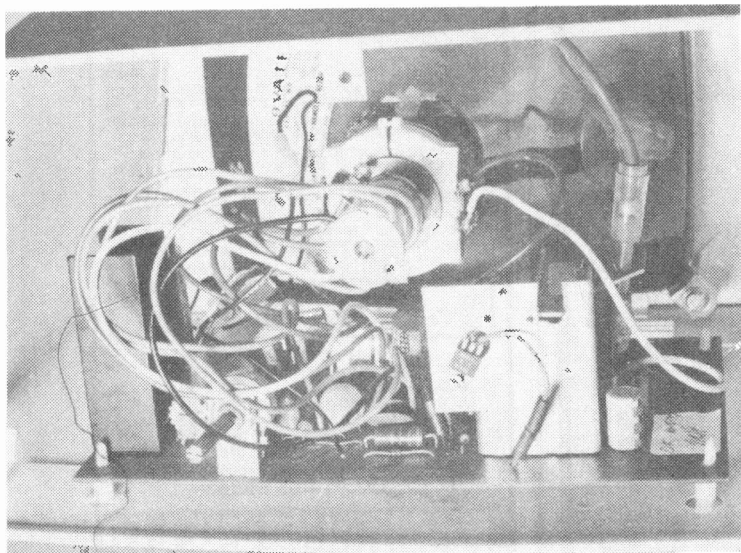


Fig. 5. Peeking in the back of the video monitor (left) reveals a fairly standard set of works.

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....ETI'S REVIEWERS DISCOVERED THAT
BY EXECUTING THE STATEMENT:
POKE 59500,72
you can have lower case letters
INSTEAD of graphics. You can't have
both on screen at once, but can
alternate them in one program.
    
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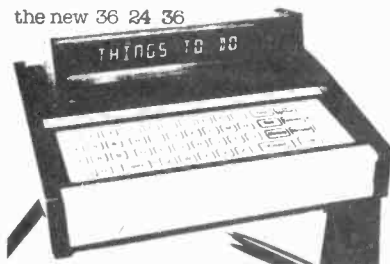
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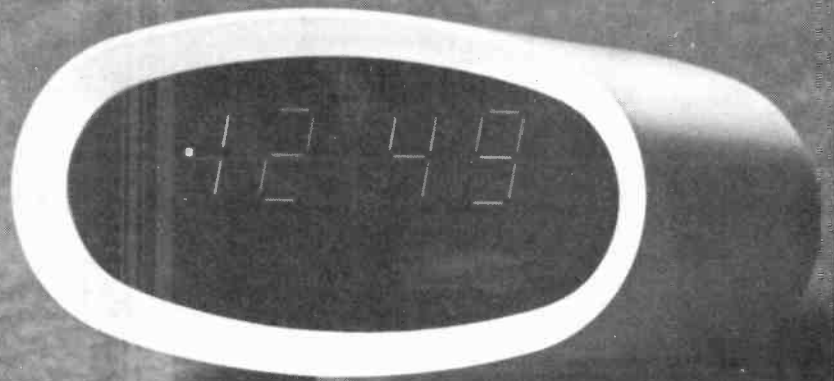
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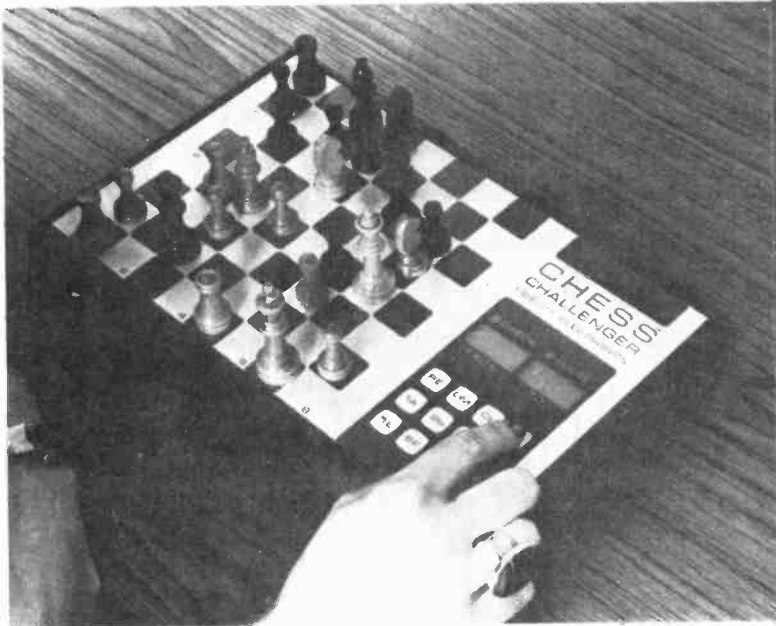
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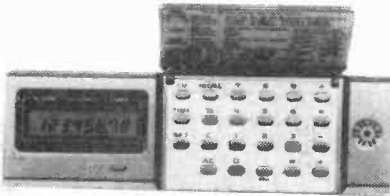
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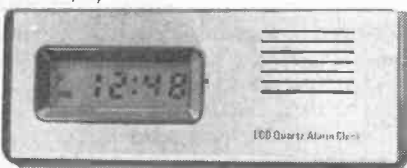
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WHITE LINE FOLLOWER

ETI's Project Team present here a project for either the modeller who wishes to go electronic, or the electronic enthusiast who wants an excuse for crawling around the carpet all weekend . . .



THE IDEA OF A SLOT CAR that doesn't need a slot is not new — in fact, sophisticated systems based on inductive loops have been used in large factories for some years. This project is at the other end of the complexity scale, and uses a simple light / photocell combination to follow a white line. The electronics involved make up a simple feedback control system — as soon as one photocell sees more light than the other, the differential amplifier applies a correcting voltage to the steering servomotor and so the model steers itself back on to the line.

We are not sure whether to class this project as a toy or as a serious experimental project. Certainly, the basic project makes a great toy, but there is tremendous scope for experimenting and 'tuning' the control circuitry. Like all control systems, this one displays a characteristic called 'damping' — if the system is overdamped, the car will steer sluggishly and will have difficulty following anything, except the smoothest curves. If the control circuitry is under-damped, the car

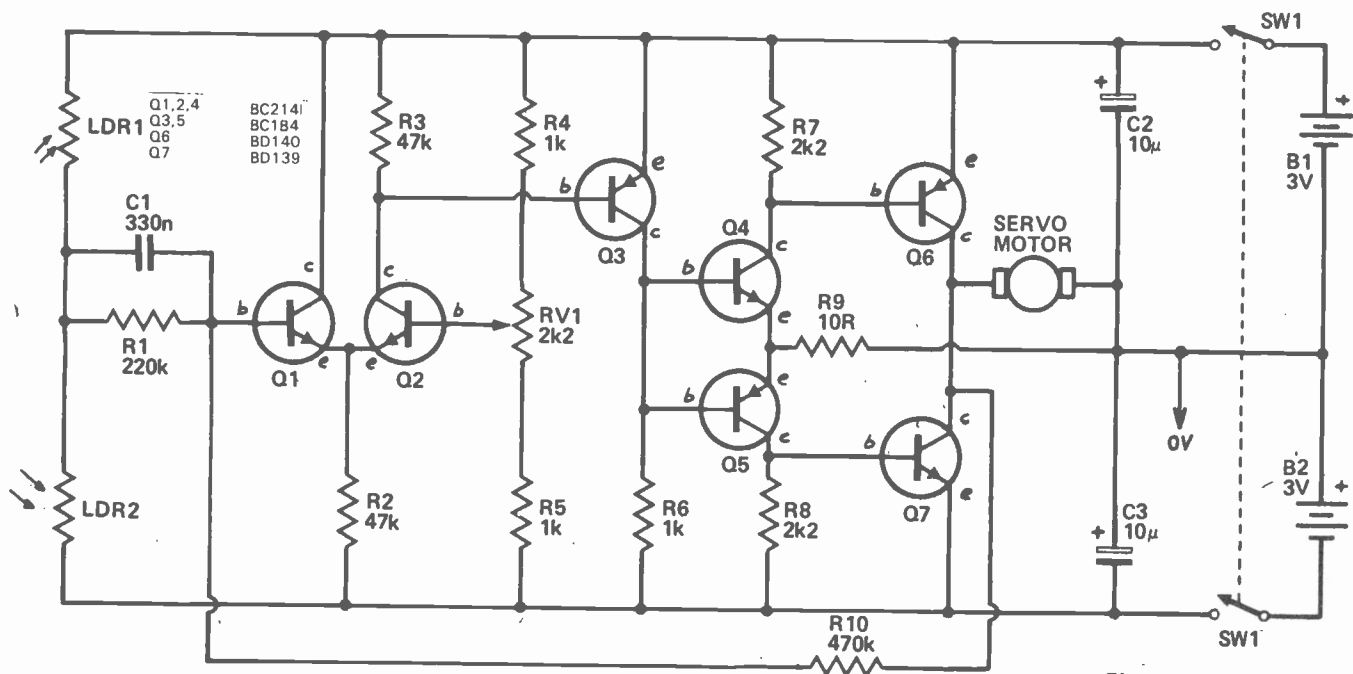


Figure 1. (Above) Circuit diagram of the white line follower unit.

HOW IT WORKS

The sensor used to look for the white line is a pair of light dependent resistors (LDRs) which are aimed at either side of the line so that each sees half white half dark. The line is illuminated by a bulb to ensure that the LDRs have a relatively low resistance. If the car is moved off the centre line one LDR will see more 'white' and its resistance will fall. The two LDRs are connected in series across the supply voltage and so the voltage at the junction will vary as the car moves in relation to the line.

This voltage is compared with that set on RV1 by Q1 and Q2, the error signal driving the servo motor in the correct direction to try to eliminate the error. Negative feedback is provided by R10 to reduce the 'open loop gain', and dynamic feedback is provided by C1 which is used to reduce overshoot.

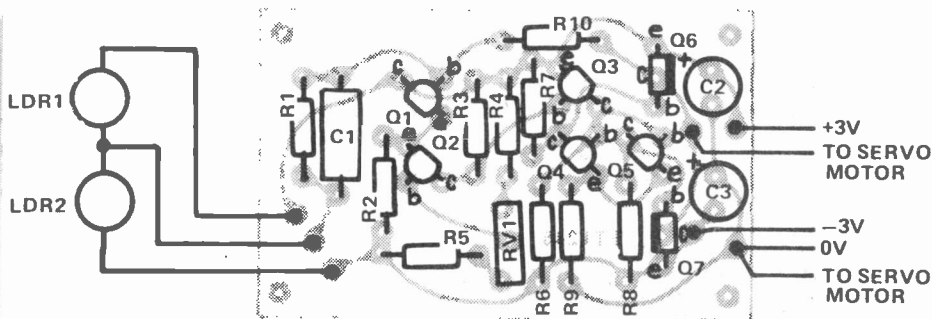


Figure 2. Component overlay. See text for details of mounting the board and servo motors within the model.

will oscillate from side to side on curves — this may also be set-off by small deviations on the straights.

The ideal situation is to have a 'critically damped' system, which has just the right combination of characteristics to respond quickly on curves without oversteering. This can be achieved by theoretical analysis, using techniques like Nyquist's Criterion, but it's more fun to tune by trial and error. The damping is a factor of the photocell spacing, the amplifier gain and the servomotor characteristics.

You can have a lot of fun racing these cars, especially since there is quite a bit of scope for tinkering and tuning them. The layout of your race track should include both smooth and tight curves — you may have problems with figure-8's that cross at anything but right angles. And of course you can time races with your ETI stopwatch!

Construction

The mechanical side of constructing the car we must leave to the individual reader. As we were more

interested in the electronics side of the project we tended to take short cuts as far as the mechanics go. The car we used was a Tamiya Porsche 935 Turbo, a model specifically designed for radio control applications but ideal for our application. No doubt the model enthusiasts amongst you will know of many other models that would prove suitable.

We cheated with the steering mechanism as well by using a commercial servo motor stripped of its electronics to provide control of ▶

PARTS LIST

RESISTORS

R1	220k
R2,3	47k
R4,5,6	1k
R7,8	2k2
R9	10R
R10	470k

LIGHT DEPENDENT RESISTORS

LDR1,2	ORP12
--------	-------

POTENTIOMETER

RV1	2k2 min vert
-----	--------------

CAPACITORS

C1	330 μ Polyester
C2,3	10 μ 10 V Electrolytic

SEMICONDUCTORS

Q1,2,4	BC214
Q3,5	BC184
Q6	BD140
Q7	BD139

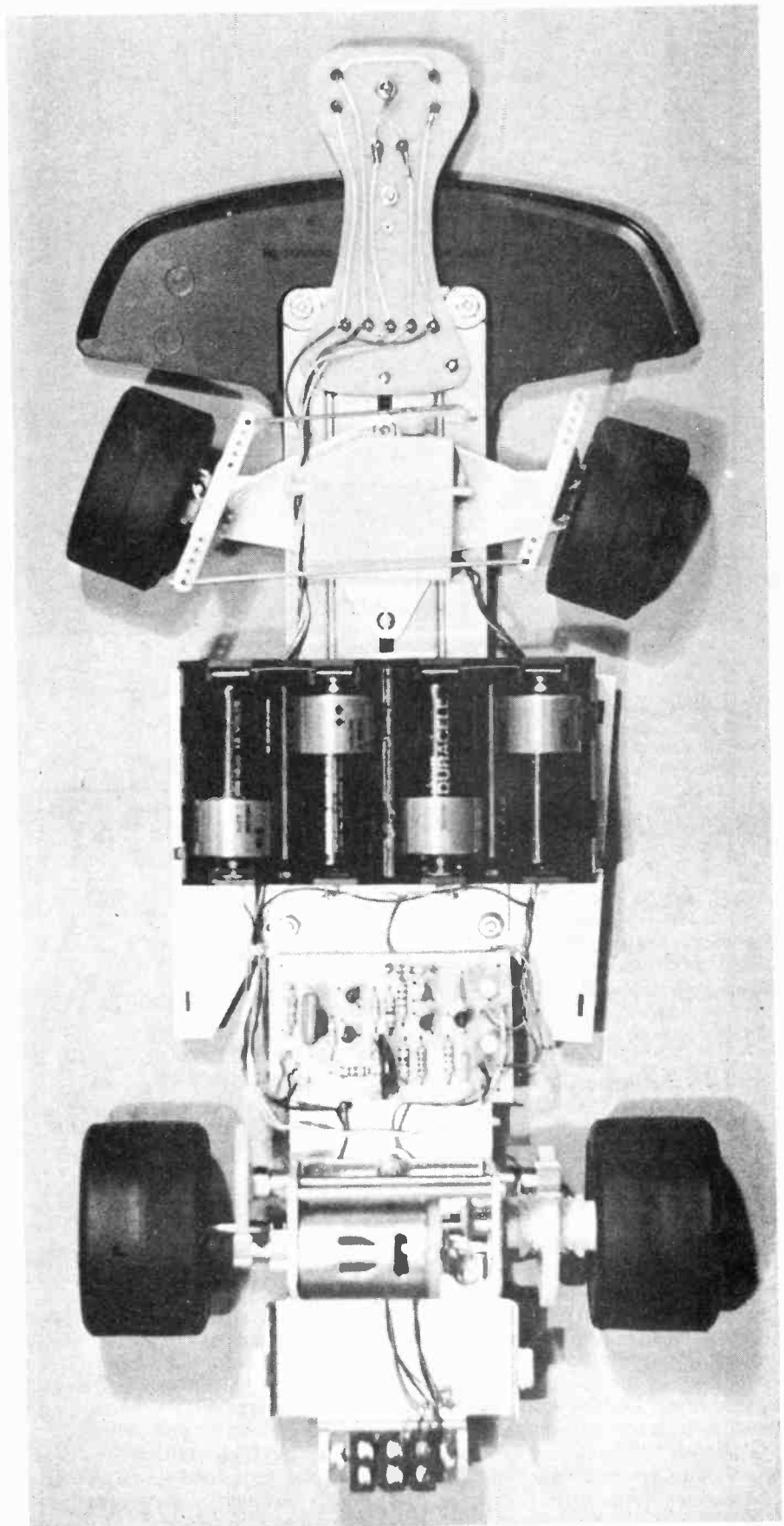
MISCELLANEOUS

PCB as pattern, 3V bulb, 2-pole on/off switch, servo motor and car (see text)

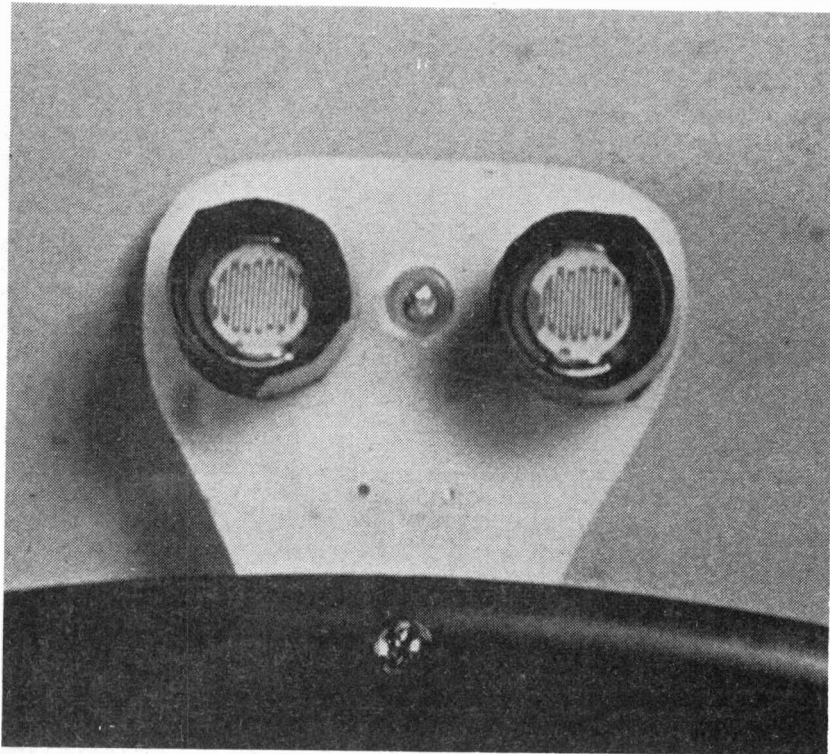
On the right the Porsche with its lid off. The PCB is mounted behind the drive motor, which is sitting between the rear wheels. The servo is sited between the front wheels, and the board upon which we put the LDRs and bulb can be seen on the front of the chassis.

BUYLINES

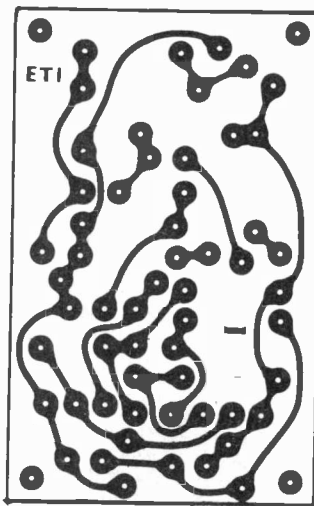
Purchasing the electronic components should prove straightforward. The mechanical parts are, as we say in the main text, a matter for the individual constructor.



PROJECT: Line Follower



Above: the eyes of the animal. The bulb lies right between the LDRs. On the right: the foil pattern for the white line follower circuit, shown full size.



the steering. Again for those with a mechanical bent, a standard model motor (one that will operate reliably on 1.5V) driving the front wheels via suitable links is probably the best bet.

Ideally the sensors should be mounted in front of the wheels and should move with them so that when the wheels turn to the right the sensor does likewise and visa versa (another test of mechanical ingenuity).

The LDRs were housed in short lengths (about 10 mm) of cardboard tube to act as a shield and were spaced about 15mm apart (we used a 12 mm wide line) with the bulb mounted between them.

Electrically the components can be built onto the PC board described which can be mounted somewhere in the car. We used separate batteries for the electronics and ran the bulb off the main batteries, to keep the electronics supply more constant.

Experimenting

Using different motors/gear ratios some changes to the electronics will probably be found necessary. These would mainly involve C1, R1 and R10. Increasing R10 or reducing R1 increases the DC gain, while increasing C1 increases the dynamic damping to reduce overshoot. Track width may also be experimented with as well as LDR spacing.

ETI

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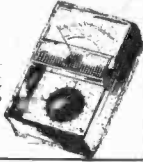


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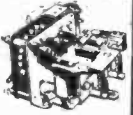
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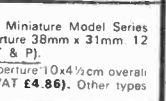
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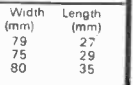
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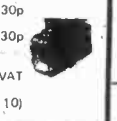
MINIATURE UNISELECTOR

12v 11 way 4 bank (3 non-bridging, 1 homing). **£2.50** P&P 35p (**£3.08** inc. VAT & P).



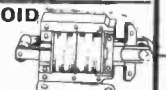
MICRO SWITCHES

As illustrated but fitted with 1" Lever. 10 for **£2.00** P&P 30p (**£2.48** inc. VAT & P).
Sub-miniature Burgess type v 41 1. 10 for **£2.50** P&P 30p (**£3.02** inc. VAT & P).
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Type 3 J15M 906T 10 for **£2.50** post paid (**£2.70** inc. VAT & P).
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NEW HEAVY DUTY SOLENOID

Mfg. by Magnetic Devices 240v AC. Operation approx. 20lb. pull at 1.25". Price **£7.00** P&P 75p (**£8.37** inc. VAT & P).
Similar to above approx. 10lb pull **£3.50** P&P 60p (**£4.43** inc. VAT & P).



230-250 VOLT A.C. SOLENOID

Similar in appearance to illustration. Approximately 1 1/2 lb. pull. Size of feet 1 3/4" x 13/16". Price **£1.00** Post 25p (**£1.35** inc. VAT & P).



24 VOLT D.C. SOLENOIDS

UNIT containing 1 heavy duty solenoid approx. 25 lb. pull at 1 in travel. 2 solenoids of approx. 7 lb. pull at 1/2 in travel. 6 solenoids of approx. 4 oz. pull at 1/2 in travel. Plus 1 24V D.C. 1 heavy duty 1 make relay. Price **£3.00** Post **£1.00** (**£4.32** inc. VAT & P).



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0-12v/24v at 1 amp. **£2.50** p&P 50p (**£3.24** inc. VAT & P)

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0-4v/6v/24v/32v at 12 amp. **£13.00** p&P **£1.50** (**£15.66** inc. VAT & P)

0-12v at 20 amp. or 0-24v at 10 amp. **£12.00** p&P **£1.50** (**£15.01** inc. VAT & P)

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300 V.A. ISOLATING TRANSFORMER

115/230 screened primary, two separate or 115v for 115 or 230v. Secondary two 115v at 150 V.A. each for 115 or 230v output. Can be used in series or parallel connections. Fully transformer. Length 13.5cm. width 11cm. weight 15lbs. Special price **£6.00**, carr. **£1.00** (**£7.56** inc. VAT & P).

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Horizontally opposed twin head diaphragm type producing 20lbs. Plus P.S.I. per head 3.5 plus C.F.M. Output virtually pulse free. Powered by 110v A.C. motor size 30x23x15cm weight 7 kilos. Price **£20** p&P **£2.00** inc. VAT **£23.76**. Suitable transformer for 230/240v a.c. **£8.00** p&P **£1.00** inc. VAT **£9.72**.

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HY-LIGHT STROBE KIT MK. IV

Latest type Xenon white light tube. Solid state timing and triggering circuit. 230/240 volt A.C. operation. Speed adjustable 1-20 f.p.s. Designed for large rooms, halls, etc. Light output greater than many (so called 4 Joule) strobes. Mini 12in. 8 watt **£2.50**, Post 25p. (**£2.97** inc. VAT & P). 9in. 6 watt **£2.00** Post 25p (**£2.43** inc. VAT & P). 6in. 4 watt **£1.75** Post 25p (**£2.16** inc. VAT & P). Complete ballast unit. Either 6", 9" or 12" tube 230V. A.C. op. **£3.50** plus P&P 40p (**£4.21** inc. VAT & P). Also available for 12V. D.C. op. **£3.50** plus P&P 40p (**£4.21** inc. VAT & P).

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4ft. 40 watt **£7.75** (callers only). 2ft. 20 watt **£5.50**, Post 80p. (For use in stan bi-pin fittings). Mini 12in. 8 watt **£2.50**, Post 25p. (**£2.97** inc. VAT & P). 9in. 6 watt **£2.00** Post 25p (**£2.43** inc. VAT & P). 6in. 4 watt **£1.75** Post 25p (**£2.16** inc. VAT & P). Complete ballast unit. Either 6", 9" or 12" tube 230V. A.C. op. **£3.50** plus P&P 40p (**£4.21** inc. VAT & P). Also available for 12V. D.C. op. **£3.50** plus P&P 40p (**£4.21** inc. VAT & P).

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Range of Xenon tubes available from stock. S.A.E. for full details

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Other types available - phone for details.

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230 volts AC 3 digits mfg. Vaeder Root type LL/144L **£1.75** P&P 25p (**£2.16** inc. VAT & P).
7 fig 24v d.c. non set **£1.50** P&P 25p (**£1.89** inc. VAT & P).
6 fig 24v d.c. resettable **£3.00** P&P 25p (**£3.51** inc. VAT & P).



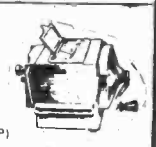
BIG INCH

Tiny precision built 3 rpm USA motor size only 1 x 1 100 volt AC op. supplied with resistor for 230 volt AC price **£2.37** 20p 4 for **£5.40** post paid.



INSULATION TESTERS (NEW)

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1000 VOLTS 1000 megohms **£46.00** Post 80p (**£60.26** inc. VAT & P)
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GEARED MOTORS

100 R.P.M. 115 lbs. ins.!!

115 lb. ins. 110 volt. 50Hz. 2.8 amp. single phase. split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled. In-line gearbox. Length 250mm. Dia. 135mm. Spindle Dia. 15.5mm Length 145mm. Ex-equipment tested **£12.00** Post **£1.50** (**£14.58** inc. VAT & P). Suitable transformer 230/240 volt **£8.00** Post 75p (**£9.45** inc. VAT & P).



BODINE TYPE N.C.I. GEARED MOTOR

(Type 1) 71 r.p.m. torque 10 lb. in. Reversible 1/70th h.p. cycle 38 amp. This U.S.A. motor is offered in with transformer for 230/240v AC. input Price type **£8.25** Post 75p (**£9.75** inc. VAT & P). or less transformer **£3.75** Post 65p (**£4.75** inc. VAT & P). (Type 3) 71 r.p.m. 230 volt A.C. Continuously rated. Non reversible **£8.50** Post 75p (**£9.83** inc. VAT & P).



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30rpm 50lbs. inch 240VAC reversible 0.7 amp sharp length 35mm dia. 10mm. weight 6 kilos 600 grams Price **£15.00** P&P 1.50 (**£17.82**).



PARVALUX GEARED MOTOR

type SD18 24v AC reversible 3u rpm 50lbs inch Price **£15.00** P&P 1.50 **£17.82** inc. VAT



A.E.G. WATER PUMP

200/240v a.c. motor. 2850 rpm. 480w approx. 1/2 hp. driving a centrifugal pump with 1 1/2" inlet and outlet delivering approx. 40 gals per min at 10ft head. Ideal for pumping or circulating any non corrosive light viscosity liquid. Dozens of uses in industrial labs. etc. Note this pump is not self-priming. Price **£15** + 75p P&P (**£17.01** inc. VAT & P).



CITENCO 19 RPM

FHP motor type C 7333/15 220/240v a.c. 19 rpm reversible motor. torque 14.5 kg. Gear ratio 144:1 Brand new incl. capacitor. our price **£14.25** + **£1.25** P&P (**£16.20** inc. VAT & P).



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General Electric 230v A.C. 1.600 r.p.m. 0.25 amp. Complete with anti-vibration mounting bracket and capacitor O/A size 110mm x 95mm Spindle 5/16" dia. 20mm long. Ex-equipment tested. **£3.00** Post 50p (**£3.78** inc. VAT & P).



METERS 90mm Diameter

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200/250V A.C. 2 on/2 off every 24 hrs. at any manually pre-set time. 36 hour spring reserve and day omitting device. Built to highest Electricity Board specification. Price **£7.75** P&P 75p (**£9.18**).



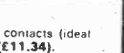
SANGAMO WESTON TIME SWITCH

115v 25/1 20/2 230/240v a.c. 2 on/2 off every 24 hours. 20 amp contacts with overvoltage switch dimmer 4 x 3" price **£6.00** P&P 50p **£7.02** inc. VAT & P. Also available with solar timer.



A.E.G. TIME SWITCH

200/250V A.C. 1 on/1 off every 24 hrs. 80 amp contacts (ideal storage heater). spring reserve. Price **£10.00** P&P 50p (**£11.34**).



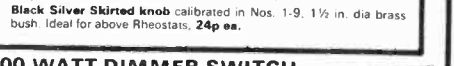
A.C. MAINS TIMER UNIT

Based on an electric clock, with 25 amp. single pole switch, which can be preset for any period up to 12 hrs. ahead to switch on for any length of time, from 10 mins. to 6 hrs. then switch off. An additional 60 min. audible timer is also incorporated. Ideal for Tape Recorders. Lights. Electric Blankets etc. Attractive satin copper finish. Size 135 mm x 130 mm x 60 mm. Price **£2.25**. Post 40p. (Total inc. VAT & Post **£2.87**).



POWER RHEOSTATS

New ceramic construction, vitreous enamel embedded winding, heavy duty brush assembly, continuously rated.
25 WATT 10 25 100 150 250 500 1k 1.5k ohm **£2.40** Post 20p (**£2.81** inc. VAT & P). 50 WATT 100 500 1k ohm **£2.90** Post 25p (**£3.40** inc. VAT & P). 100 WATT 1/5 10/25 100/250 500/1k 1.5k/2.5k/5k ohm **£5.50**. Post 35p (**£6.32** inc. VAT & P).
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600 WATT DIMMER SWITCH

Easily fitted. Fully guaranteed by makers. Will control up to 600w of lighting except fluorescent at mains voltage. Complete with simple instructions. **£3.95** Post 25p (**£4.53** inc. VAT & P). 1000 watt model **£5.60** Post 25p (**£6.32** inc. VAT & P). 2000 watt model **£9.75** Post 40p (**£10.96** inc. VAT & P).

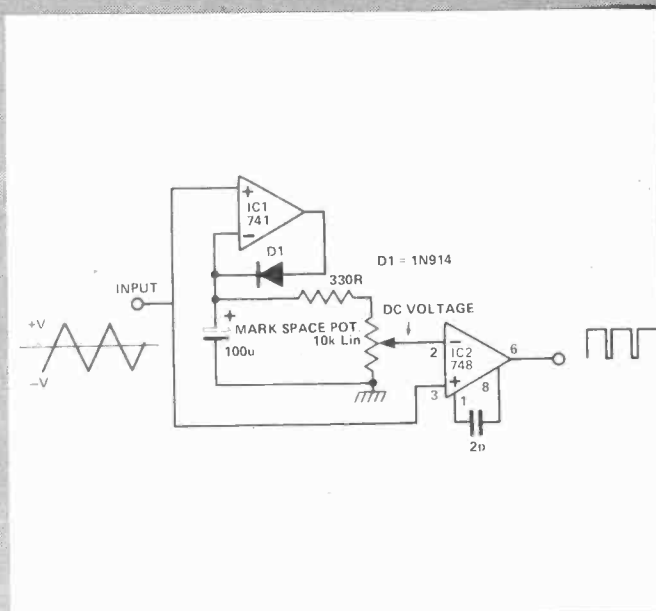
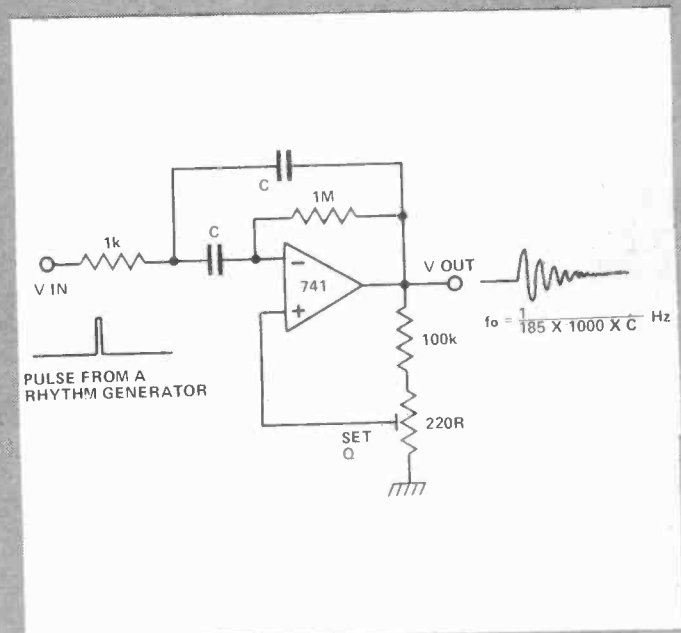


OP-AMPS PART 3

Continuing along Tim Orr's circuit strewn path through op-amps

Simple Musical Chime Generator

The circuit shown is that of a multiple feedback band-pass filter. The preset is used to add some positive feedback and so further increase the Q factor. The principle of operation is as follows. A short click (pulse), is applied to the filter and this makes it ring with a frequency which is its natural resonance frequency. The oscillations die away exponentially with respect to time and in doing so closely resemble many naturally occurring percussive or plucked sounds. The higher the Q the longer the decay time constant. High frequency resonances resemble chimes, whereas lower frequencies sound like claves or bongos. By arranging several of these circuits, all with different tuning, to be driven by pulses from a rhythm generator an interesting pattern of sounds can be produced. There may be some stability problems when high Q or high frequency operation is involved. To achieve better performance, an op-amp with a greater bandwidth than the 741 should be used. Alternatively, a different structure, such as a state variable filter could be used. Qs of up to 500 can be obtained with this latter circuit.

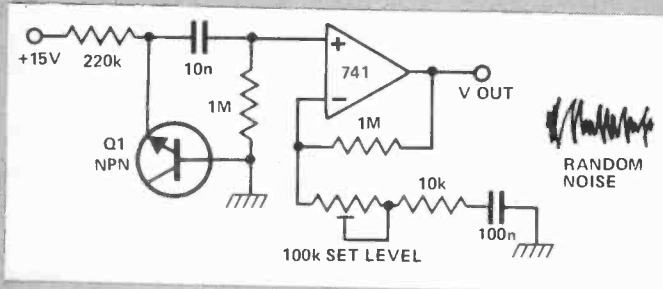
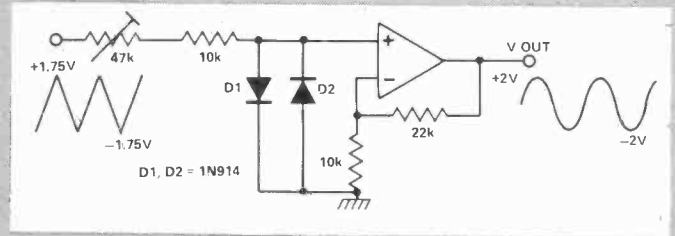


Variable Markspace Squarewave Generator with Automatic Level Adjustment

By putting a triangle wave into one input of a comparator and a manually controlled DC level into the other, it is possible to generate a variable ratio mark/ space square wave. However, if the amplitude of the triangle varies then so will the markspace ratio. Alternatively, if you want the manual control to produce a very thin waveform at one end of its travel, then you will probably need a preset and a very stable triangle amplitude. However, this circuit solves these problems. The DC voltage is generated by a peak voltage follower, IC1, driven by the triangle itself. Thus the circuit tracks the peak voltage level. Secondly, only 97% of this voltage is ever fed to the comparator, IC2, and so at the end of the markspace pot, a 60:1 ratio square wave is generated. At the other end of the pot the ratio is 1:1. A 748 is used as the comparator because it has more bandwidth than the 741. As the frequency of the triangle increases, it may be necessary to use an even faster op-amp for IC2 or even a comparator.

Simple Triangle to Sinewave Converter

A simple way of converting a triangle to a sinewave is shown. The logarithmic characteristic of the diodes is used to approximate to that of a sine curve. The distortion to be expected is of the order of 5%. However, the distortion may be tolerable if the sinewave is only used to generate audio tones.

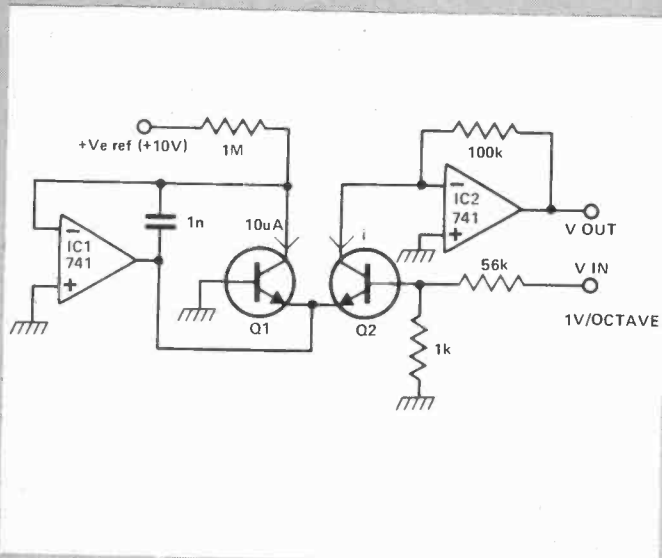
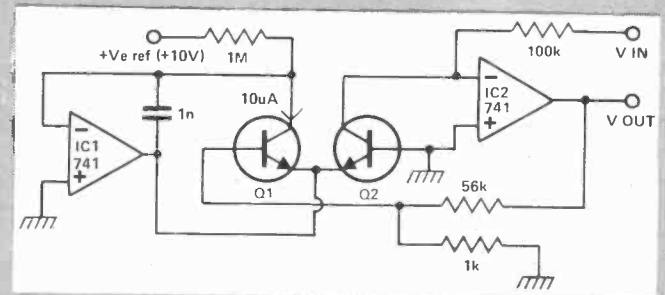


Noise Generator

The zener breakdown of a transistor junction is used in many circuits as a noise generator. The breakdown mechanism is random and so generates a small noise voltage. Also this voltage has a high source impedance. By using the op-amp as a high input impedance, high AC gain amplifier, a low impedance, large signal noise source is obtained. The preset is used to set the noise level by varying the gain from 40 to 20 dB.

Logarithmic Voltage to Voltage Converter

The output voltage is logarithmically proportional to the input voltage. The difference between this circuit and the previous is that the exponentiator is in the feedback loop of the op-amp and hence the mathematical function has been inverted. The circuit is useful for performing true logarithmic compression or for converting linear inputs into dBs.



Exponential Voltage to Current/Voltage Converter

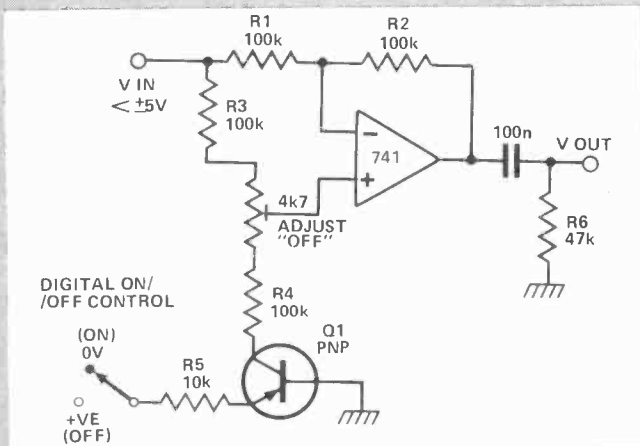
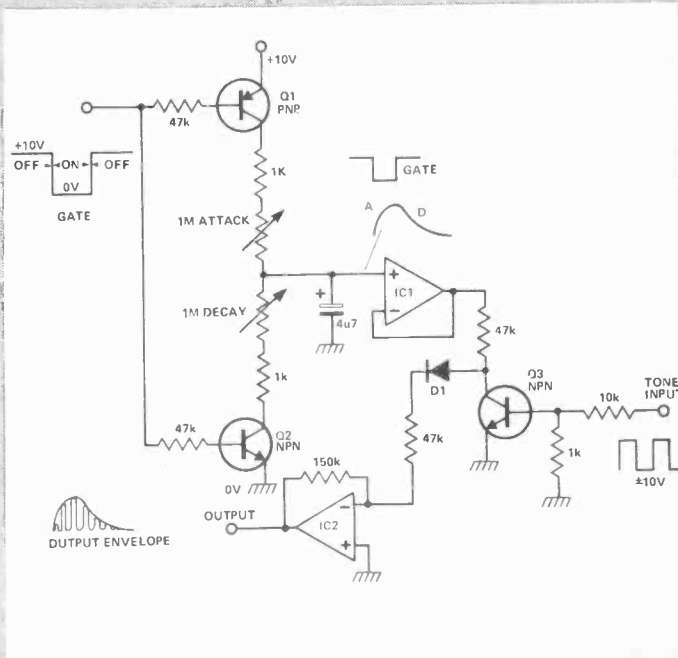
The circuit shown converts a linear input voltage into an exponential current or voltage. This type of circuit is used in music synthesizers to change linear control voltages into musical intervals. That is, if the circuit were used to control an oscillator, input increments of 1 V would change the pitch by one octave. The exponential characteristics of a transistor are employed to generate the correct transfer function. Q1 and Q2 are a matched pairs of transistors, preferably a transistor dual. IC1 maintains Q1 at a constant current. Thus, the op-amp serves only to bias the emitter of the second transistor Q2 into a suitable operating region. The purpose of Q1 is to generate this bias voltage. The base emitter junction of a transistor has a high temperature coefficient ($-1.9 \text{ mV}/^\circ\text{C}$) and so the reason for using a matched pair is to use the first transistor, Q1, to provide temperature compensation for the second.

Musical Envelope Generator and Modulator

A gate voltage is applied to initiate the proceedings. When the gate voltage is in the ON state, Q1 is turned on, and so the capacitor C is charged up via the attack pot in series with the 1K resistor. By varying this pot, the attack time constant can be manipulated. A fast attack gives a percussive sound, a slow attack the affect of 'backward' sounds. When the gate voltage returns to its off state, Q2 is turned on and the capacitor is then discharged via the decay pot and the other 1K resistor, to ground. Thus the decay time constant of the envelope is also variable.

This envelope is buffered by IC1, a high impedance voltage follower and applied to Q3 which is being used as a transistor chopper. A musical tone in the form of a squarewave is connected to the base of Q3. This turns the transistor on or off and thus the envelope is chopped up at regular intervals, the intervals being determined by the pitch of the squarewave.

The resultant waveform has the amplitude of the envelope and the harmonic structure of the squarewave. IC2 is used as a virtual earth amplifier to buffer the signal and D1 ensures that the envelope dies away at the end of a note.

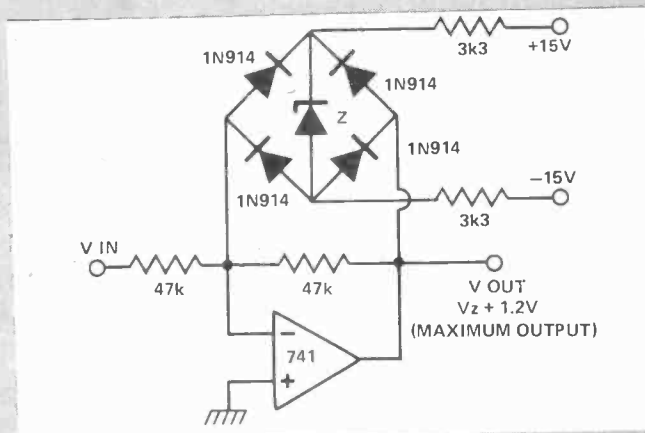


Transistor Used To Turn An Op Amp On Or Off

When transistor Q1 is switched off, the circuit behaves as a voltage follower. By applying a positive voltage to the emitter of Q1 via a 10K resistor, the transistor is made to turn on and go into saturation. Thus the lower end of R4 is shorted to ground. The circuit has now changed into that of a differential amplifier (see fig. 7), but where the difference is always 0v. Now as long as the resistor ratios in the two branches around the op amp are in the same ratio then there should be zero output. A 4K7 preset is used to null out any ratio errors so that the 'OFF' attenuation is more than 60dB. The high common mode rejection ratio of a 741 enables this large attenuation to be obtained.

Fast Symmetrical Zener Clamping

The problem with using two zeners, back to back in series to get symmetrical clamping are one, the knee of the zener characteristics is rather sloppy. Two; charge storage in the zeners causes speed problems and Three; the zeners will have slightly different knee voltages and so the symmetry will not be all that good. The circuit overcomes these problems. By putting the zener inside a diode bridge then the same zener voltage is always experienced. The voltage errors due to the diodes are much smaller than those due to the zener. Also the charge storage of the bridge is much less. Lastly by biasing the zener on all the time, the knee appears to be much sharper.



To be continued

GAS MONITOR

ETI Project Team present a machine which nose when you're fuming, and which can be suitably alarming. Particularly useful to boat owners, and of value to all needing to keep an eye on the gases.

PETROL VAPOUR, closed space and electrical sparks are not ideal companions. Many a boat has been destroyed when the owner has switched on the ignition without realising there had been a petrol leak and the vapour content in the engine compartment is at a dangerous level. Unfortunately the circumstances also lead to injury and loss of life. Therefore any system which can prevent this is of great value.

This unit is designed to meet this requirement and uses a semiconductor gas detector (TGS cell) to monitor the atmosphere in the engine compartment and either prevent the engine being started or shut it down if a high vapour concentration occurs during operation.

Construction

This is relatively easy if the printed circuit board is used and the wiring diagrams are followed. Some precautions should be taken if the unit is to be used in a boat to prevent corrosion. The rear side of the board should be coated with a cellulose spray (dope, nail polish, etc.) and the box, while having to be near the control panel, should be shielded from direct spray. Although we have used a separate box the unit can be mounted behind the control panel if desired.

A small heatsink (about 25 mm square aluminium) should be bolted on to IC 1 to keep it cool.

The relay should be capable of handling up to 5A and should have a 12V coil with a resistance of over 100 ohms.

Obviously the sensor must be mounted in the engine compartment and while it must be in free air it must also be protected against mechanical damage.



Installation and Adjustment

The sensor should be mounted in a position where vapour may be expected and should be mechanically protected against damage. The

connection to the sensor should be via a four core cable (on long runs use a shielded cable).

Note that the sensor is symmetrical in layout and also the fact that it will fit into a standard seven pin miniature valve socket.

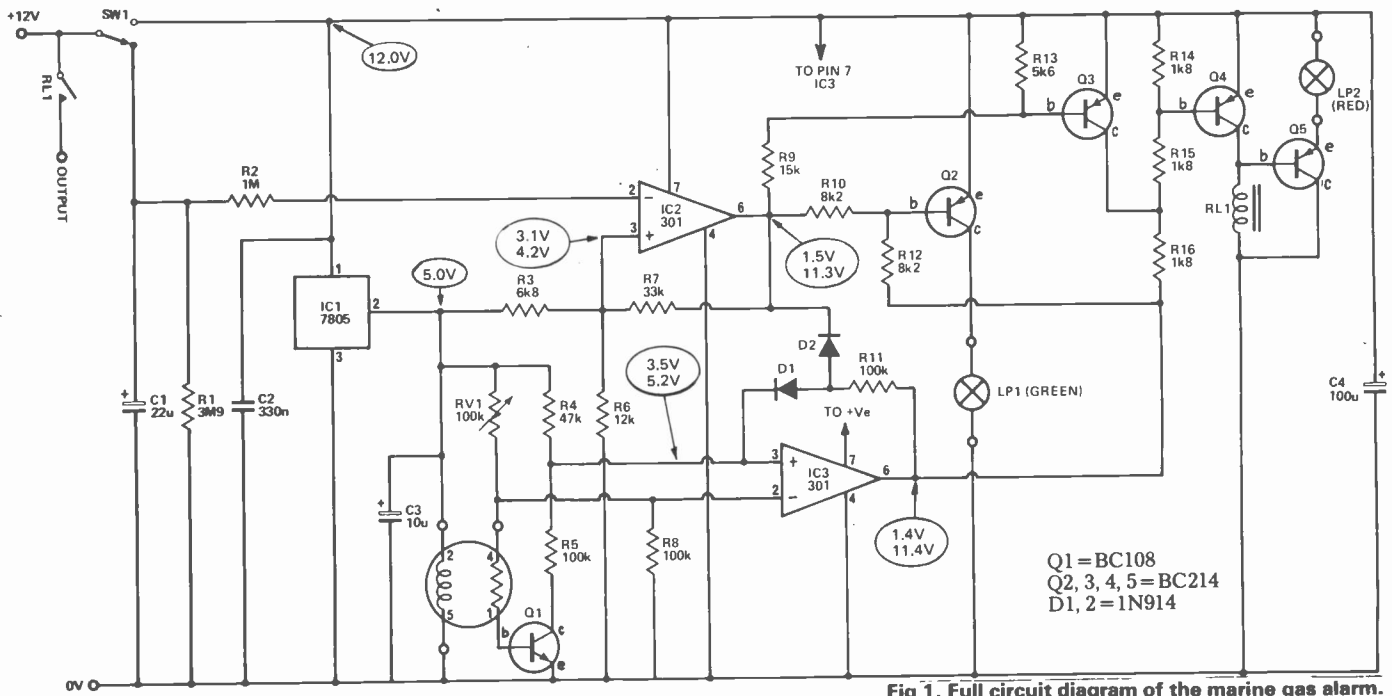


Fig 1. Full circuit diagram of the marine gas alarm.

HOW IT WORKS

This project is designed primarily to monitor the concentration of volatile gases inside the bilge of petrol-engined boats. The circuit provides an electrical cutout which prevents the engine from being started if fumes are present and also will remove all electrical power if fumes become present at any time.

The unit acts as a master switch and due to its warm up requirements, a two minute delay occurs on switch on. Two indicator lights indicate either "safe" or "fail" condition and in the initial warm up period both lights are on. The initial timing is performed by C1 and IC2. With the main switch off there is +12 V across C1. When it is switched on the

capacitor is allowed to discharge through R1. IC2 compares the voltage on C1 with that on pin 3 (about 3 V). During this period the output of IC2 will be about +2 V.

IC1 is a 5 V regulator and supplies the power for the heater of the sensor. The sensor's resistant element is in series with RV1 and this voltage is compared to the voltage set by R4/R5.

The transistor Q1 gives a fail safe operation and if the sensor is not connected this transistor will be off giving +5 V on pin 3 of IC3. Resistor R8 ensures that the voltage on pin 2 will always be slightly less than +5 V.

If vapour is present the sensor resistance will be low and the output of IC3 will be high. During the first two minutes the diodes D1 and D2 prevent the feedback loop (R11) operating. After two minutes if the output goes high the reference voltage on pin 3 of IC3 will go above 5 V and therefore the IC will latch in that position.

The relay is operated by Q4 and for it to close the output of IC3 must be low (no vapour) and also the output of IC2 must be high (more than two minutes after switch on). If the unit does switch off, or prevents initial switch on, it must be switched off and then on again (after clearing the fumes) and the two minute delay operates again.

The only adjustment is the sensitivity control and this is set by bringing a small container of petrol near the sensor and ensuring it operates. The adjustment should be as sensitive as possible without giving false operation.

Other Applications

By suitable choice of sensor from the TGS range (see data sheet this issue) the basic electronics, with perhaps a few modifications, can be used for a number of other applications — for example switching on an extractor fan if the carbon monoxide level in a garage reaches a dangerous level. No doubt numerous other applications for this project will occur to you.

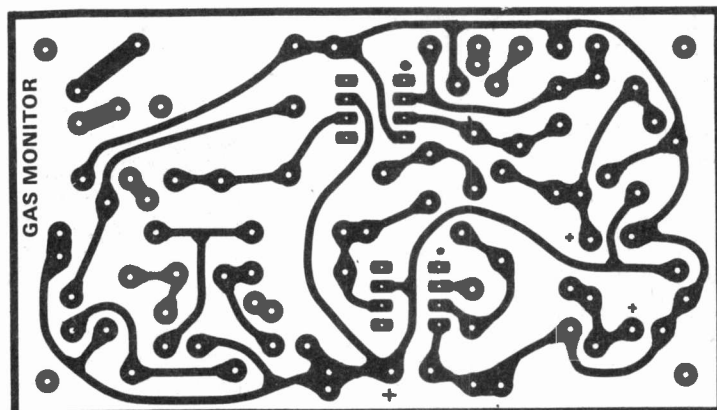


Fig 2. PCB pattern foil side shown full size (52 x 92 mm).

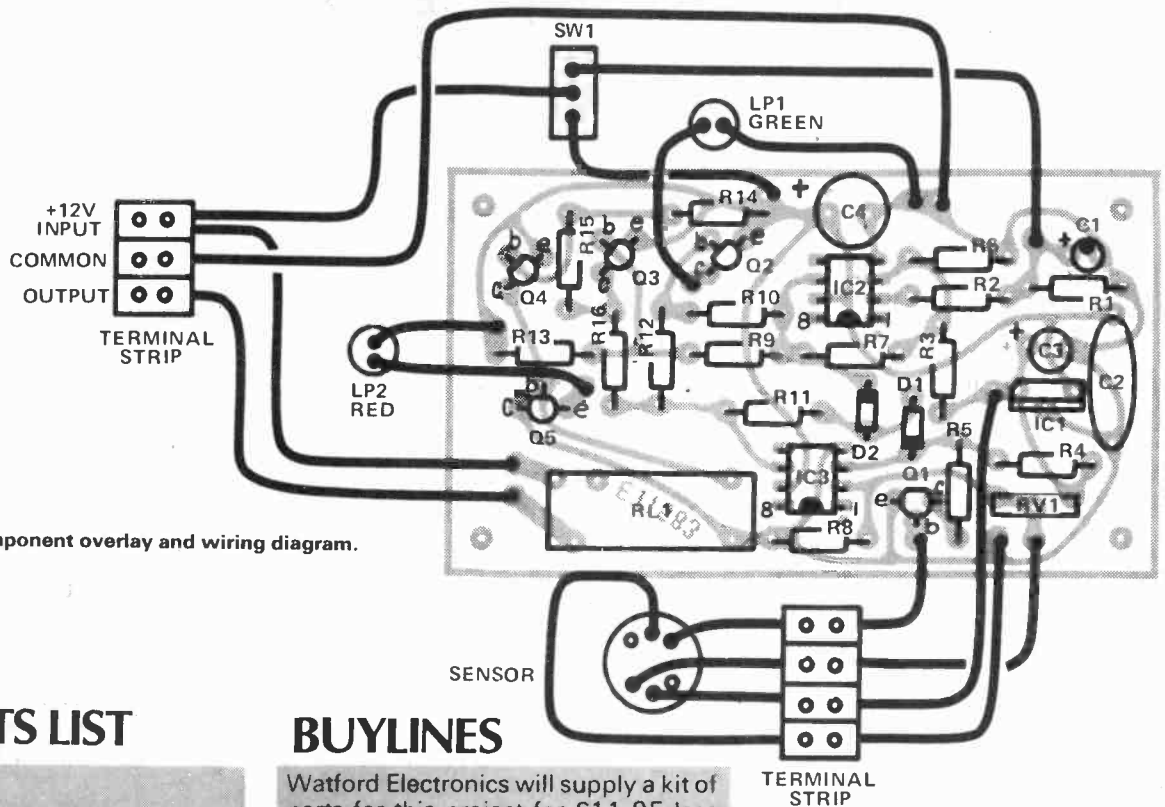


Fig 3. Project component overlay and wiring diagram.

PARTS LIST

RESISTORS

R1	3M9
R2	1M
R3	6k8
R4	47k
R5,8,11	100k
R6	12k
R7	33k
R9	15k
R10,12	8k2
R13	5k6
R14,15,16	1k8

POTENTIOMETERS

RV1	100k vert. preset
-----	-------------------

CAPACITORS

C1	22u 16V Tantalum
C2	330n Polyester
C3	10u 16V Electrolytic
C4	100u 25V Electrolytic

SEMICONDUCTORS

IC1	7805
IC2,3	LM301A
Q1	BC548
Q2,3,4,5	BC214

SENSOR

TGS	812 or 813
-----	------------

LAMPS

LP1,2	12V 100mA
-------	-----------

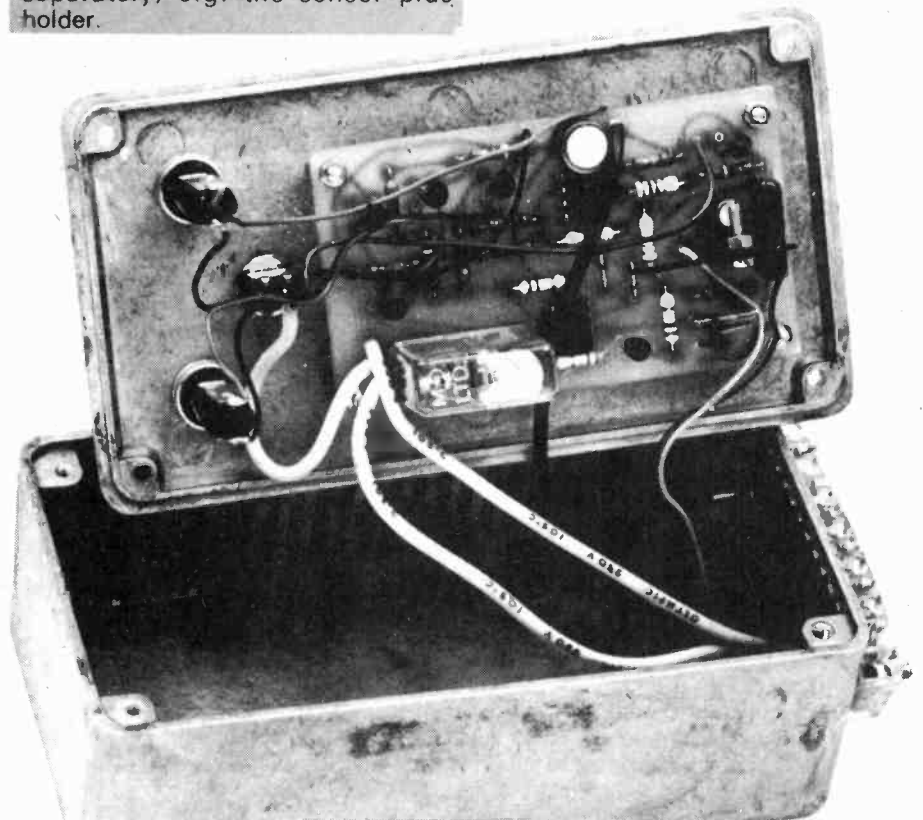
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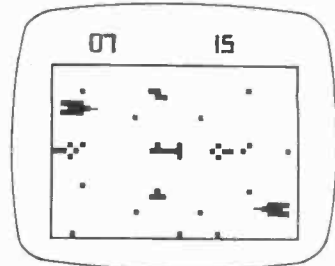
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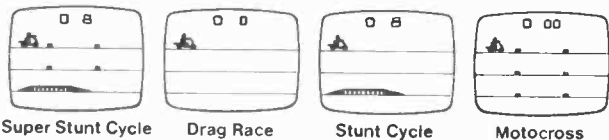
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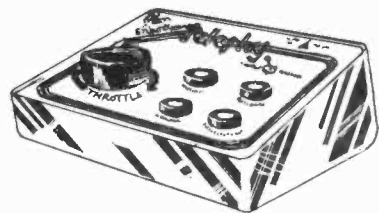
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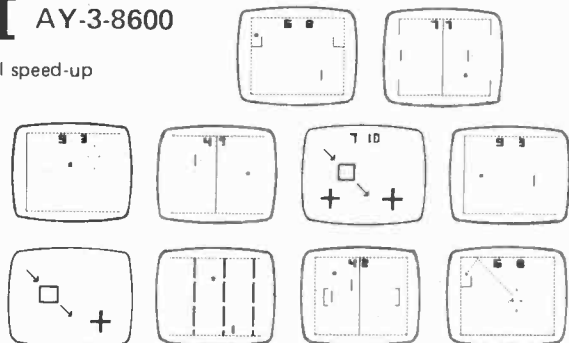
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DIGITAL ELECTRONICS

THE 7490 DECADE COUNTER is a single-chip counter containing four flip-flops and various gates, which are arranged so that frequency division and decimal counting can be carried out. To make the counter more versatile, one flip-flop is separately connected so that it can be independently used as a scale-of-two counter, and the remaining three flip-flops are gates so that they act as a scale-of-five. The two sections of the counter can be connected together in different ways, either as a divide-by-ten circuit, or as a decimal counter with BCD outputs.

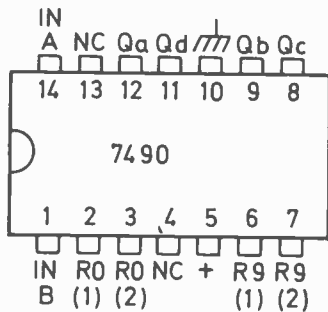


Figure 1. Pinout of 7490 Decade counter.

Twos Into Tens

BCD — meaning Binary-Coded-Decimal — is a form of binary code which is particularly useful if decimal numbers have to be displayed. In a BCD count, each figure of a decimal number is represented by its binary equivalent, so that the number 85 (decimal) becomes 1000 0101, binary 8 and binary 5. Although more convenient, because each BCD counter can then drive a display unit, this form is longer than a pure binary number (binary 85 = 1010101, only seven figures), and BCD numbers are not so simple to add and subtract as pure binary numbers.

BCD in Practice

Connect the power supplies to the 7490 with pin 10 to earth and pin 5 to +5 V. Pins 2 and 7 should also be

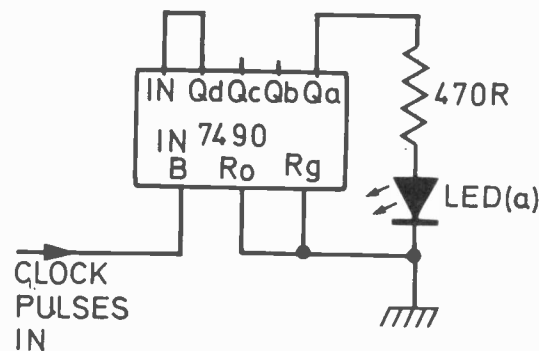
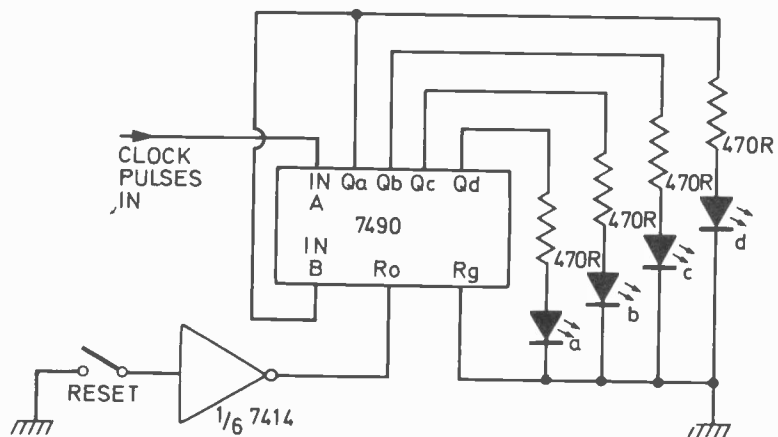


Figure 2. Connections for frequency division by ten — note that the symbol does not show the true pin positions.

Figure 3. Connections for BCD counting, with reset switch. The reset pin must be kept at logic zero for counting, and taken to logic 1 for reset, so that an inverter must be used along with the push-button switch.



earthed for most of the experimental work in this section, although we may use pin 2 later for resetting to zero. Now connect LEDs and their limiting resistors, using the spare pads on the board, to Qa on pin 12 and Qd on pin 11. Connect the clock pulse from the slow oscillator to input A (pin 14) and by watching the clock LED and the LED connected to pin 12 (Qa), note the action of this section of the counter.

Switch off, transfer the clock pulse input to input B on pin 1, and switch on again, watching the clock LED and the Qd LED on pin 11. Note that the counter will operate only if the reset pins are earthed. There are two pairs of reset pins, each pair being inputs to an AND gate which operates the reset. Pins 2 and 3 are the reset to zero pins, and earthing either of them enables

the counter. If both are allowed to float to logic 1, or are taken to logic 1, the counter resets to zero. Pins 6 and 7 also act through an AND gate, but with both high the reset is to BCD 9 (1001) rather than to zero.

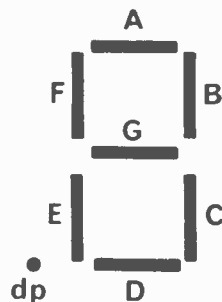


Figure 5. Arrangement of segments in a seven-segment display. The decimal point, which may be on the other side of the figure, is always energised separately, often from a range switch.

BY EXPERIMENT PART 7

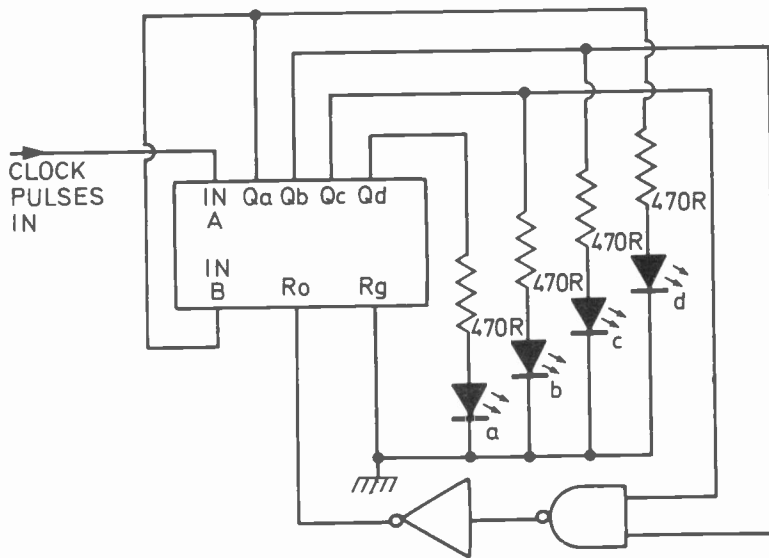


Figure 4. A terminated count. At some stage in the count, the gate will force the counter to reset. When does this happen?

Number/ Character	a	b	c	d	e	f	g
0	x	x	x	x	x	x	-
1	-	x	x	-	-	-	-
2	x	x	-	x	x	-	x
3	x	x	x	x	-	-	x
4	-	x	x	-	-	x	x
5	x	-	x	x	-	x	x
6	-	-	x	x	x	x	x
7	x	x	x	-	-	-	-
8	x	x	x	x	x	x	x
9	x	x	x	-	-	x	x
[-](10)	x	-	-	x	x	x	-
] (11)	x	x	x	x	-	-	-
⌋(12)	-	x	-	-	-	x	x
⌈(13)	x	x	-	x	-	x	x
⌊(14)	-	-	x	x	x	x	x
Blank (15)	-	-	-	-	-	-	-

x - lit
- - unlit

	A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	0	0	0	0	0	0	0	1
1	1	0	0	0	1	0	0	1	1	1	1
2	0	1	0	0	0	0	1	0	0	1	0
3	1	1	0	0	0	0	0	0	1	1	0
4	0	0	1	0	1	0	0	1	1	0	0
5	1	0	1	0	0	1	0	0	1	0	0
6	0	1	1	0	1	1	0	0	0	0	0
7	1	1	1	0	0	0	0	1	1	1	1
8	0	0	0	1	0	0	0	0	0	0	0
9	1	0	0	1	0	0	0	1	1	0	0

Figure 6 (left) Truth table for figure and character displays.
Figure 7 (above). Truth table for a common-anode display, figures only.

To use the 7490 as a frequency divider (Fig. 2), we connect Qd (pin 11) to INa (pin 14) and take the clock pulse to INb (pin 1). The output will appear at Qa, on pin 12, and the state of this output is monitored by an LED already. Connect up the clock pulse from the slow oscillator on the board, and by counting pulses, confirm that the correct division ratio is being obtained.

For a BCD count, the connections must be changed around (Fig. 3). We now need LED indicators on the Qb (pin 9) and Qc (pin 8) outputs as well

as on Qa (pin 12) and Qd (pin 11), and the cross-connections are different, with Qa connected to input B and the clock input taken to input A on pin 14. Label the LEDs as A, B, C, and D, and switch on, noting the values at each stage of the count. Use de-bounced switch as a clock supply if the oscillator is too fast to follow. Note that in the circuit of Fig. 3 a reset switch has been used; because we are using push-to-make switches, an inverter must be used as shown.

Because the 7490 is on a single chip it may be convenient to adapt it

for counts of less than 10, rather than use separate flip-flops. This is made easier by the arrangement of the reset lines, connected through AND gates. Ignoring the reset-to-nine pins, we can arrange for pin 2 to be driven by a gate whose output must be zero during the count, rising to 1 at the end of the count. Pin 3 must be kept high, or the count will not be interrupted.

Try the circuit of Fig. 4 — can you work out what the count figure will be? Connect up and try the circuit out.

Displays

Though several other forms of display exist, the most convenient type for use with TTL circuits is the seven-segment LED display. The type used for this board, the BI-PAK DL747 (Jumbo) is one of the largest displays of this type available at the time of writing, and has been selected from the point of view of easy reading at a distance. If any other type is substituted, care will have to be taken with the pin connections, since there are several pinout standards for this type of display.

As the name suggests, the seven-segment display consists of seven LEDs made in one chip in the arrangement of a figure-of-eight, as shown in Fig. 5. The letters allocated to the strips are also shown (fortunately these are standardised).

Looking at the arrangement of the segments, we can draw up a table of the segments that will have to be activated (ON) for each number we want to display. Fig. 6 shows such a

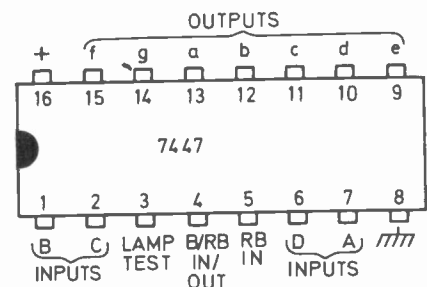


Figure 8. Pinout of 7447 BCD to 7-segment decoder-driver.

table for the numbers 0 to 9, and also some of the other characters which can be obtained. We now have to translate this ON/OFF table into terms of logic 1 and 0.

The next step depends on the type of display that is being used — common cathode or common anode. As the name suggests, the common cathode display has all of the LED cathodes connected together to logic 0, and each anode must be taken to logic 1 to be illuminated. To prevent excessive current flowing — because the normal forward voltage across the LED is less than the +5 V of the logic circuits — we must wire a limiting resistor in the connection to each anode. We cannot use one single resistor in the cathode lead, as this would cause the brightness of the display to alter according to the number of segments lit.

The other possibility is to connect the anodes of the LEDs together and take the cathodes out to separate pins. In this common-anode type of display, the segments will be lit when their respective cathodes are at logic zero, and once again limiting resistors must be used between each cathode and the TTL driving stage.

The type of display specified for this board is a common anode type, with several of the pins on the display connected to the common anode. Only one of these pins need be connected to the 5V line.

Decoders

To obtain a decimal readout from the BCD output of the 7490 counter, a decoder stage is needed with the truth table shown in Fig. 7.

The type used here is the 7447 BCD-to-seven segment decoder/-driver, which has output stages of transistor collectors with no loads. In this way, the combination of LED and limiting resistor acts as load for the collectors of the output transistors in the 7447.

Care should be taken that the outputs of a 7447 are never connected directly to the +5 V line, as excessive currents could flow if the decoder were operated.

In use, the segment output pins of the 7447 are connected through the limiting resistors to the segment pins of the display. The values of the limiting resistors used will determine the brightness of the display. For the 7447 display we can use 150 R res-

istors, but 470R resistors have been specified on our board to ensure long life and to cut down current consumption. If other displays are used, 470R should also be suitable — in general the small displays need less current, and so larger values of limiting resistors should be used than with larger displays. If a common cathode display, such as the MAN-3 types, had been used, the 7448 decoder would have been needed.

Now connect up the display and the decoder on your board, noting the connection diagram of Fig. 9. In the

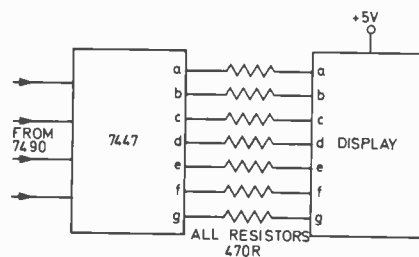


Figure 9. Connection of 7447 to display — not that the arrangement on the board is tidy as the diagram would suggest!

prototype boards, the very small resistors used for limiting could be passed under the body of the display, so avoiding long paths around it. The +5 V supply is taken to pin 16 of the 7447, and earth is taken pin 8. The outputs of the 7447, all on the side facing the display, and marked on the circuit diagram with small letters, are taken through the 470R limiters to the correspondingly lettered pins of the display. The inputs indicated by the capital letters A, B, C and D on pins 1, 2, 7 and 6 of the 7447 are for the BCD input from a 7490 and should be connected to the appropriate Q outputs from the 7490 counter.

Testing and Blanking

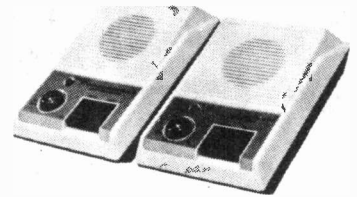
Note that pin 3 of the 7447 is labelled "lamp test." Taking this pin to logic 0 illuminates all segments of the display irrespective of what stage the count has reached, and is a useful check on the operation of the display. For example, an operator can check that a steady display of is not just with two segments faulty.

Pins 4 and 5 on the 7447 are for blanking, used mainly when the display is one of a set, to suppress zeros occurring before the first significant figures and after the last one. When pin 4 is low, the display is blanked out, though counting is unaffected.

To be continued

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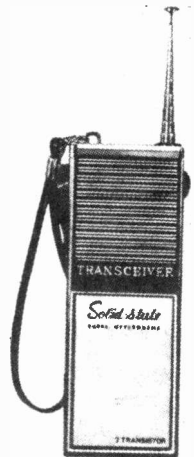
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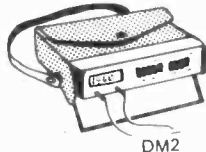
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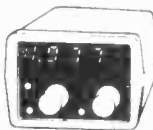
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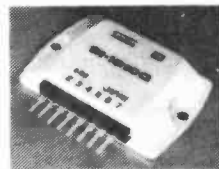


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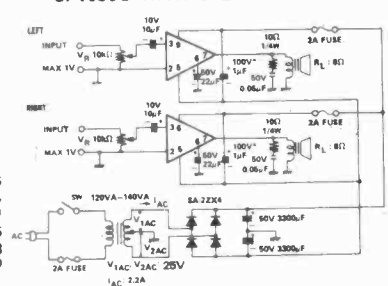


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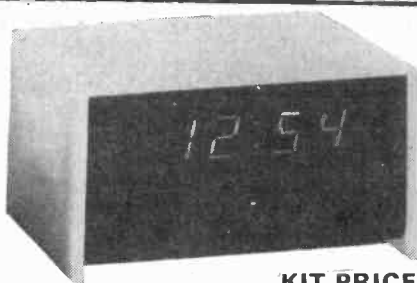
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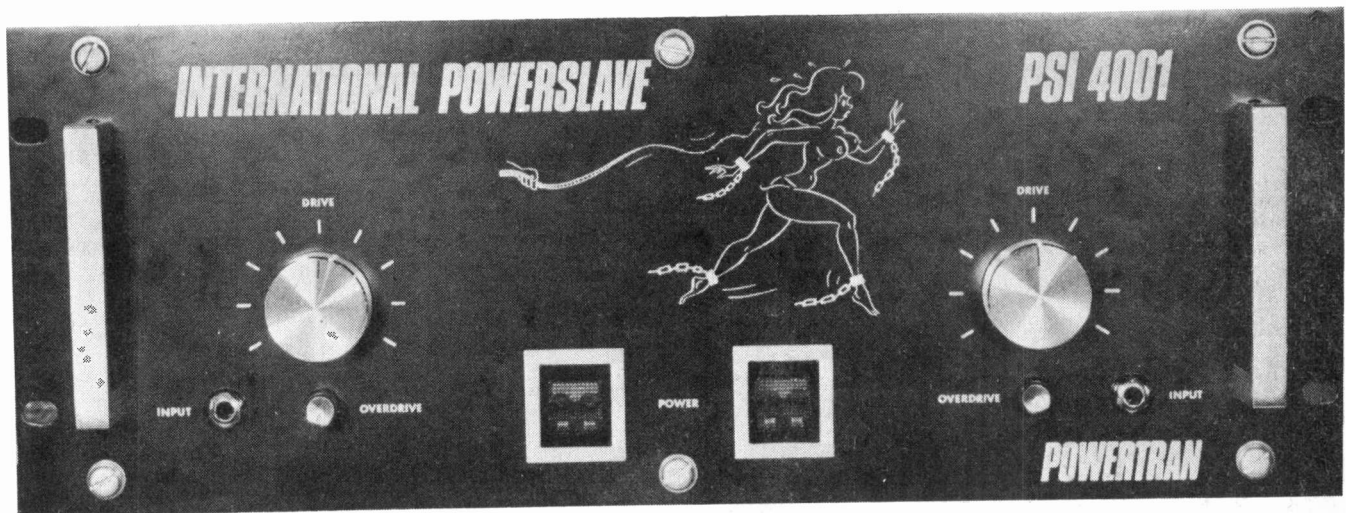
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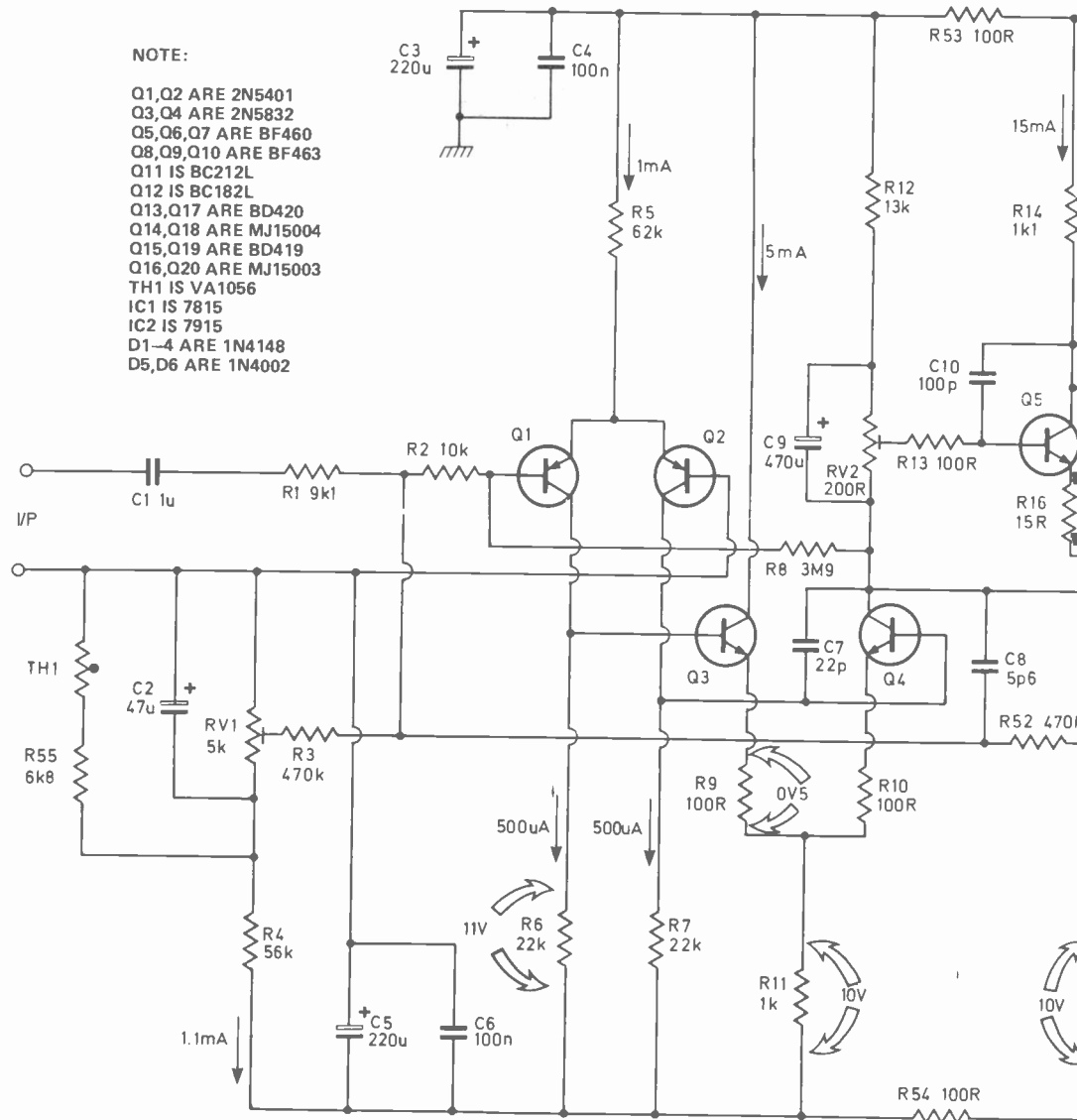
The subjective quality of the design is such that it will not be out of place in the highest of hi-fi set-ups, and its power enables it to drive the more inefficient monitors which seem to dominate such spheres.

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Output power	200 W	
Input sensitivity (for rated output)	.775 mV (0 dB)	
Distortion at 200 W	1 kHz	0.031 %
	10 kHz	0.073 %
	1 kHz	0.025 %
20 W	10 kHz	0.060 %
	1 kHz	0.027 %
2 W	10 kHz	0.042 %
Signal to noise ratio (CCIR weighted)	-101 dB	
Frequency response (-3dB)	10.2 Hz — 70.0 kHz	
Slewing rate	20 V/u sec	

NOTE:

- Q1,Q2 ARE 2N5401
- Q3,Q4 ARE 2N5832
- Q5,Q6,Q7 ARE BF460
- Q8,Q9,Q10 ARE BF463
- Q11 IS BC212L
- Q12 IS BC182L
- Q13,Q17 ARE BD420
- Q14,Q18 ARE MJ15004
- Q15,Q19 ARE BD419
- Q16,Q20 ARE MJ15003
- TH1 IS VA1056
- IC1 IS 7815
- IC2 IS 7915
- D1-4 ARE 1N4148
- D5,D6 ARE 1N4002



HOW IT WORKS

USE OF DIFF. PAIRS

Extensive use is made in the design of the 'long-tailed' or differential pair. The basic voltage amplification stage is shown in Fig.2. The symmetrical operation of the long-tailed pairs run with equal current in each arm affords the stage low distortion. Differential operation also possesses high linearity, as any non-linearity in V_{be} for either transistors is compensated for by the other.

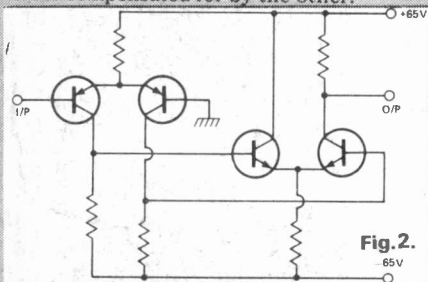


Fig. 2.

It is normal to operate differential pairs with a constant-current source in the tail, i.e.

Q8, D2 and R22-24 supply Q9 and Q10, and Q7, D1 and R18-20 supply Q5 and Q6. However, at the input of the amp (Q1 and Q2), only very small changes in tail current occur due to the small voltage swings, and a fairly 'large' value resistor, i.e. R5 will suffice. Similarly for R11 and Q3 and Q4. In the output driver stages very large voltage swings will be present and thus a current source is essential to correct operation.

OPERATION

For the purposes of operation the amplifier can be considered in four blocks: Two low gain, low distortion voltage amplification stages formed by Q1 and Q2 and by Q3 and Q4 output drivers Q5 and Q6 with Q9 and Q10 and finally the fully complementary output stages which consist of paralleled darlings. Discrete devices are employed for their better operating characteristics and speed 2MHz. Q15 and Q16 are paralleled with Q19 and Q20 to form in effect a single output 'transistor'. Q13, Q14, Q17 and Q18 constitute

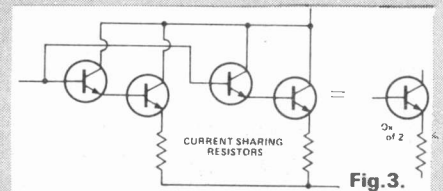


Fig. 3.

an identical configuration for the other half of the cycle. Fig.3 shows how the four may be combined into 'Qx'.

OUTPUT TRANSISTORS

The output types themselves are 250 watt devices, since for reliability the load line of these transistors must lie within the "safe operating" area (Fig 4). This is simply achieved with a pure resistive load, but not with the reactive component of a loudspeaker added. For a 4R load instantaneous dissipation in this design has a max of 144W, but with a reactive load dissipation can rise to 288 W. For these reasons lower power

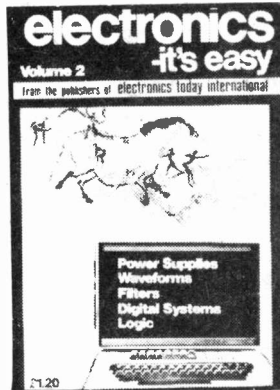
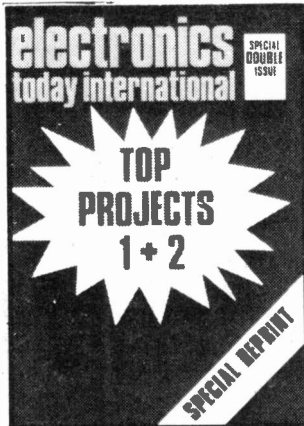
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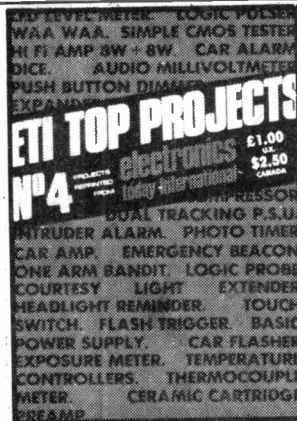
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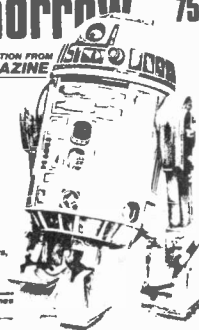
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This is our latest special, and one which even we consider very special! Comprised entirely of new material, the edition covers such diverse subjects as Star Wars and hi-fi! The magazine contains projects for everyone — none of which have appeared in ETI — and a look at the future of MPUs, Audio, Calculators and Video. How can you not read it?

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ELECTRONICS TODAY



READER SURVEY

Dear Reader,

Can you spare a few minutes to help ETI?

Pages 47 and 48 take the form of a reader survey/questionnaire. We want as many readers as possible to fill in and return these to us. As a token of our appreciation we will be giving away 60 ETI T shirts, the lucky readers will be picked at random on the 10th of April. The only reason we ask for your name and address is to send out the T shirts, if you don't want a T shirt and would prefer to remain anonymous please still fill in and return the page —without your name or address.

We have done several surveys in the past, the most recent being in 5% of the July 1977 issue. Since this we have made several changes in the magazine's format and organization, a lot of the changes being catalysed by careful analysis of the returned questionnaires. Yes, we really do care about what you, the reader, thinks!

Thanks for your help,
May the EMF be with you.



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is entitled to 50p off any purchase valued at £1.00 or over. Only valid for one transaction per person. Must be presented in person—no orders by post.
Offer available 1st April—31st May 1978.

Please Note: For commercial reasons the Tandy catalogue is only being inserted in most copies of the magazine for U.K. distribution, and the 50p off coupon is only valid at U.K. Tandy Shops.

THIS ISSUE RECENT

1. Please tick your interest in each of these features:

	Readership			Rating (if read)		
	Read Fully	Scanned Over	Not Read	Good	Average	Poor
200W AMPLIFIER	✓			✓		
<u>WHITE LINE FOLLOWER</u>	✓			✓		
RAIN ALARM		✓			✓	
GAS MONITOR		✓			✓	
<u>PET REVIEW</u>	✓				✓	
CASING SURVEY	✓			✓		-
OP-AMPS PART 3			✓			-
DIGITAL ELECTRONICS			✓			
<u>TECH TIPS</u>		✓			✓	
DATA SHEET		✓				
MICROFILE						
ELECTRONICS TOMORROW						
NEWS DIGEST						
AUDIOPHILE						-
LETTERS PAGE						
<u>SYSTEM 68</u>						

2. a) Please underline any features above that you find particularly interesting.
 b) Please circle any features you find poor or uninteresting.
 c) Please mark an asterisk (*) next to the single best feature from your point of view.
3. a) Do you consider yourself a regular reader? YES/NO
 b) If yes, for how long? Last six months / 1 year / 2 years / 3 years / Longer
 c) If a reader for one year or more, how do you rate recent issues of E.T.I. (Say those of the past three months, compared to those of a year ago?)
 Much better / Slightly better / Same / Slightly worse / Much worse
 d) How long do you keep your copies of E.T.I.? 1 month / 3 months / 6 months / 1 year / Longer
 e) How long have you been interested in electronics?
 Last six months / 1 year / 2 years / 3 years / Longer
 f) How did you become a reader of E.T.I.? Friend's copy / Impulse purchase / Advertisement / Other (please specify)
 saw a circuit I wished to build. O.
 g) How many other people read your copy? O.

4. a) Have you ever built a project from E.T.I.? YES/NO
 b) If yes, how many have you built in the last year?
 c) Please give details of those built in the last year (including those originally featured in the magazine over a year ago).

- d) What are your main areas of interest?
 MP3s / Audio / Video / RF / Gadgets / Other (please specify)
 e) What would you like to see as a project?
 f) In general do projects work first time? YES/NO

5. Do you own, hope to own, or have access to the following (please tick).

	Own	Year acquired	Hope to own	Access to
Good Multimeter				
Cheap Multimeter				
Oscilloscope				
G.P. Power Supply	✓			
A.F. Signal Gen				
R.F. Signal Gen				

6. a) What proportion of E.T.I.'s advertising do you normally read?
 Over 75% / 50-75% / 25-50% / Below 25% / None
 b) Would you like more advertising (as long as the editorial pages are not cut back to accommodate it): YES/NO
7. Offers.
 a) We run quite a lot of offers in E.T.I. Do you consider them a good idea? YES/NO
 b) How do you rate these recent offers?

	Purchased	Good	O.K.	Uninterested
L.C.D. Calculator	X			
Smoke Detector	X	X	✓	X
M.P.U. Doorbell	X	✓	X	X
Chess Challenger	X			

- c) What would you like to see as an offer?
 more offers on components for projects
 (preferably those which are difficult to obtain)
 eg. IC's SCR's LDR's Transistors etc.

8. The Competition.

	READ				OPINION			RATING
	Regularly	Often	Never	Used to Read	Good	OK	Poor	
Practical Electronics								
Practical Wireless			✓					
Wireless World								
Everyday Electronics	✓				✓			9
Elektor			✓					
Radio Constructor			✓					
Television			✓					
ETI	✓							10

On an arbitrary 1-20 scale with E.T.I. rating 10, please rate your opinion of our competitors. Please mark an asterisk (*) next to any magazines you subscribe to.

9. a) Do you read E.T.I. as an extension of your job? **YES/NO**
- b) Are you employed in the electronics (or closely related) field?
YES/NO/Not in Full time employment
- c) If yes to 9b, in what capacity (please tick) *see 12 a (i)*
- Management Maintenance Clerical
- R & D Buying Technician
- Production Sales Other
- d) Are you a student or studying full time? **YES/NO**
- e) If a student, do you hope to get work in the electronics or closely related fields?
YES/NO
- f) Have you ever considered taking a course in electronics? **YES/NO**
10. a) Have you read the Electronics Tomorrow special? **YES/NO**
- b) If yes how do you rate it? **Poor/OK/Good/V. Good**
- c) Did you see the February issue? **YES/NO**
- d) If yes, did you like the colour sections? **YES/NO**
- e) Would you like us to do more colour issues? **YES/NO**
- f) Do you like the free catalogues? **YES/NO**
- g) Would you like more catalogues? **YES/NO**
11. a) Have you ever purchased goods by mail order from E.T.I.? **YES/NO**
- b) Approximately how much do you personally spend on electronics annually?
 £ *No idea*
- c) Do you usually purchase by mail order or personal visit? **Mail/Visit**

12. Personal information. If you find it offensive to answer please ignore this question.

- a) Educational.
- i) What was your age last birthday? *14*
- ii) Highest educational level achieved (please tick)
 For Scottish readers and those educated outside U.K. please tick equivalents
- CSE A level Degree
- O level HNC etc. Other
- b) Income.
- i) Are you paid (please delete) *Weekly/Monthly/Other*
- ii) Basic Income p.w./p.a.
- Average overtime, commission, bonus, etc p.w./p.a.
- Other income (including that from second job) p.w./p.a.
- iii) Do you have any of these credit cards (please tick)
- Barclaycard/Visa Access American Express
- c) Sex. **Male/Female/Other (please specify)**

13. What is your interest in microprocessors? **Very High/High/Fair/Little**
14. What do you like about E.T.I.?
15. What do you dislike about E.T.I.?
16. Have you any suggestions for improvements?
17. Other comments

Please enclose a separate sheet if not enough space for your comments.

Name	<i>N. Crook</i>
Address	<i>19 Greenlands Rd. Stones, Midx TW5 4R</i>
If you win a T shirt, what size do you want? Small/Medium/Large	

THANK YOU FOR YOUR TIME,
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 LONDON W1R 1RF

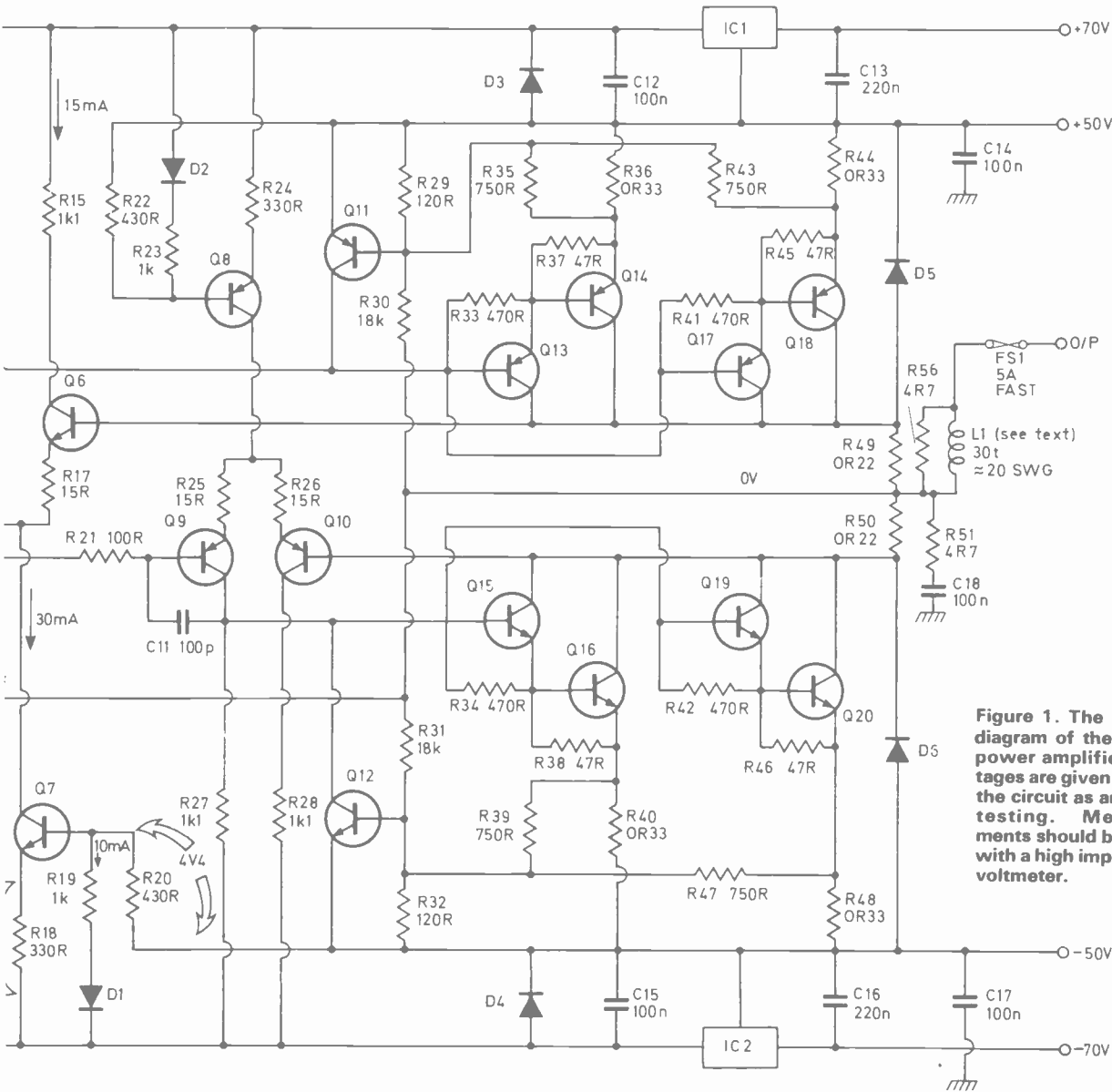


Figure 1. The Circuit diagram of the 200W power amplifier. Voltages are given around the circuit as an aid to testing. Measurements should be made with a high impedance voltmeter.

RKS-Main Amp

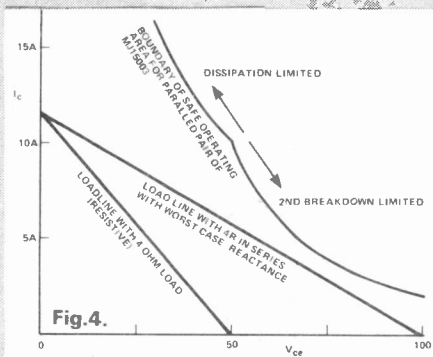


Fig. 4. devices are not recommended for use, unless more are paralleled to share the load.

Because the amp employs low overall feedback (14 dB) the bias current for Q1 is not obtained via the feedback resistor R52 since this would result in a large DC offset at the output. An independent supply is provided, consisting of RV1, R55 and R4. Temperature compensation is provided by TH1.

QUIESCENT CURRENT

With the employment of long-tailed pairs, setting of quiescent current in the output 'switches' QX is somewhat different to a 'normal' design. The function is affected by RV2, which varies the DC between Q5 and Q6 bases. Q5 base will follow the base of Q6 by differential pair action, and similarly Q9 and Q10 this means that the voltage across R49 and R50, which is proportional to I_q will be 'referred back' to RV2. Temperature effects can be removed by keeping Q5 and Q6 as well as Q9 and Q10 at the same temperature, and to ensure this pair is thermally connected to a (different) heat sink.

Regulators IC1 and IC2 are employed to stabilize the 50-volt rails with respect to the 65-volt rail for the constant current sources supplying driver stages Q5 and Q6 and Q9 and Q10.

Diodes D3 and D4 protect IC1 and IC2 from any reverse voltages that might be present at switch on.

OUTPUT PROTECTION

Conventional short circuit protection is employed, using load-line limiting, i.e., refer-

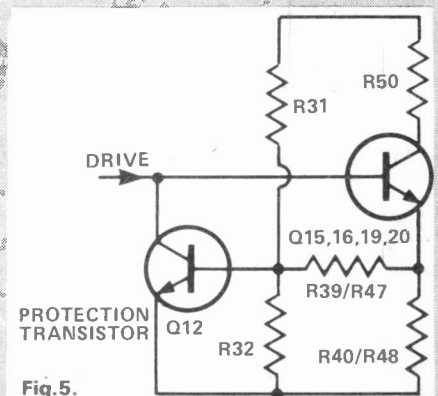
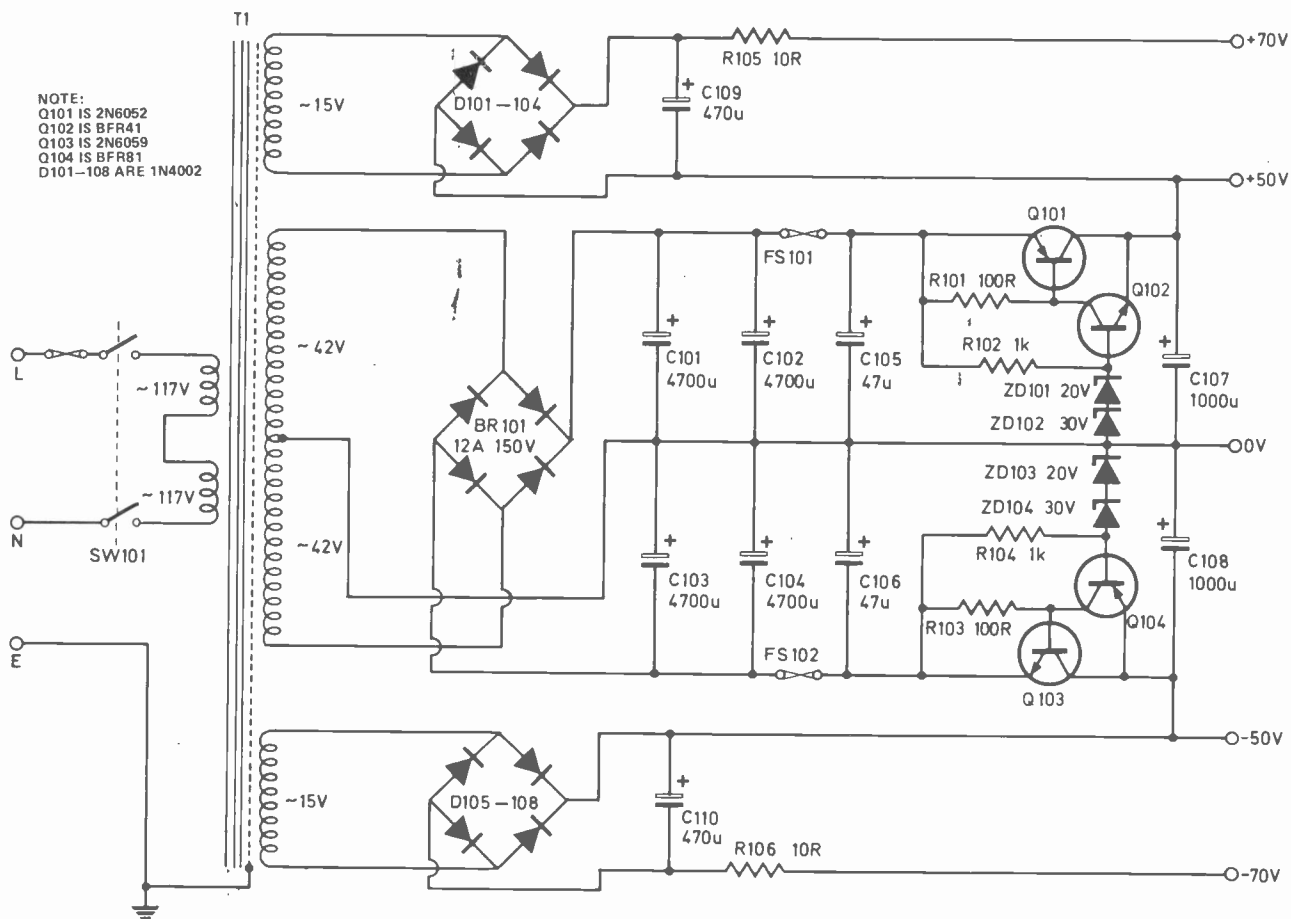


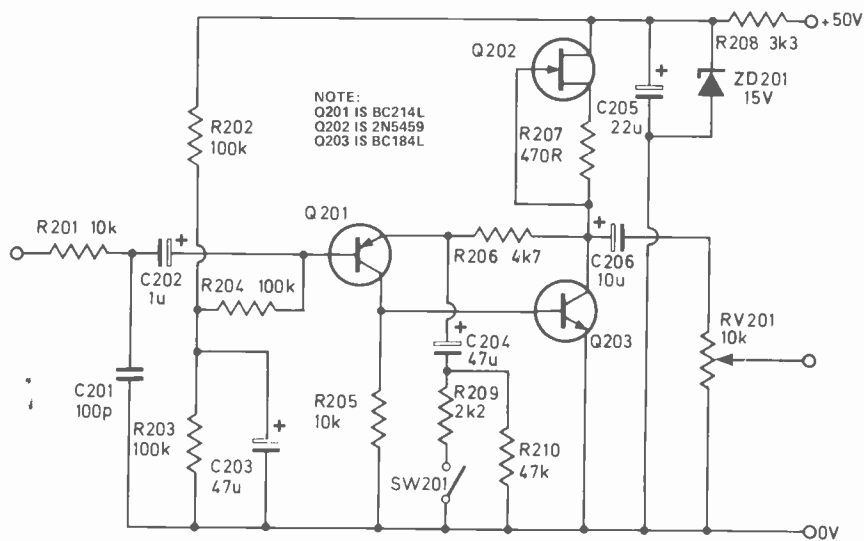
Fig. 5.

ring to Fig 5. The current through R31 will voltage limit the output, and the current through the parallel combination imposes a current limiting function. If either limit is exceeded, Q12 switches on and closes down the drive signal.



NOTE:
 Q101 IS 2N6052
 Q102 IS BFR41
 Q103 IS 2N6059
 Q104 IS BFR81
 D101-108 ARE 1N4002

Figure 6. (Above) Circuit diagram for the PSU. Note that the transformer is a special unit wound for the 200W amplifier by Powertran Electronics. Figure 7. (Below) The circuit diagram for the buffer to increase the input impedance of the unit, and provide variable input sensitivity if required.

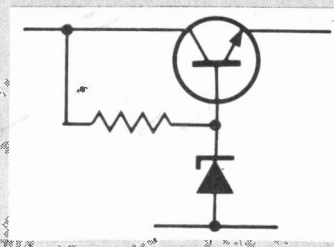


NOTE:
 Q201 IS BC214L
 Q202 IS 2N5459
 Q203 IS BC184L

HOW IT WORKS ~Buffer & PSU

THE power supply is a conventional series pass circuit. The basic circuit elements are shown below. The circuit is essentially an emitter follower, the voltage at the base of the transistor being some 0V6 below that set by the zener in the base. The final circuit shown in Fig. 6 shows that Q101 forms the pass element in the +50V rail while Q103 forms the complementary device in the negative rail. Q102 and Q104 provide increased drive to the pass elements.

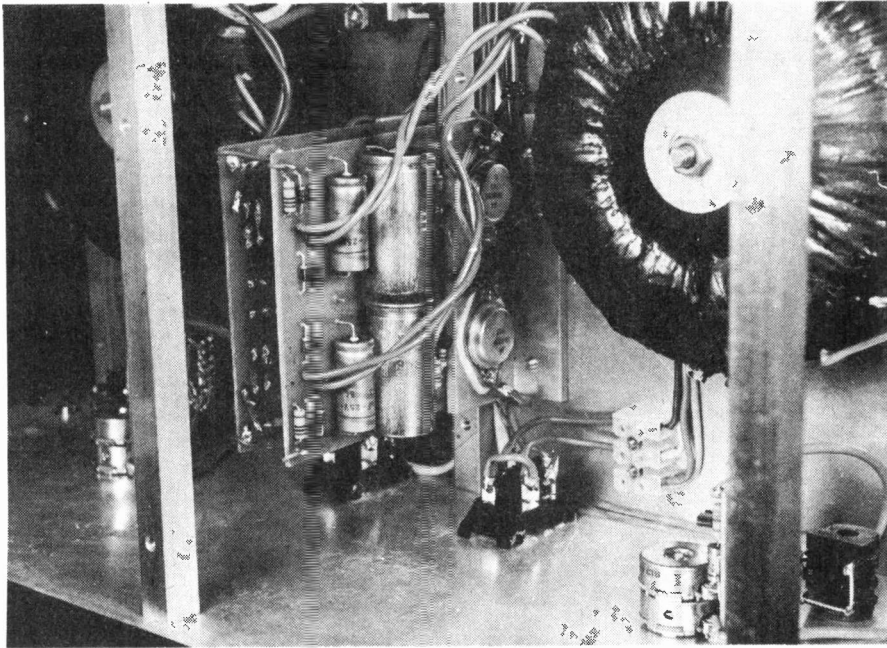
The $\pm 70V$ rails are derived from a simple bridge rectifier circuits.



THE BUFFER

The buffer is a straightforward circuit formed by Q201-203. The buffer provides an high input impedance and allows for two gains, with RV201 at maximum, +0dB with SW201 open and +10dB with R209 in circuit. Changing the value of R209 to 470R will give a 20dB boost when SW1 is operated.

The buffer is powered from the +50V rail with ZD201 included to provide a 15V rail.



The PSU can be seen above. The layout of all the major components can be seen with the buffer (in close up below) just appearing at bottom right.

In addition the bodies of diodes D1 and D2 should be in contact with the heat sink of the appropriate group transistors.

The coil L1 is formed by winding thirty turns of self-fluxing polyurethane covered wire (about 26 SWG) around resistor R56 (4R7), soldering the wire to the leadouts at either end of the resistor.

The interwiring of the various completed units should be undertaken by referring to the overlays and the various views of the amplifier chassis designed to show the layout that should be adopted in the completed unit.

Testing

Test of the amplifier should commence with satisfying yourself that the power supply is operating correctly before connecting it to the main amplifier. The voltages shown in Table 1 should be present upon switching on the mains.

TABLE 1

C102+ to 0 V	62 V
C103- to 0 V	-62 V
C109- to C109+	22 V
C110- to C110+	22 V

If all is well switch off and — please — discharge the four hefty capacitors via a resistor before doing anything further or else you will be in danger of having a lot of energy make its way to earth via you.

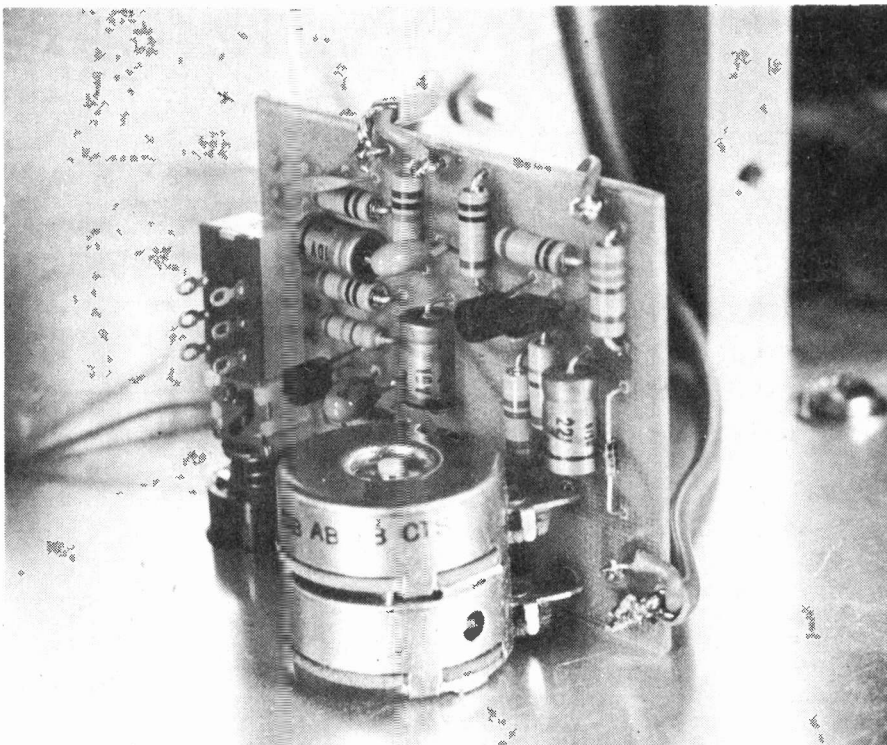
Next connect a 1k5 1W resistor between Q101c and 0V and a similar resistor between Q103c and 0V. Switch on and hopefully the voltages will be shown in Table 2.

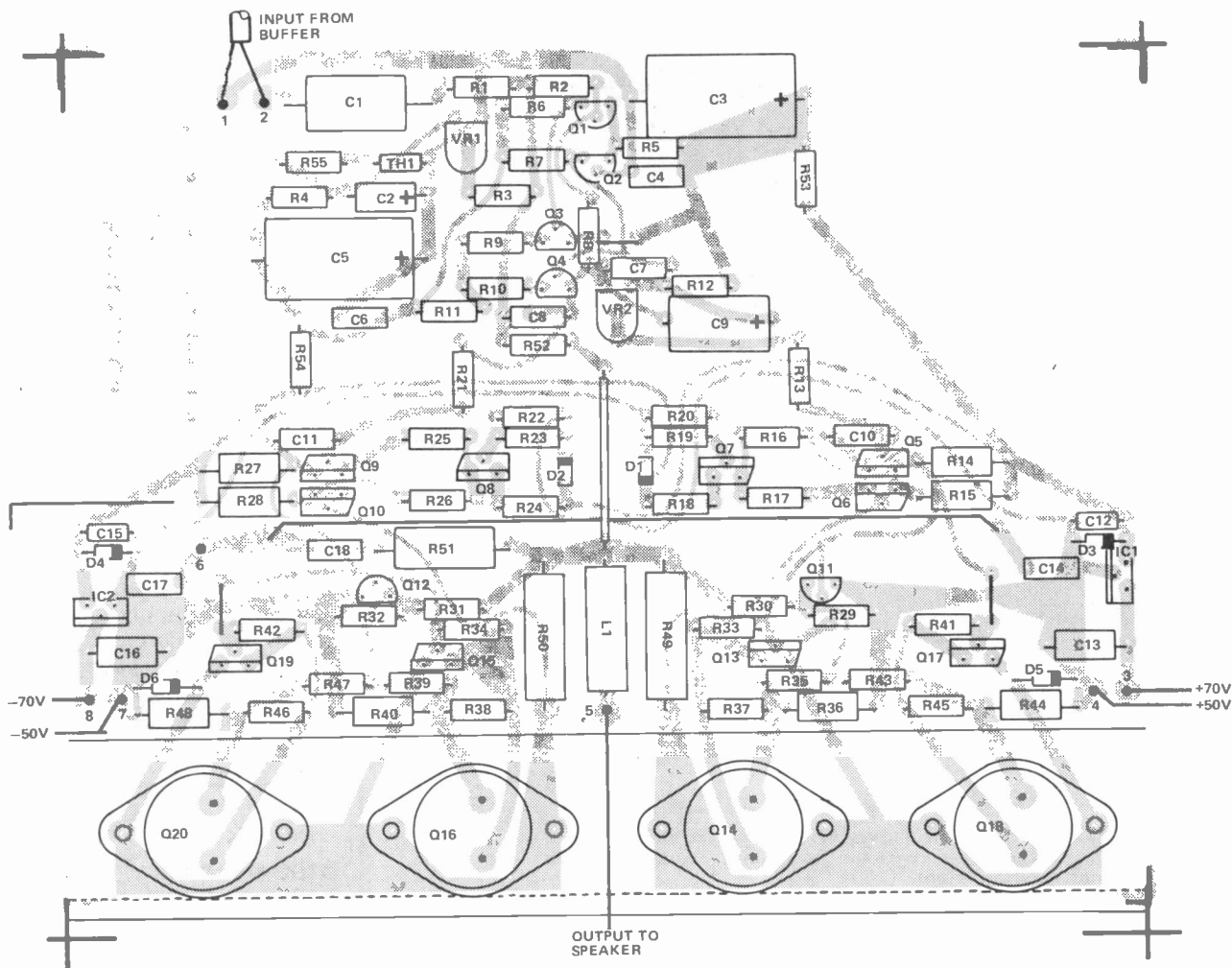
TABLE 2

Q101c to 0 V	+50 V
Q103c to 0 V	-50 V
PSU pin 101 to 0 V	+72 V
PSU pin 106 to 0 V	-72 V

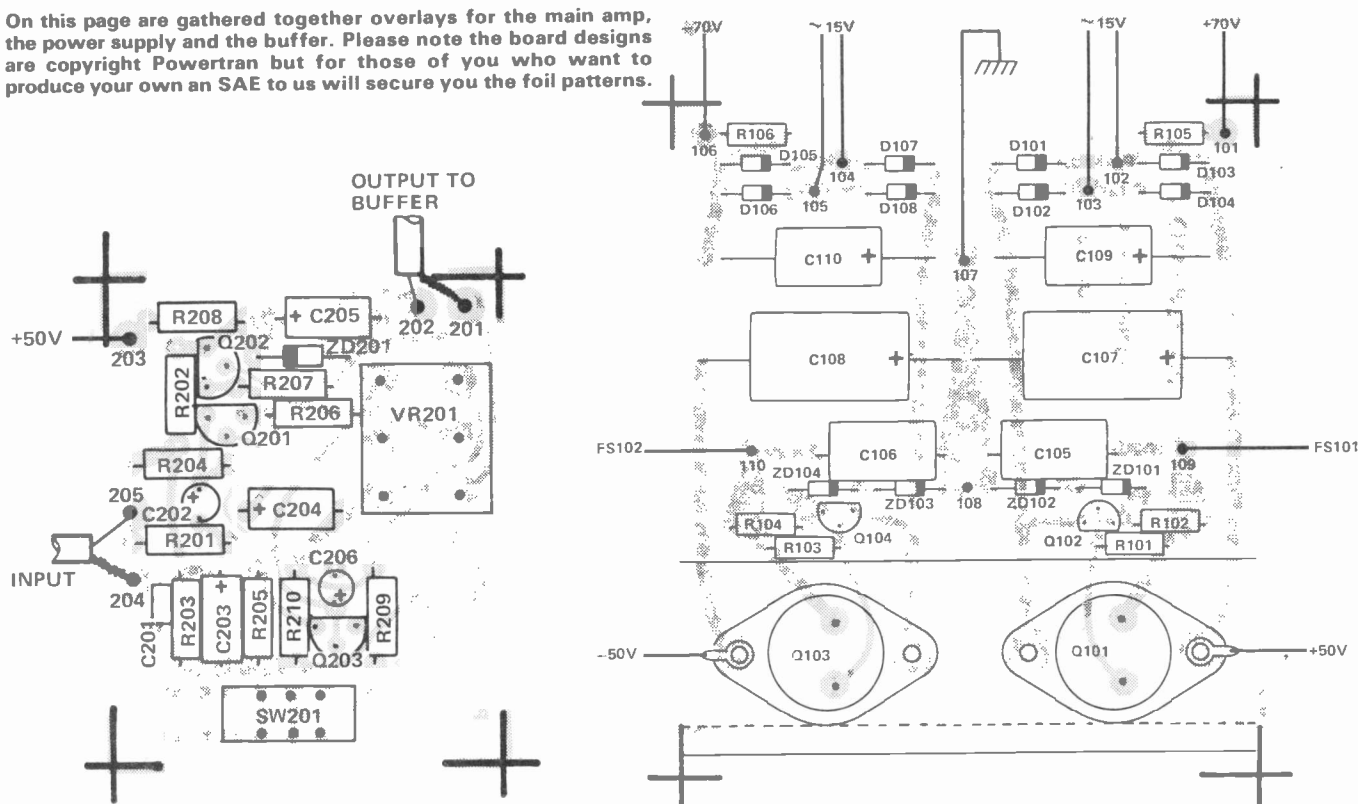
Again if OK, switch off and discharge those Cs.

Next replace the 5A PSU fuses with a 12V 2W4 light bulb in series with a 47R ½W resistor. This





On this page are gathered together overlays for the main amp, the power supply and the buffer. Please note the board designs are copyright Powertran but for those of you who want to produce your own an SAE to us will secure you the foil patterns.



PARTS LIST~Buffer & PSU

POWER SUPPLY PARTS LIST		BUFFER	
RESISTORS (allows 2% metal oxide unless stated).		RESISTORS (All 2% OW5 metal oxide unless stated).	
R101, 103	100R	R201, 205	10k
R102, 104	1k	R202, 203, 204	100k
R105, 106	10R	R206	4k7
CAPACITORS		R207	470 R
C101, 102, 103	4700u 63 V electrolytic	R208	3k3
104		R209	2k2
C105, 106	47u 63 V electrolytic	R210	47k
C107, 108	1000u 63 V electrolytic	POTENTIOMETERS	
C109, 110	470u 25 V electrolytic	RV20 1	10k
SEMICONDUCTORS		CAPACITORS	
Q101	2N6052	C201	100p polystrene
Q102	BFR 41	C202	1u 16 V tantalum
Q103	2N 6059	C203, 204	47u 10 V electrolytic
Q104	BFR 81	C205	22u 25 V electrolytic
D101-108	1N4002	C206	10u 16 V tantalum
BR1	12A 150 V bridge	SEMICONDUCTORS	
ZD 101, 103	20 V 400 mW	Q201	BC214L
ZD 102, 104	30 V 400 mW	Q202	2N5459
TRANSFORMER		Q203	BC184L
T1	see text	ZD1	15 V 400 mW
MISCELLANEOUS PCB as pattern, fuses.		MISCELLANEOUS PCB as pattern.	

Construction

With a project of this type, while attempting to keep construction as straightforward as possible, the sheer physical size of many of the components precludes mounting them on a PCB. This inevitably leads to more constructional work and hence to a greater scope for error. Care taken during assembly and careful checking at each stage can save time and (plenty of) money later on. With this in mind please read this section thoroughly and study the photographs of the finished unit before starting constructional work.

The first stage in building up the amplifier is to mount all the passive components and links on the three PCBs according to the appropriate overlay. Needless to say all soldering must be of the highest standard and checks should be made to ensure that there are no solder bridges present.

Power And Its Place

The four power transistors associated with the amplifier and the two required for the power supply are mounted on cooling brackets as shown in our photographs. Care should be taken to ensure that there are no burrs around the holes in the heat sink that might damage the mica washers that must be fitted to all six transistors. In order to aid heat flow from the transistors silicon grease should be smeared on both sides of these mica washers.

Note that solder tags are required to connect to the cases of the two PSV transistors but not on the main amp's devices where connection is made via the PCB.

Bracketed Cooling

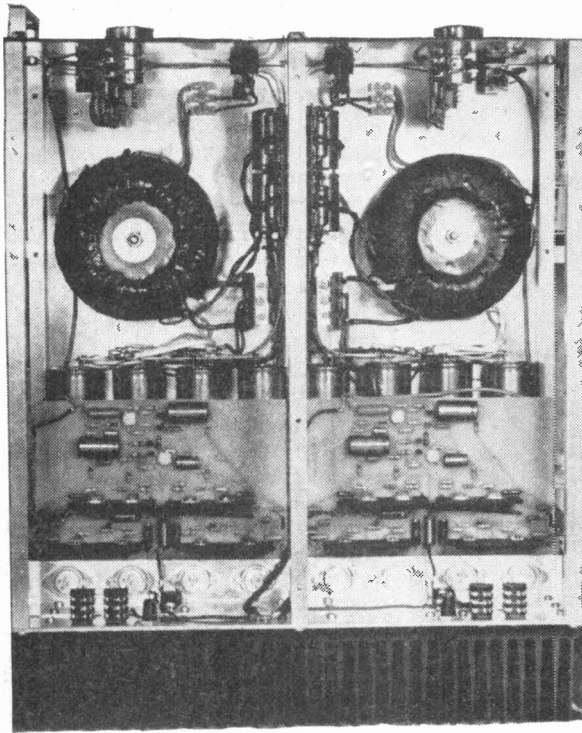
The thermal cutout is also fitted to the cooling bracket on which the amplifier's output devices are mounted.

As can be seen in the photos of the amplifier board the following groups of transistors are thermally connected

Q5 Q6 and Q7
Q8, Q9 and Q10
Q13 and Q17
Q15 and Q19

PARTS LIST~Main Amp.

200 W AMP PARTS LIST		CAPACITORS	
RESISTORS (all 2% OW5 Metal Oxide unless stated)		RESISTORS (all 2% OW5 Metal Oxide unless stated)	
R1	9k1	C1	1u polyester
R2	10k	C2	47u 10 V electrolytic
R3, 52	470k	C3, 5	220 63 V electrolytic
R4	56k	C4, 6, 12, 14, 15, 17, 18	100n polyester
R5	62k	C7	22p 160 V polystrene
R6, 7	22k	C8	5p6 63 V polystrene
R8	3M9	C9	470u 6V3 electrolytic
R9, 10, 13, 21, 53, 54	100R	C10, 11	100p 160 V polystrene
R11, 19, 23	1k	C13, 16	220n poltester
R12	13k	SEMICONDUCTORS	
R14, 15, 27, 28	1k1 1W Carbon Film	Q1, 2	2N5401
R16, 17	15R	Q3, 4	2N5382
R18, 24	330R	Q5, 6, 7	BF460
R20, 22	430R	Q8, 9, 10	BF463
R25, 26	15R	Q11	BC212L
R29, 32	120R	Q12	BC182L
R30, 31	18k	Q13, 17	BD420
R33, 34, 41, 42	470R	Q14, 18	MJ15004
R35, 39, 43, 47	750R	Q15, 19	BD419
R36, 40, 44, 48	OR33 2W5 Wire Wound	Q16, 20	MJ15003
R37, 38, 45, 46	47R	INDUCTOR	
R49, 50	OR22 5W Wire Wound	IC1	7815
R51	4R7	IC2	7915
R55	6k8	D1-4	1N4148
R56	4R7 2WG Wire Wound	D5, 6	1N4002
POTENTIOMETERS		MISCELLANEOUS PCB as pattern, thermal fuse, mica washers, connecting wire, etc.	
RV1	5k Cermet		
RV2	200R Cermet		
THERMISTOR			
TH1	VA1056		



Below can be seen the main circuitry. The heatsinking arrangements of the various output devices can be seen as well as the mounting of C101-C104. Above — an overall view of the amplifier.



The photograph above shows a version of the amplifier built with power level meters. The circuitry required to provide this facility is shown below.

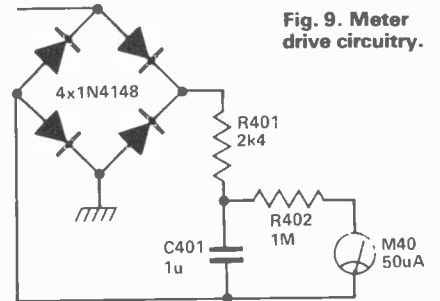
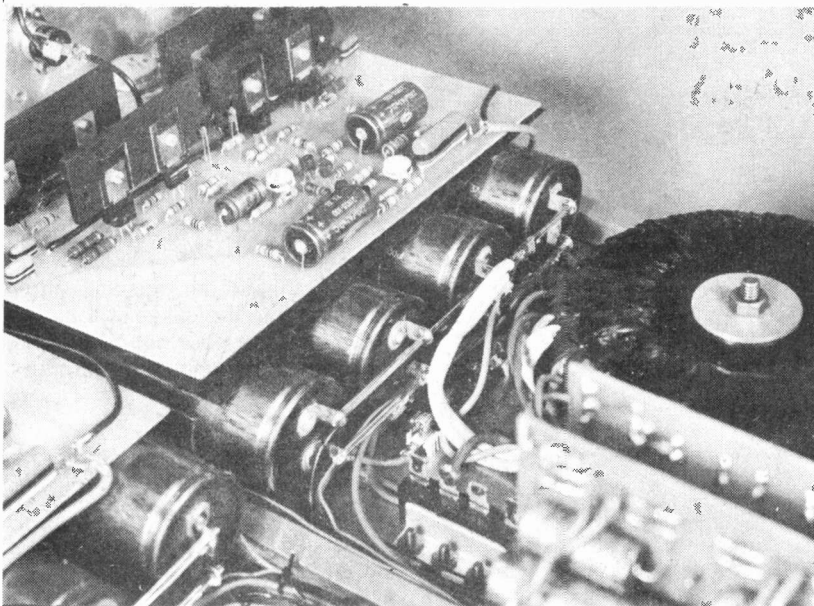


Fig. 9. Meter drive circuitry.



BUYLINES

Powertran are to provide a complete kit of parts for this project. For prices and further details see their advert on the inside front cover.

provides a convenient method of monitoring and limiting the current drawn by the amplifier. Note that if the main amplifier is working correctly you will see an initial surge of light from the bulb which should then die away.

Before connecting power to the amplifier set RV1 to its centre position RV2 fully clockwise and RV201 fully anti-clockwise.

Switch on and check that the voltage between 0V and the R56 and R51 junction is near zero. RV1 should be adjusted until this voltage is exactly zero.

Next RV2 should be rotated until the lamps in the power supply lines start to brighten.

If everything is still going according to plan, replace the power supply fuses and adjust RV2 until the voltage between Q14c and Q16c is 20mV. Resetting the output to zero volts with RV1 completes setting up.

Leave the amp on for about half an hour and recheck all voltages, making any necessary adjustments connect a speaker to the output and 'test drive' the amp for about an hour. A final check of all voltages and your amplifier is ready to go into service.

ETI

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BC212, BC182, BC237, BF197, BC159, BCY71, all 8p each, RCA 2015 TO3 Power Transistor (Sim to 2N3055) 35p, ACY18 18p BF200 20p Motorola MRD 3051 Photo Transistors 35p, N. Channel F.E.T.s, similar to 2N3819 18p, Mosfet Sim to 40673 35p, 3N140 Mosfets 50p, M203 Dual Matched Pairs Mosfets Single Gate per F.E.T. 40p, SL301 Dual Matched Pair SIL N.P.N. Power Transistors FT 300MHz 30p, Intel 1024 bit MOS Rams 95p, Mullard 68113 Triple Varicap Diode 35p, MC1310 Stereo Decoder I.C.s £1.20, TBA800 I.C. Amps 90p CD4051 CMOS 50p, 741 8-pin D.I.L. 23p, MM5316 Clock Chips £3.50 500v 600mA Bridge Rect. (ex. equip.) 25p, 1N4002 100v 1A Diodes 4p, 14005 800v 1A Diodes 7p, E.H.T. SIL Rec 15Kv 2.5mA, 15mm x 5mm 85p, 7812 12v 1A Plastic V. Rees 95p, Min. Nixies ITT 58705i 13 x 6mm Fig Size 85, Nixies ITT GN/9A 13 x 8mm 65p, 0.2" or 0.125" Red LEDs 12p each, MAN3A 3mm LED Displays 50p, Murata 40KHz transducers 15mm diam, £2.95 pair, 300 volts 2 amps (TOS) Thyristors 30p.

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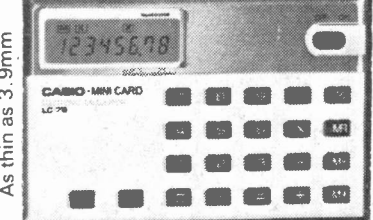


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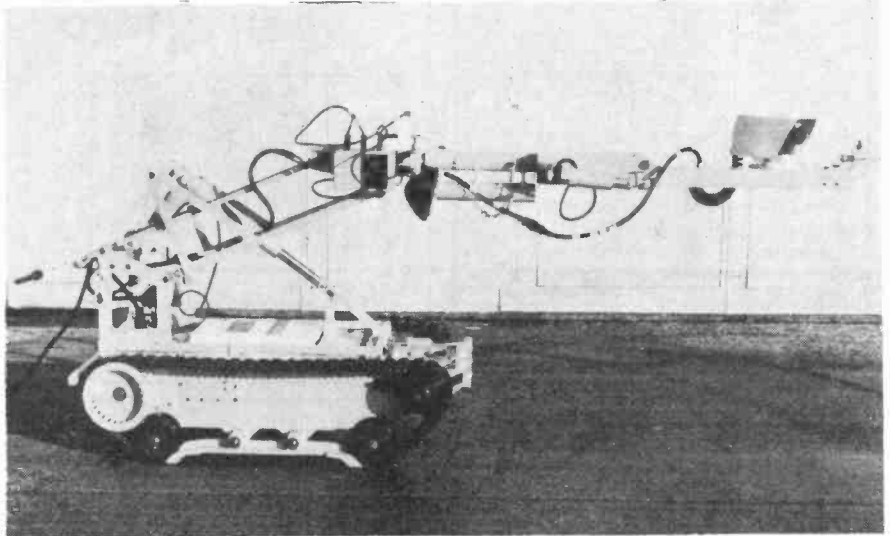
international

What to look for in the May issue: On sale April 8th

ROBOT ISSUE

To many people robots are in the realm of fantasy, forming part of the visionary world of science-fiction. Sci-Fi authors paint scenarios about possible future existences; Dr Peter Sydenham, Electronics Today International special correspondent, and one time robot builder himself, presents the factual side of robots.

Features discuss what robots are, their purpose and structure. An exclusive interview with Britain's robot expert, Professor Thring of Queen Mary College, London, will provoke thought about the future. Dr Mike Larcombe, Head of the Warwick University Robot Laboratory, will explain the state of the art of robot brainpower and combines with Dr Sydenham to provide a guide to constructing professional-quality robots.



C.C.D. PHASER

In the beginning there was tape phasing, and it was good — but cumbersome. Then ETI said, 'Let us use new technology,' and it was good — and compact. Next month we publish a state-of-the-art phaser/flanger using the Mullard TDA1022 delay line, which is a charge coupled device. So if you want really good effects, don't miss the May edition of ETI!

MK2 ELECTRONIC IGNITION

The Mk 1 was originally published in September 1973, and many thousands have been successfully built since then. Stirling Sound have taken the design a step further, refining the component values and designing a PCB (instead of the tagboards). So if you missed it first time round, you can investigate the Mk 2 with added vitamin B and marilbone jelly!

SPOCK RADIO

"Most illogical! How did primitive Earthlings design such a machine?" Beam down next month for the answer.



T159 Review

The Texas T159 is one of the latest pocket card programmables to challenge the calculator market. With its phenomenal programming power — up to 960 program steps memory position, software in plug-in pre-programmed modules and pocketability, this calculator will undoubtedly set the pace for the next few years. Next month we shall be looking critically at the T159 and bringing you all the facts.

HELPING HAND PROJECT

Quite a while ago, we ran a competition in conjunction with the Royal National Institution for the Deaf — next month we publish the winning entry. Although designed as an integrated system, we think the separate units will find applications in other areas besides remote warning for the deaf.

Articles mentioned here are in an advanced state of preparation but circumstances may affect the final contents.

data sheet

TGS 812/813 GAS SENSOR

FIGARO

THE TGS 812/813 are semiconductor gas sensors suitable for general purpose combustible gas detection.

The sensor consists of a ceramic tube onto which is deposited a layer of the semiconductor (mainly tin dioxide) and the electrodes.

In fresh air the resistance of the semiconductor is constant, but as the concentration of the detectable gases increases and comes into contact with the sensor's surface, the resistance of the semiconductor changes.

In order to increase the response time of the device, the sensor is heated to a temperature between 200 and 400°C by a heated coil in the ceramic tube.

The sensitivity characteristics of the TGS sensors are altered by changes in atmospheric temperature and humidity. The detection principle of the sensor is based on chemical absorption and desorption of gases on the sensor's surface, and because these reactions are temperature dependent and water vapour can be considered a gas, the effects of temperature and humidity changes cannot be eliminated from the sensor. These effects can, however, be reduced by suitable circuit design (see Fig 7).

The TGS812/813 sensors are available from:
Watford Electronics
 33-35 Cardiff Road Watford Herts.

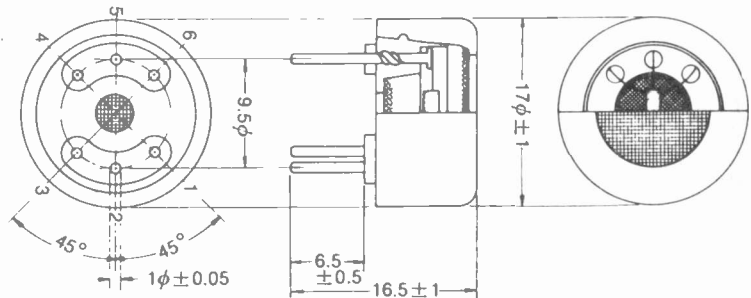
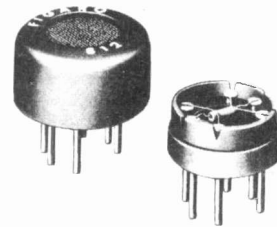
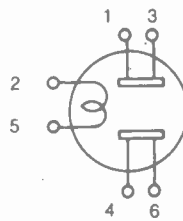
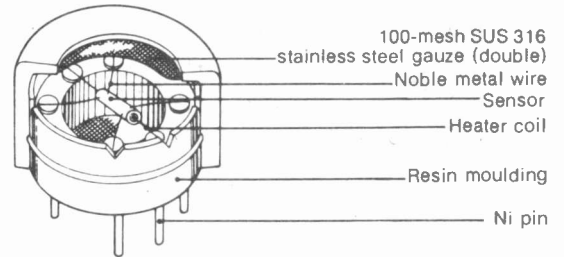


Fig 1. Mechanical structure of types 812 & 813 sensors, in mm.

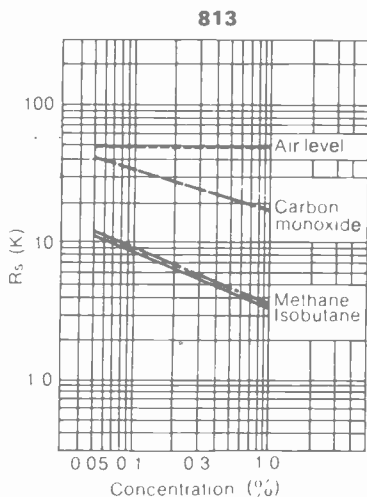
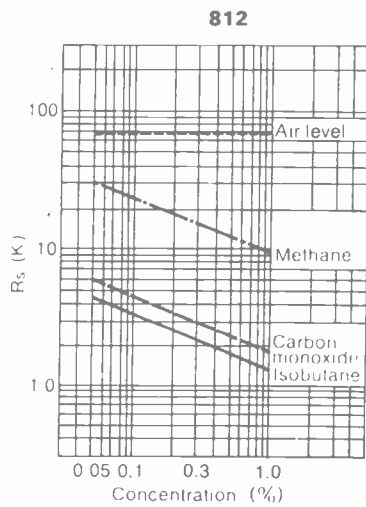


Fig 2. Sensor resistance (R_s) changes with different concentrations of gas.

TYPE NO.	TGS 812/813
TEST CONDITION	
(A) Circuit Voltage (VC)	10V (A.C. or D.C.)
(B) Heater Voltage (VH)	5.0V (A.C. or D.C.)
Heater Power	
Dissipation (PH)	Approx. 650mW.
(C) Load Resistance (RL)	4K
WARM-UP TIME	Approx. 2 min.
HEATER RESISTANCE (RH)	38±3
SENSOR RESISTANCE (Rs)	1~10K in Isobutane 1000ppm/air
RATIO OF RESISTANCE	$\frac{R_s \text{ in Isobutane } 3000\text{ppm/air}}{R_s \text{ in Isobutane } 1000\text{ppm/air}} = 0.63 \pm 0.05$

Fig 3. Sensor characteristics.

Sensor type	Electrical ratings	Applications and Features
812	V _{CC} : (Max.)24V V _H : 5.0V	General purpose combustible gas detection. Carbon Monoxide detection. High CO sensitivity enables most types of smoke to be detected.
813	V _{CC} : (Max.)24V V _H : 5.0V	General purpose combustible gas detection. Methane detection. High CH ₄ sensitivity makes it suitable for Natural Gas detectors.

Fig 4. Differences in sensitivities between 812 & 813.

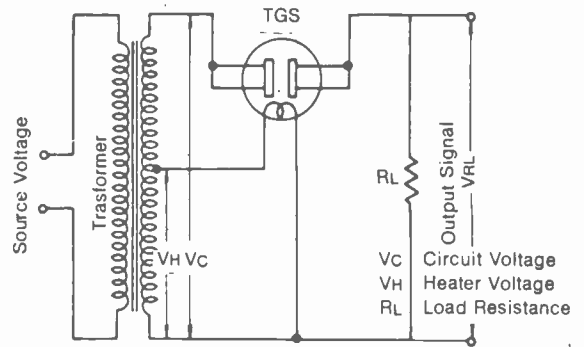


Fig 5. Basic test and measuring circuit.

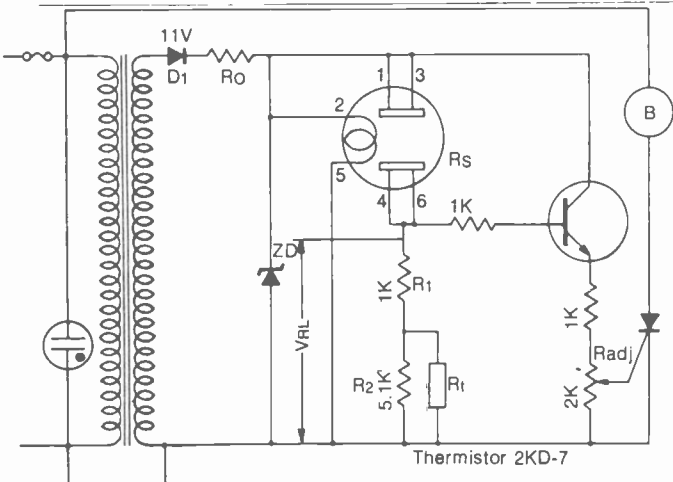


Fig 6. Circuit for use as a gas leak detector.

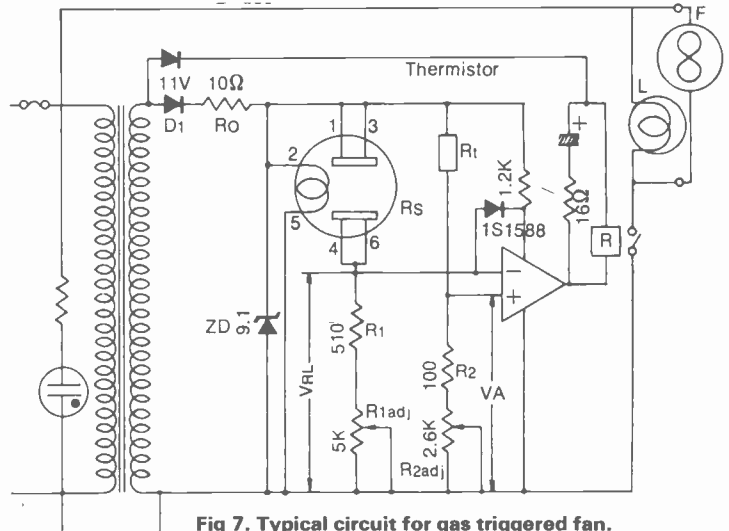


Fig 7. Typical circuit for gas triggered fan.

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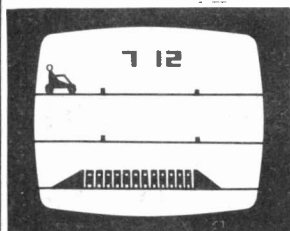
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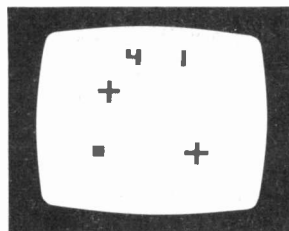
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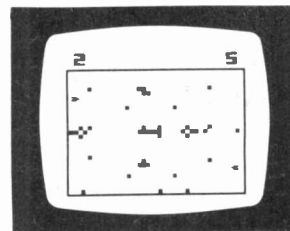
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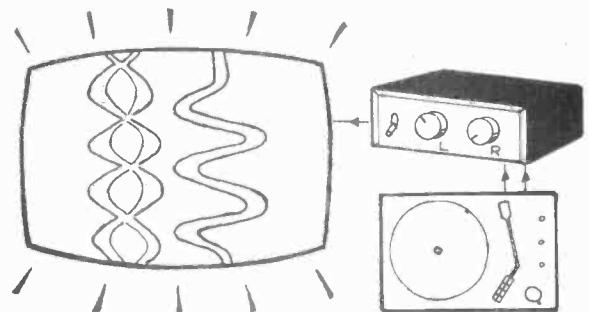
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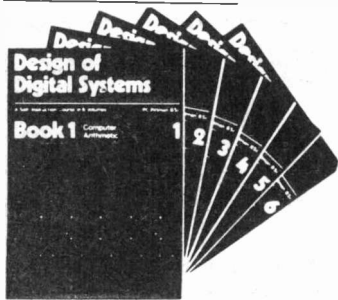
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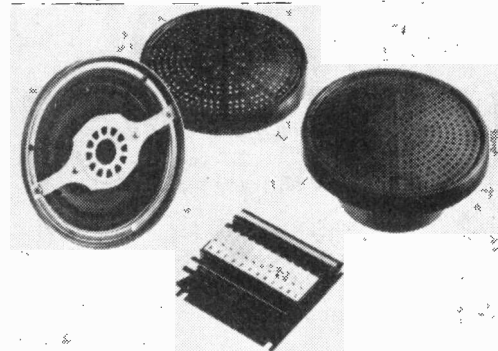
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(14)	25	20	16	14	16	36	34	32	30
(16)	25	20	16	14	18	38	36	34	32
(20)	28	27	26	20	22	40	38	36	34
(22)	34	33	30	239	28	42	40	38	36
(28)	36	35	34	28	24	44	42	40	38
(34)	36	35	34	289	36	46	44	42	40
(36)	44	43	42	367	36	46	44	42	40
(40)	60	58	57	493	40	56	54	52	50

7400 TTL Series

7400	18	7441	75	7496	80	74160	130
7401	20	7442	76	7497	82	74161	130
7402	20	7443	120	74100	125	74162	130
7403	20	7445	105	74107	40	74163	140
7404	20	7446	105	74108	40	74164	150
7405	25	7447	85	74110	80	74165	140
7406	35	7448	95	74116	200	74166	150
7407	35	7450	70	74120	70	74167	150
7408	25	7451	20	74121	55	74170	200
7409	25	7453	20	74122	45	74172	9.75
7410	30	7454	20	74123	90	74173	100
7411	25	7460	20	74125	55	74174	1.10
7412	40	7470	40	74126	60	74175	1.20
7413	75	7472	74	74128	65	74176	1.50
7416	35	7473	40	74132	1.50	74177	90
7417	40	7474	40	74136	1.80	74180	1.00
7420	20	7475	70	74141	1.15	74181	2.00
7422	75	7476	40	74142	4.00	74182	90
7425	30	7479	200	74144	4.00	74184	2.00
7426	30	7480	60	74145	1.10	74185	2.00
7427	35	7482	1.50	74147	2.50	74186	12.00
7428	40	7483	85	74148	7.75	74190	1.40
7429	40	7485	1.10	74150	1.00	74191	1.25
7430	25	7486	40	74151	1.10	74192	1.10
7432	30	7489	2.75	74153	1.10	74193	1.10
7433	40	7490	55	74154	1.10	74194	1.20
7437	30	7491	1.10	74155	1.10	74195	1.00
7438	35	7492	60	74156	1.10	74196	1.10
7439	36	7493	60	74157	1.20	74197	1.30
7440	20	7494	85	74158	7.75	74198	1.50
		7495	90	74159	3.60	74199	1.75

74LS00

74LS00	29	74LS130	125	74LS192	275
74LS01	29	74LS131	125	74LS193	275
74LS02	29	74LS132	125	74LS194	275
74LS03	29	74LS133	125	74LS195	187
74LS04	29	74LS134	125	74LS196	187
74LS05	29	74LS135	125	74LS197	187
74LS10	29	74LS136	125	74LS201	200
74LS12	29	74LS137	125	74LS202	200
74LS13	29	74LS138	125	74LS203	200
74LS14	110	74LS139	125	74LS204	200
74LS15	40	74LS140	125	74LS205	200
74LS16	69	74LS141	125	74LS206	200
74LS17	69	74LS142	125	74LS207	200
74LS18	69	74LS143	125	74LS208	200
74LS19	69	74LS144	125	74LS209	200
74LS20	69	74LS145	125	74LS210	200
74LS21	40	74LS146	125	74LS211	200
74LS22	40	74LS147	125	74LS212	200
74LS23	40	74LS148	125	74LS213	200
74LS24	40	74LS149	125	74LS214	200
74LS25	40	74LS150	125	74LS215	200
74LS26	39	74LS151	125	74LS216	200
74LS27	39	74LS152	125	74LS217	200
74LS28	39	74LS153	125	74LS218	200
74LS29	39	74LS154	125	74LS219	200
74LS30	29	74LS155	125	74LS220	200
74LS31	29	74LS156	125	74LS221	200
74LS32	29	74LS157	125	74LS222	200
74LS33	29	74LS158	125	74LS223	200
74LS34	29	74LS159	125	74LS224	200
74LS35	29	74LS160	125	74LS225	200
74LS36	29	74LS161	125	74LS226	200
74LS37	29	74LS162	125	74LS227	200
74LS38	29	74LS163	125	74LS228	200
74LS39	29	74LS164	125	74LS229	200
74LS40	29	74LS165	125	74LS230	200
74LS41	29	74LS166	125	74LS231	200
74LS42	29	74LS167	125	74LS232	200
74LS43	29	74LS168	125	74LS233	200
74LS44	29	74LS169	125	74LS234	200
74LS45	29	74LS170	125	74LS235	200
74LS46	29	74LS171	125	74LS236	200
74LS47	29	74LS172	125	74LS237	200
74LS48	168	74LS173	125	74LS238	200
74LS49	29	74LS174	125	74LS239	200
74LS50	29	74LS175	125	74LS240	200
74LS51	29	74LS176	125	74LS241	200
74LS52	29	74LS177	125	74LS242	200
74LS53	29	74LS178	125	74LS243	200
74LS54	29	74LS179	125	74LS244	200
74LS55	29	74LS180	125	74LS245	200

CMOS

34001	40	4050	61	4517	850	MM74C129N	139
4000	25	4051	110	4518	105	MM74C130N	139
4001	25	4052	110	4519	90	MM74C131N	139
4002	25	4053	110	4520	185	MM74C132N	139
4004	350	4060	325	4521	25	MM74C133N	139
4006	40	4061	700	4522	175	MM74C134N	139
4007	25	4063	250	4527	300	MM74C135N	139
4008	125	4066	35	4528	175	MM74C136N	139
4010	48	4067	600	4583	145	MM74C137N	139
4011	25	4068	35	4584	75	MM74C138N	139
4012	25	4070	85			MM74C139N	139
4013	60	4071	35			MM74C140N	139
4014	125	4072	35	MM74C00N	38	MM74C00N	84
4015	125	4073	35	MM74C01N	38	MM74C01N	84
4016	59	4075	35	MM74C02N	38	MM74C02N	84
4017	125	4076	185	MM74C03N	38	MM74C03N	84
4018	125	4077	47	MM74C04N	38	MM74C04N	84
4019	70	4078	35	MM74C05N	38	MM74C05N	84
4020	125	4081	35	MM74C06N	38	MM74C06N	84
4021	125	4082	35	MM74C07N	38	MM74C07N	84
4022	125	4085	135	MM74C08N	38	MM74C08N	84
4023	35	4086	300	MM74C09N	38	MM74C09N	84
4024	100	4089	300	MM74C10N	38	MM74C10N	84
4025	35	4093	75	MM74C11N	38	MM74C11N	84
4026	225	4098	250	MM74C12N	84	MM74C12N	565
4027	50	4100	175	MM74C13N	84	MM74C13N	565
4028	125	4161	175	MM74C14N	200	MM74C14N	1200
4029	150	4162	175	MM74C15N	200	MM74C15N	1200
4030	60	4163	175	MM74C16N	99	MM74C16N	1200
4032	160	4174	175	MM74C17N	675	MM74C17N	1200
4033	200	4175	160	MM74C18N	132	MM74C18N	1200
4034	350	4184	180	MM74C19N	389	MM74C19N	1200
4035	160	4501	175	MM74C20N	189	MM74C20N	84
4038	160	4502	175	MM74C21N	189	MM74C21N	84
4040	150	4503	175	MM74C22N	189	MM74C22N	84
4041	48	4506	70	MM74C23N	189	MM74C23N	84
4042	125	4507	100	MM74C24N	567	MM74C24N	84
4043	120	4508	400	MM74C25N	340	MM74C25N	84
4044	25	4510	175	MM74C26N	171	MM74C26N	84
4045	250	4511	200	MM74C27N	257	MM74C27N	84
4046	150	4512	150	MM74C28N	189	MM74C28N	84
4047	250	4514	475	MM74C29N	161	MM74C29N	84
4048	100	4515	475	MM74C30N	161	MM74C30N	84
4049	61	4516	175	MM74C31N	161	MM74C31N	84

LINEAR

LM300A	170	LM702H	79	LM211N	139
LM301AH	35	LM703LN	45	LM2900N	139

Avoid the horrors of heavenly H₂O with our Project Teams

RAIN ALARM

MARCH WINDS AND APRIL showers bring forth May flowers — not exactly poetry, more accurate reporting of activity on the weather and horticulture fronts at this time of year. Additionally the bit about April showers is likely to bring forth more than the odd May bud if one of these periods of intermittent precipitation disrupts a busy housewife's washday by relegating her almost dry laundry to the ranks of the wet behind the eiderdown brigade.

It May Rain!

It's here that the good guys of the ETI project team come to the rescue with their Rain Alarm. This little fellow might well upstage any canine companion as a housewife's best friend, at least on washday, by giving a warning at the first sign of rain, giving plenty of time to get the washing in before it gets too wet.

The rain alarm should be placed out in the open and a length of two core wire run between it and an eight ohm speaker. We used an old

intercom sub-station to provide a home for our speaker but a car extension speaker or indeed any suitably boxed eight ohm device would be fine.

Any rain falling on the sensor track, formed as part of the PCB (neat innit?), will set off the alarm and produce a distinctive, intermittent bleep-bleep.

Construction

Construction is straightforward if the PCB layout shown is used and in the case of this project we would recommend that the PCB is used, as this adds to the attractiveness of the project.

Assemble the components according to the overlay, ensuring that the tantalum capacitor is connected the right way round. If you do not use a socket for IC1, solder pins seven and fourteen before the others (this allows the device's internal protection circuitry to function).

In our prototype we used a value of 4M7 for R1 which acts as a sensitivity adjustment. This value leads to a 'hair trigger' alarm and the value could well be reduced according to the level of sensitivity required.

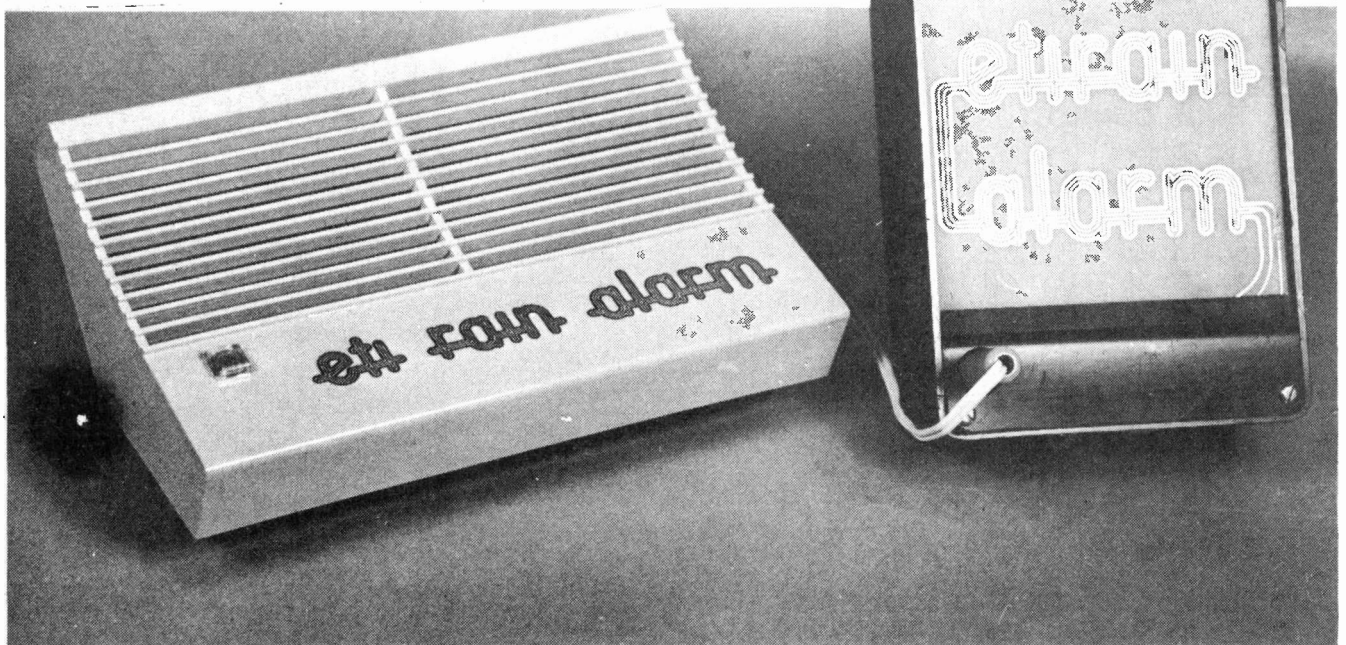
When construction is complete and the alarm has been tested the area of the PCB that holds the components should be covered with some suitable non-conducting potting compound — epoxy resin should do — to render it waterproof.

Power To Your

Power consumption of the unit is so low when the alarm is not triggered that it was not thought necessary to provide an on/off switch.

While this unit is not as effective as a device to control the weather — still working on that one — it should at least prevent some of those washday blues.

ETI



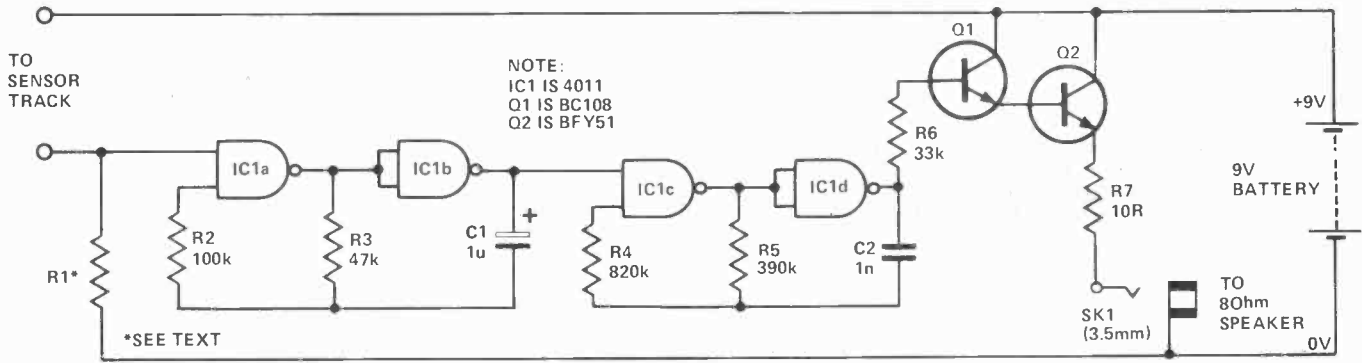
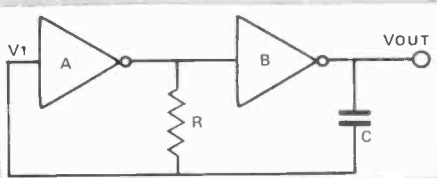


Fig. 1. Circuit diagram of Rain Alarm.

HOW IT WORKS

THE rain alarm is formed by two gated CMOS oscillators and an audio output stage.

The basic CMOS oscillator is shown in Fig. 2. Upon switch on, with C discharged, the output of inverter B will be low, the input to A low and its output high. Capacitor C will now commence to charge towards supply, the voltage level at A's output, via resistor R.



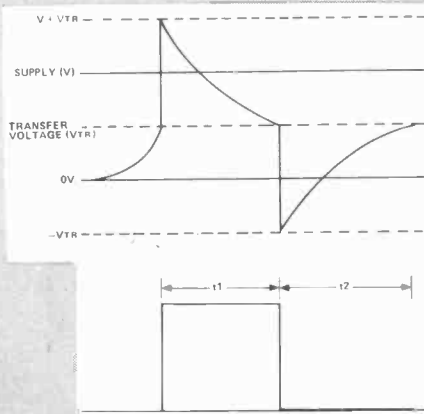
We can consider a CMOS gate to be a comparator that will change output state when the level of voltage at its input reaches a specified value, the transfer voltage (V_{tr}), usually about half supply. Thus as the voltage on C increases due to the charge current being supplied by R there will come a point when the voltage on the input of A will pass its transfer voltage and the output of B to go high.

At this point the charge on C corresponds to a voltage level of approximately half supply.

As the inverters A and B change states the end of C that was held at 0 volts is now at

supply and the end of C that was connected to supply via R is now returned to 0 volts via the same resistor.

These changes together with the charge stored on C mean that the potential across C is now supply plus the transfer voltage of gate A. This is shown in Fig. 3.



Capacitor C will now discharge via R until once again the transfer voltage of A is reached whereupon the outputs of the inverters will assume their original states.

The conditions are not quite the same as at

switch on because, as can be seen in Fig. 3, the Potential across C is now a negative value equal to A's transfer voltage.

From this point C charges via R again to repeat the cycle.

The output is shown in Fig. 3 where $t_1 = t_2 = 1.1 RC$ (the time taken for C to charge (discharge) via R to two-thirds of the maximum value of voltage across it).

In practice, due to the protection networks associated with modern CMOS devices, it is necessary to include a resistor in series with the input of A in order to ensure that the voltages across C are allowed to reach the values shown in Fig. X.

The final circuit diagram (Fig. 1) of the Rain Alarm shows that the inverters are in fact formed from the four NAND gates of a 4011 package. In each oscillator, while one gate is configured as a straightforward inverter, the other has one input that can act as a control input, oscillator action being inhibited if this input is held low.

The first oscillator (IC1a and IC1b) has this input tied low via a high value resistor (R1) that acts as a sensitivity control. Thus this oscillator will be disabled until the control input is taken high. Any moisture bridging the sensor track will so enable the output which is square wave at about 10 Hz. This in turn will gate on and off the 500 Hz oscillator formed by IC1c and IC1d.

This latter oscillator drives the loud-speaker via R6, the Darlington pair formed by Q1 and Q2 and resistor R7.

PARTS LIST

RESISTORS (all 1/4W 5%)

R1	See text
R2	100k
R3	47k
R4	820k
R5	390k
R6	33k
R7	10R

CAPACITORS

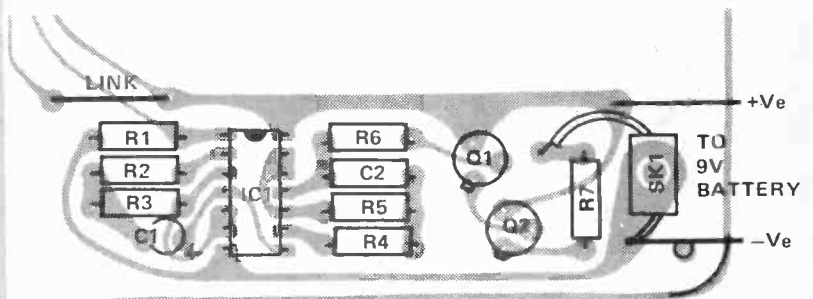
C1	1u0 16 V tantalum
C2	1n0 polyester

SEMICONDUCTORS

IC1	4011
Q1	BC 108
Q2	BFY 51

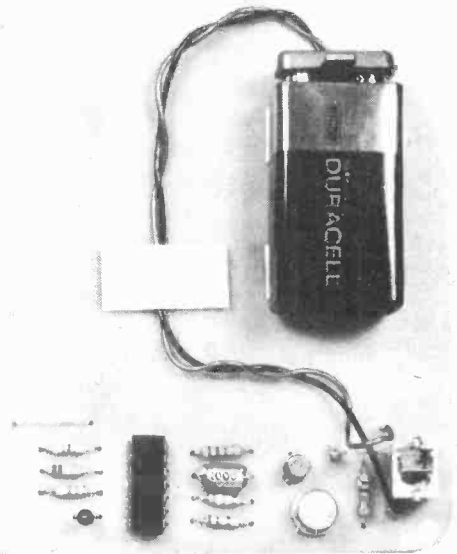
MISCELLANEOUS
PCB as pattern, 3.5mm jack socket, 8R speaker, battery.

Fig. 2. Overlay of the section of the Rain Alarm PCB that holds the components.



BUYLINES

The PCB will be available from any of the usual suppliers that advertise in ETI. C1 must be a low voltage tantalum but this component should be widely available. All of the other components are likewise obtainable from most electronic retailers.



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* 30 Kynar stripped 1" on each end. Lengths are overall Colors: Red, Blue, Green, Yellow, Black, Orange, White. Wire packaged in plastic bags. Add 25¢/length for tubes.

	100	500	1000	5000
2 1/2 in.	78	2.40	4.30/K	3.89/K
3 in.	82	2.50	4.71/K	4.22/K
3 1/2 in.	86	2.80	5.12/K	4.55/K
4 in.	90	3.00	5.52/K	4.88/K
4 1/2 in.	94	3.21	5.93/K	5.21/K
5 in.	98	3.42	6.34/K	5.52/K
5 1/2 in.	1.02	3.65	6.75/K	5.86/K
6 in.	1.06	3.85	7.16/K	6.19/K
6 1/2 in.	1.15	4.05	7.57/K	6.52/K
7 in.	1.20	4.25	7.98/K	6.85/K
7 1/2 in.	1.25	4.45	8.39/K	7.18/K
8 in.	1.29	4.65	8.80/K	7.53/K
8 1/2 in.	1.32	4.85	9.21/K	7.84/K
9 in.	1.36	5.05	9.62/K	8.17/K
9 1/2 in.	1.40	5.25	10.03/K	8.50/K
10 in.	1.45	5.51	10.44/K	8.83/K
Addl. in.	10	.41	.82/K	.66/K

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18 pin	.45	.43	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.44	.41
20 pin	.54	.78	.71	.63	.59	.54
22 pin	1.30	1.20	1.10	.95	.90	.84
24 pin	.91	.84	.78	.68	.64	.59
28 pin	1.25	1.15	1.08	.95	.89	.82
40 pin	1.65	1.55	1.42	1.25	1.15	1.09

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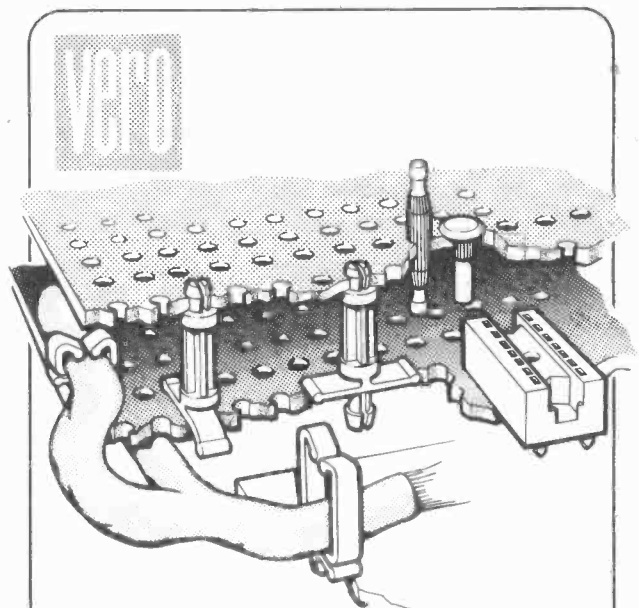
	SINGLE ENDED			DOUBLE ENDED		
	14 pin	16 pin	24 pin	14 pin	16 pin	24 pin
6"	1.24	1.34	2.05	2.24	2.45	3.37
12"	1.33	1.44	2.24	2.33	2.55	3.92
24"	1.52	1.65	2.63	2.52	2.76	4.31
48"	1.91	2.05	3.40	2.91	3.17	5.08

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POWER AMP 60 — 60w. r.m.s./4 ohms, 2 ch. mixer **£48.00**

POWER AMP 100 — 100w. r.m.s./4 ohms, 4 ch. mixer **£85.00**

100w. SLAVE AMP **£50.00**

LOUDSPEAKERS

Disco 25 — 25w. r.m.s. in cabinet, 20' lead **£23.95**

Disco 50 — 50w. r.m.s. in cabinet, 20' lead **£39.95**

Disco 100 — 100w. r.m.s. in cabinet, 20' lead **£55.95**

Ampower 50 — 50w. amp & speaker in cabinet **£60.00**

Ampower 100 — 100w. amp & speaker in cabinet **£80.00**

Complete Disco with Disco 2 console and

Ampower 50 **£155.00**

ditto with Disco 2 console & two Ampower 50s **£210.00**

ditto with Disco 2 console & one Ampower 100 **£175.00**

ditto with Disco 2 console & two Ampower 100s **£250.00**

Carriage in U.K. please add for SSTL Unit £1; for Power Amps 40 & 60 £1.50; for Power Amp 100 & 100w. Slave Amp or Disco 25 or 50 £2.00 Ampower 50 and 100, Disco Console or Disco 100 £5.00. Complete Discos, £10.

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BASIC MODULES

For constructors wishing to build systems to their own requirements. As their description implies, these

modules will require control knobs, pots in some cases, etc. Each module is supplied assembled on its own PCB

SSB4 Phase splitter (for two SS 105s) **£2.75**

SS104/2 Two channel mixer stage **£3.75**

SS104/4 Four channel mixer stage **£7.00**

SS.DTM

Output control stage Master vol. 30dB variation on both treble and bass; 3mV in for 2V out. 18V working voltage

£6.75

SSTL3/250 Sound/light, 3 ch., 250w. ea **£9.25**

SSTL3/1000 Sound/light, 3 ch., 1000w. ea **£11.50**

POWER AMPS.

Ready assembled on P.C.B.s, tested and guaranteed. Easy to connect. With instructions. Output ratings ± 1 dB.

- SS.103 1 C. amp. 3 watts R.M.S. using 20V/8 Ω or 14V/4 Ω . Input 100mV **£2.85**
- SS.103-3 Stereo version of above, 2 I.C.s. **£5.00**
- SS.105 5 watts R.M.S. into 3 Ω using 13.5V. Sensitivity — 30mV. THD — 0.3%. $3\frac{1}{4}$ " x 2 " x 1 " **£3.95**
- SS.110 10 watts R.M.S. into 4 Ω using 24V. Sensitivity — 60mV. THD — 0.3%. $3\frac{1}{4}$ " x 2 " x 1 " **£4.65**
- SS.120 20 watts R.M.S. into 4 Ω using 34V. Sensitivity — 80mV. THD — 0.3%. $3\frac{1}{4}$ " x 2 " x 1 " **£5.15**
- SS.125 25 watts R.M.S. into 8 Ω using 50V. Sensitivity — 140mV. Distortion — Less than 0.05% into 8 Ω S/N better than 70dB **£7.25**
- SS.140 40 watts R.M.S. into 4 Ω using 45V. Sensitivity — 300mV. Distortion typically 0.1%. 5 " x $3\frac{1}{2}$ " x $1\frac{1}{4}$ " **£6.50**
- SS.160 64 watts R.M.S. into 4 Ω using 50V. Sensitivity — 350mV. Distortion typically 0.1%. 5 " x $3\frac{1}{4}$ " x $1\frac{1}{4}$ " **£8.50**
- SS.1100 100 watts R.M.S. into 4 Ω using 70V/2A. Input sensitivity — 500mV. Distortion at half-power, typically 0.1%. 5 " x $3\frac{1}{2}$ " x $1\frac{1}{4}$ " **£10.50**
- HS.160 Multi-finned heatsink for SS.140 or SS.160 **75p**
- HS.1100 Ditto for SS.1100 **£1.50**

POWER SUPPLIES

Every Stirling Sound Power Unit is tested and guaranteed under working conditions before despatch. All units except SS.312 include a stabilised low voltage take-off point (13-15V) for pre-amp, tone control, radio tuner, etc. Outputs quoted are minimal unloaded ratings.

SS.312 12V/1A **£6.60**

SS.318 18V/1A **£6.95**

SS.324 24V/1A **£7.65**

SS.334 34V/2A **£8.75**

SS.345 45V/2A **£10.75**

SS.350 50V/2A **£11.75**

SS.360 60V/2A **£12.75**

SS.370 70V/2A **£14.75**

SS.310/50 Stabilised power supply unit with variable output from 10V to 50V/2A. Short circuit protected **£17.75**

SS.300 Power stabilising unit variable from 10 to 50V/BA for adding to unstabilised supply units **£5.50**

CONTROL/PRE-AMPS.

UNIT ONE

Combined stereo pre-amp & active tone control unit 50mV in for 200mV out 10 16V operation Bass ± 15 dB; Treble ± 15 dB; Balance control; Volume control. Ceramic P.U., radio or tape inputs. WITH FREE CONTROL PANEL FASCIA **£9.00**

UNIT TWO

Controls as UNIT ONE but for magnetic cartridge input. 5mV in for 200mV out. R.I.A.A. corrected. WITH FREE CONTROL PANEL FASCIA **£12.43**

CONTROL PANEL FASCIA

For above **50p**

SS.100

Basic active stereo tone control module to provide ± 15 dB on bass at 30Hz and on treble at 10KHz **£3.00**

SS.101

Stereo pre-amp suitable for ceramics, tape, radio, etc **£2.75**

SS.102

Stereo pre-amp for mag. pick-ups **£4.45**

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Please send (or as list attached) for which I enclose £

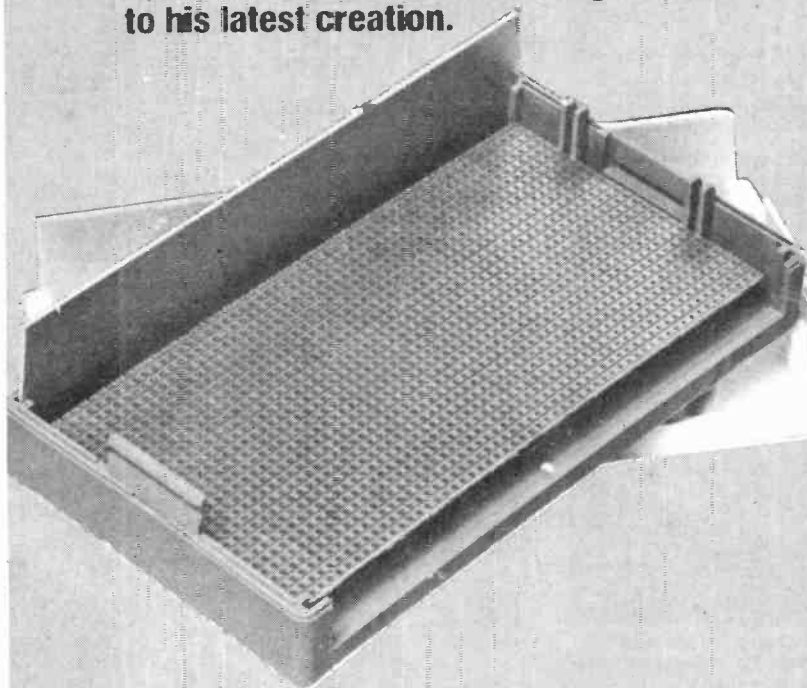
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PROJECT CASINGS SURVEY

Built a project recently and don't know where to put it? William King has been looking at some of the vast range of project cases available to the amateur constructor to enable him to add the finishing touches to his latest creation.



UNLESS YOU ONLY go in for the assembly of commercial electronic kits which come complete with a ready drilled case and all the nuts, bolts and washers required to produce a project with an almost professional finish, you may never have realised that amateur "electronics" is more than just soldering neatly and knowing the difference between a pretty "C280" series capacitor and a liquorice allsort, but that a little "metal bashing" is also required.

Casing The Joints

Electronics can often be a very uninteresting subject and a PCB full of the latest chips is not going to be as interesting to a friend (with little or no electronic knowledge) as would be a (say) simple electronic dice built in a nice neat plastic box. Although some people seem to believe that so long as their latest high power electronic rat exterminator works it doesn't matter if it is housed in a tobacco tin held together with insulating tape and chewing gum. Needless to say this is not the attitude we expect from ETI readers.

A little extra money spent on a few basic tools (small drill and assorted bits, files, nuts, bolts, washers) is really essential (making holes in plastic boxes with your soldering iron is not a good idea). This coupled with a little time spent selecting a case, can turn a mediocre run-of-the-mill project into an impressive piece of electronic sophistication that you won't feel embarrassed to have lying around when the friends/relatives drop in unexpectedly.

Although there are many different cases in a multitude of shapes and sizes, the daunting prospect of choosing a suitable case is eased by the parameters governed by the project itself — is screening required? Will it take a PP9 battery, will it fit in your pocket?

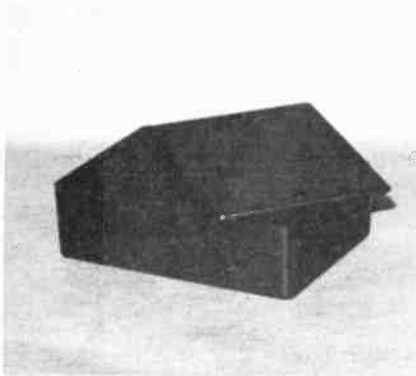
Once a box has been chosen the work begins. The first essential is a layout of all the controls, sockets cable exits and any other holes which need to be made. Careful attention should be made to details such as not mounting audio switches near mains switches to avoid hum pick up.

Once satisfied that the panel has been designed to be both aesthetic and functional, drilling can begin. This successfully completed leaves only one more stage before the project can be fitted into its housing, this is inscribing legends for the controls.

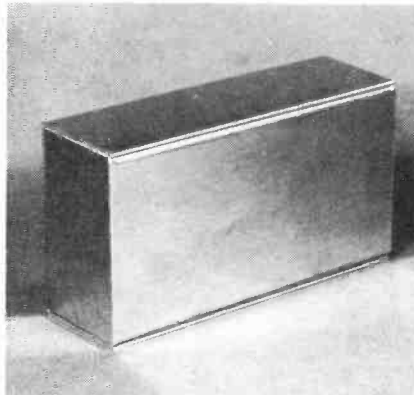
This can be done in a variety of ways (typed labels glued on, dymo type labelling strips . . .) but the method which gives the most professional appearance is rub down lettering transfers (a set of transfers suitable for panel marking, including potentiometer scales (rotary and slider) is available from ETI — see the advert in this issue.

If using transfers it is best to either use a clear varnish spray or self adhesive plastic film to prevent the lettering from rubbing off with use.

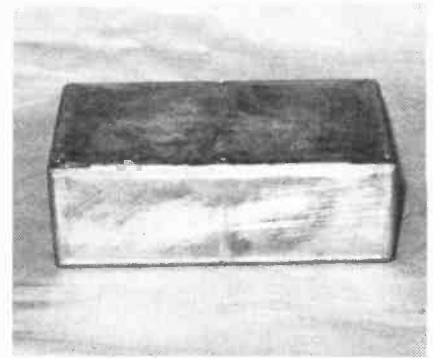
All that remains then is to secure the project in its case, stand back and admire . . .



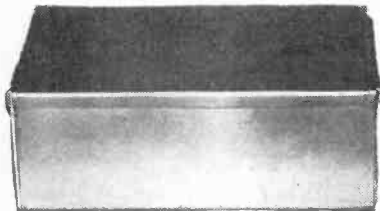
All-plastic 'Gemini' box and lid in black, grey or white. 110x70x30 at 71p. Supplier B.



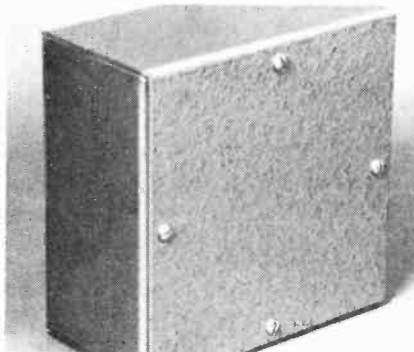
Aluminium plate box in two parts. 6 sizes available. Supplier B.



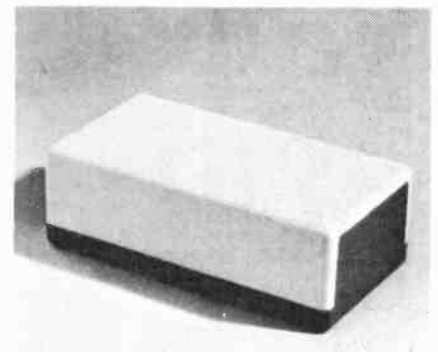
'Eddystone' die-cast aluminium boxes in 1.5mm thick walls. 8 sizes available from 89x38x32 to 222x146x108. Prices from £1.13. Suppliers B & C.



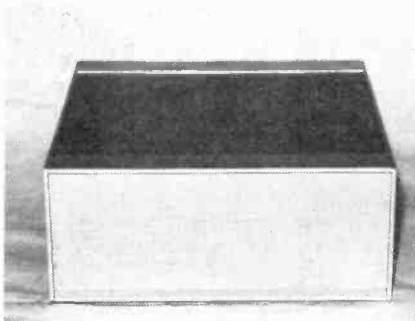
Folded aluminium boxes with lid and screws. 20 sizes from 76x51x25 to 304x203x76. Prices from 49p to £2.27. Supplier B



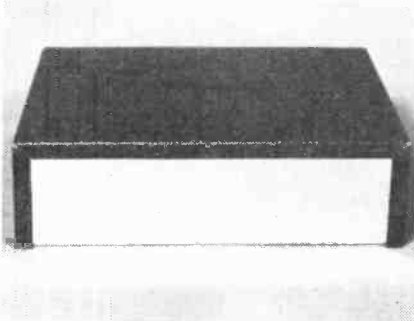
16 SWG aluminium, silver hammer finish cubical boxes. Type N in 3 sizes from 102x102x51 to 203x152x51. Prices from £1.90. Supplier A.



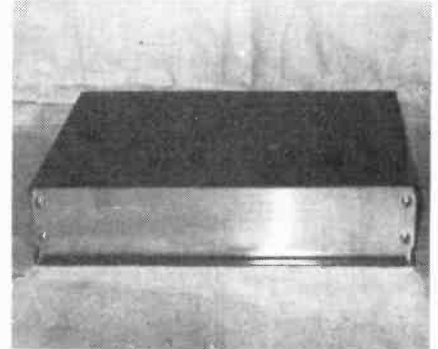
65 series plastic two-piece rectangular cases in white/grey. Sizes from 100x50x25 at £1.80. Supplier G.



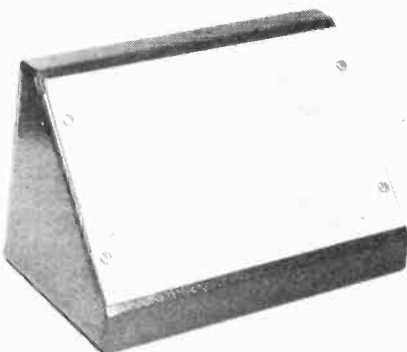
'Classic' instrument case. Satin-finished anodised aluminium with textured vinyl-coated steel top & bottom plates. 6 sizes from 216x127x63. Price from £7.94. Supplier B.



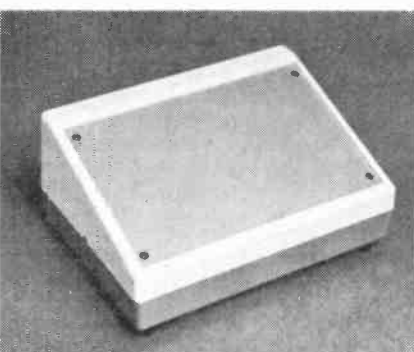
Aluminium two part construction case (type PJ) with front and rear vinyl covered. 7 sizes available from 127x63x57 to 305x158x133. Prices from 65p. Supplier B.



'Opal range', steel cases with aluminium panels, in 3 sizes from 65x58x210 to 65x160x210 with price from £9.67. Supplier B.

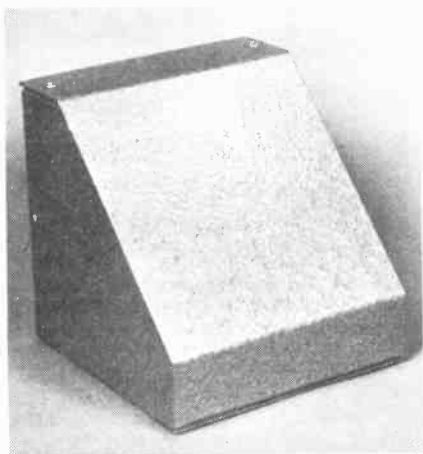


Steel cases with 45° sloping aluminium panels available in 3 sizes, from 150x95x95 with 150x100 front panel. Price from £2.10. Supplier E.



Two colour plastic case with sloping aluminium panel with mounting points for EUROCARD board. Size 171x121x75. Type 75-1798K at £4.53. Supplier G.

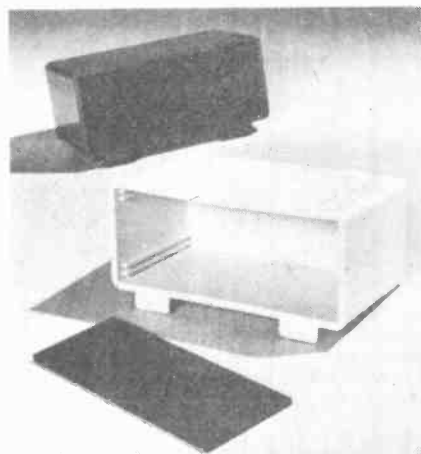
A key to the supplier codes is printed at the end. All dimensions are in millimetres. Prices include VAT but not postage and packing and should be used as a guide only.



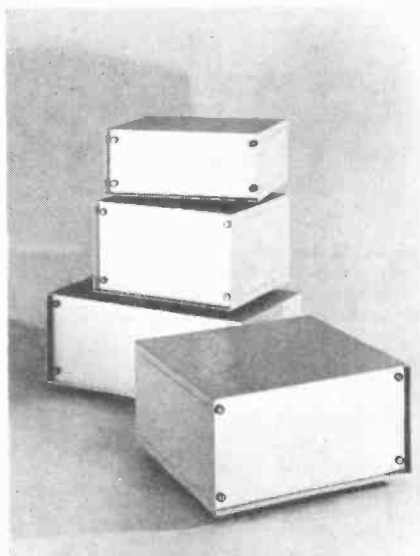
16 SWG aluminium, silver hammer finish. 3-piece construction. Type U case in 8 sizes from 76x76x76 to 381x229x229 from £1.50. Supplier A.



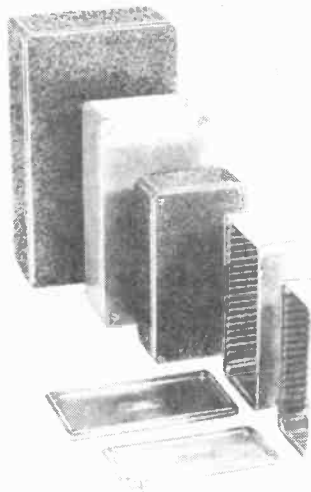
Flip-top polypropylene boxes with aluminium alloy panel in black or yellow. Two sizes 130x75x34 and 196x127x51 at approx £2.05 and £2.70. Supplier G.



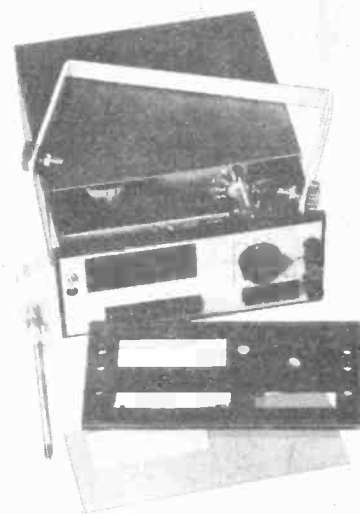
"Time box" for digital clocks in antistatic ABS. Slots for two PCBs available in white, red, orange or blue. Price £2.22. Supplier C.



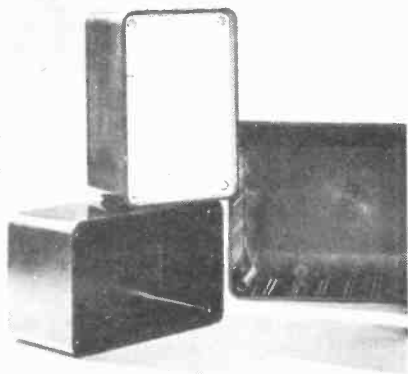
Veropak 49 series cases made of heavy gauge PVC clad steel in 5 sizes from 277 x 113 x 219 with prices from £9.70. Supplier G.



5000 series boxes in die-cast aluminium in 5 sizes with slotted guides for 1.5mm PCBs. Sizes from 100x50x25 with natural or hammertone. Price from £1.05.



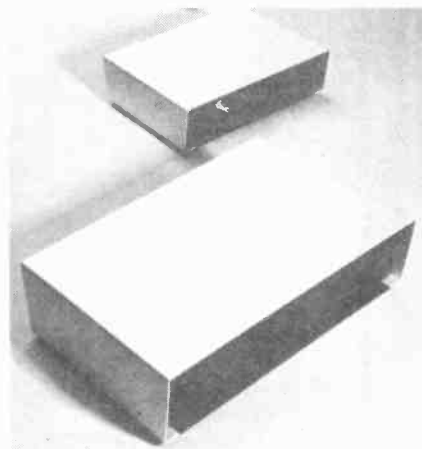
Amatek PDS instrument case system in PVC-coated aluminium with ready drilled front panel. Accepts push button switches, digital displays, meters. Size 178x80x152. Price £9.18. Supplier D.



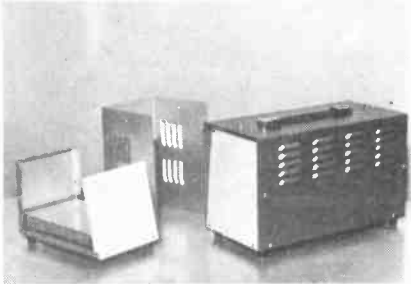
Miniature "Minos" cases in black or white ABS with aluminium panel. Guides for PCBs. 4 sizes from 65 x 100 x 50 to 130 x 200 x 54 at prices from 52p. Supplier C.



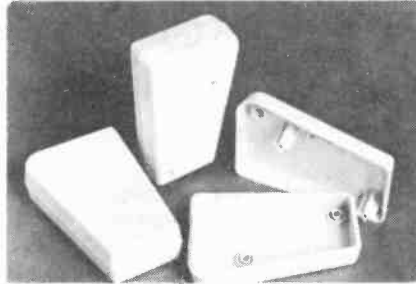
Two vacuum formed cases in black ABS with aluminium panel supplied, for mounting keyboards. Sizes 220 x 276 (about £8) and 550 x 340 (price TBA). Supplier G.



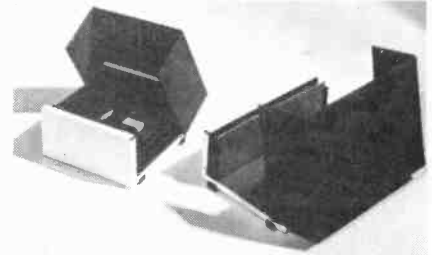
"G range" cases with sloping visor, in 3 sizes with slide on cover. 3 sizes from 44x134x123 from £4.86. Supplier G.



Hammered finished 20 SWG zinc-coated mild steel cases in two colours and 4 sizes, from 101x101x155 to 177x152x307. Supplier E.



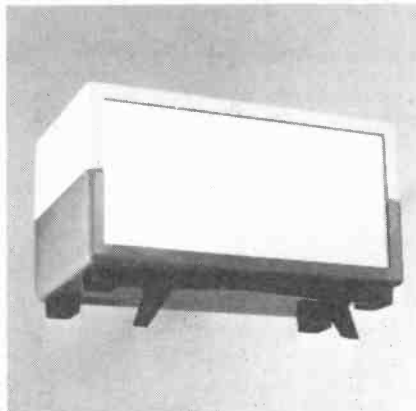
Hand held plastic control boxes approx. 61x94x27 type 75-1799E, in white high impact ABS. Price approx 70p. Supplier G.



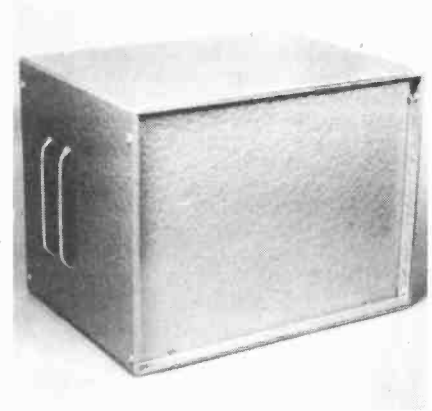
Samos miniature cases in 7 sizes. Two part construction, holds up to 4 PCBs with special PCB feet. Sizes from 50x50x100 to 75x200x125. Prices from £1.47. Supplier C.



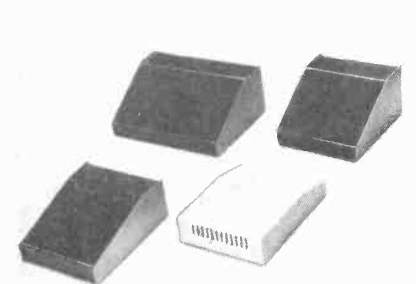
Alfa range plastic cases in 3 sizes. Aluminium panel front & rear. Sizes from 173x130x35 to 173x130x70 with prices from £3.46. Supplier B.



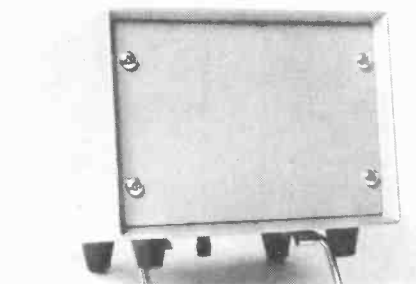
A range of cases in two colours. Plastic with aluminium front & rear panels with provision for tilt leg. Sizes from 85x40x154 at £2.76. Supplier G.



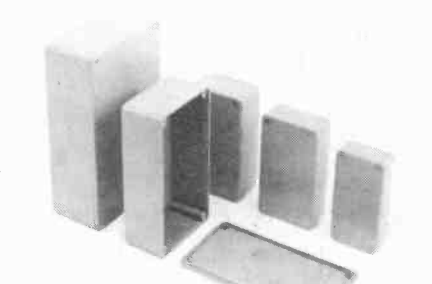
16 SWG aluminium case, silver hammer finish (type W). 4 sizes from 203x152x152 to 381x228x203 with prices from £4.55. Supplier A.



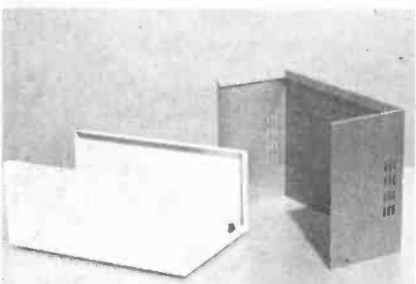
7000 series consoles of all-metal or ABS/metal construction with sizes from 102x28x140 to 356x33x287. Prices from £10.18. Supplier F.



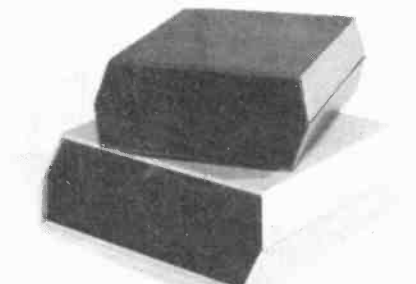
Minicases in mild zinc coated steel sheets with hammertone finish. Sizes from 165x114x114. Supplier E.



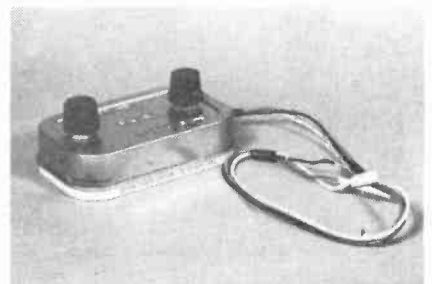
2000 range of boxes in ABS moulded in four colours with slotted guides for 1.5mm PCBs. 5 sizes from 100x50x25 from £1.03. Supplier F.



Zinc-coated mild steel case with vents in blue/light grey. Available in 8 sizes from 127x69x101 with price from £2.64. Supplier E.



"Nuova" enclosures in anti-static abs. Transparent red front panel is inclined at 70°. Contains pillars for PCBs. Four colours and three sizes available, from 120x50x90 at £1.72. Supplier C.



One size boxes in tin-plated steel popular with some constructors. Boxes come with free contents which should be burnt before use. Price varies.

SUPPLIER CODES

A

H. L. Smith & Co Ltd
278-289 Edgware Road
London W2 1BE

D

Amatek
22 Bardsley Lane
Greenwich, London SE10

G

Vero Electronics Ltd
Industrial Estate
Chandlers Ford
Hampshire SO5 3ZR

B

Watford Electronics
33 Cardiff Road
Watford, Herts.

E

Olson Electronics Ltd
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London E2 8HJ

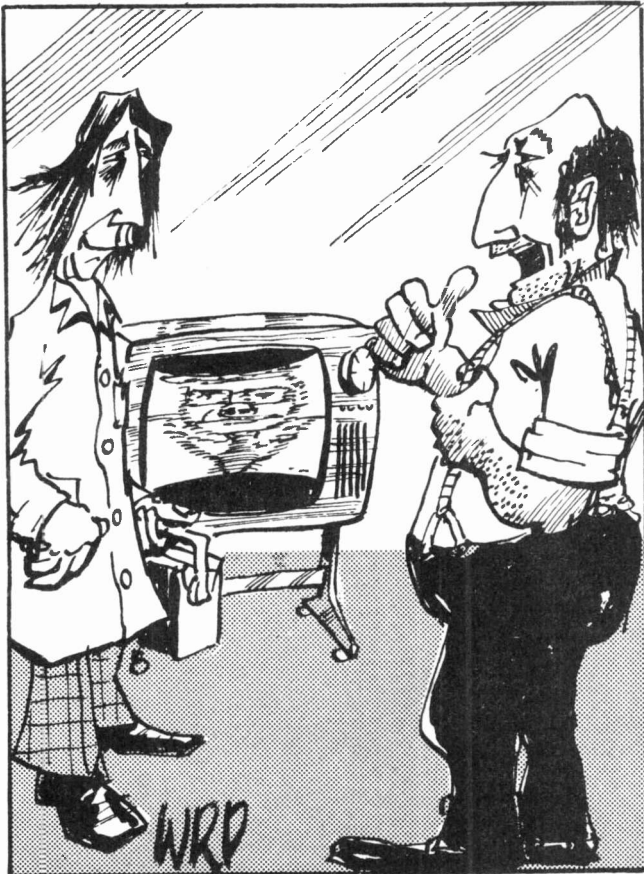
C

West Hyde Developments
Unit 9, Park Street Industrial
Estate
Aylesbury, Bucks.

F

Boss Industrial Mouldings
2 Herne Hill Road
London SE24 0AU

We would like to thank the suppliers for providing photographs and details of their products, and in particular Watford Electronics who rendered us valuable assistance during the compilation of this article.



If it gets much worse the wife'll begin to notice!



That young devil Jenkins is on about lowering the modulus of elasticity of air . . . is he sending me up again Stan?!!

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TRANSFORMERS 6-0-6V 100mA 1.00* 0-0-9V 75mA 1.00* 12-0-12V 100mA 1.15* 0-8-17V 1A 2.15* 0-8-17V 2A 3.25* 0-8-17V 4A 4.35* 20-0-20V+ 1A 3.25* 24-0-24V 500mA 2.15* 0-19-25-33-40-50V+ 1A 3.25* 0-19-25-33-40-50V+ 1A 3.85* 0-19-25-33-40-50V+ 2A 5.45* 0-12-15-20-24-30V+ 1A 3.25* 0-12-15-20-24-30V+ 2A 4.35* Please add an extra 50p to items marked +			DIODES BA114 15p BY105 25p OA91 10p BA115 25p BY126 12p OA200 10p BA145 20p BY127 12p OA202 10p BA148 20p BY133 25p IN914 5p BA155 15p BY182 1.85 IN4003 7p BA156 15p BY250 30p IN4007 8p BAX16 12p OA47 12p IN4148 5p BB105B 50p OA79 12p IN5401 15p BY103 25p OA90 10p IN5407 25p			LIGHT EMITTING DIODES 9-125" (inc. clip) 1+ 10+ 100+ TIL209 Red 15p 13p 11p* TIL212 Yellow(H.B.) 27p 22p 17p* TIL216 Red(H.B.) 27p 22p 17p* TIL232 Green(H.B.) 27p 22p 17p* 8-2" (inc. Clip) TIL220 Red 15p 13p 11p* TIL224 Yellow(H.B.) 30p 26p 20p* TIL228 Red(H.B.) 30p 26p 20p* TIL234 Green(H.B.) 30p 26p 20p* (H.B.)—High Brightness.			POLYESTER CAPACITORS Mullard C281 Series 250Vw 0-01µf 5p 0-088µf 8p 0-47µf 12p 0-015µf 5p 0-10µf 8p 0-68µf 17p 0-022µf 5p 0-15µf 8p 1-0µf 25p 0-033µf 5p 0-22µf 8p 1-5µf 34p 0-047µf 5p 0-33µf 8p 2-2µf 40p Mullard C281 Series 400Vw 0-01µf 10p 0-088µf 15p 0-47µf 33p 0-015µf 10p 0-10µf 15p 0-68µf 35p 0-022µf 10p 0-15µf 18p 0-033µf 12p 0-22µf 25p 0-047µf 15p 0-33µf 30p		
HEATSINKS TO 92 7p* TO 5 (5F) 8p* TV 2 25p* TO 18-(18F) 11p* TV 3 25p* U1 (TBA900) 10p* TV 4 25p* U2 (TBA810AS) 21p* TV 5 24p* U3 (TDA2020) 52p* TV 16 33p* AY 14 51p* CH 106 31p* 1-18 E-17 94p* 3-15 E-18 1.49p* 3-15 E-19 1.68p* (For 1xTDA2020) (For 2xTDA2020) Transistor Covers TO66 and TO3 12p*			ZENERS BZY88 400mw 2-7v-33v 10p 1ZS 1w 3.6v-100v 20p			I.C. SOCKETS 8 pin 10p* 16 pin 14p* 28 pin 30p* 14 pin 12p* 24 pin 26p* 40 pin 44p* I.C. pins 100 54p* 1,000 £3.78*			CERAMIC CAPACITORS Mullard 632 Series 1-8pf 10pf 56pf 390pf 1500pf 2-2pf 12pf 82pf 470pf 1800pf 3-7pf 15pf 82pf 560pf 2200pf 2-7pf 18pf 100pf 680pf 2700pf 3-9pf 22pf 120pf 820pf 3300pf 4-7pf 27pf 150pf 1000pf 3900pf 5-8pf 33pf 180pf 1200pf 4700pf 6-8pf 39pf 220pf 1500pf 5600pf 8-2pf 47pf 270pf 2000pf 7500pf 330pf 8p each Mullard 623 Series 0-01uf 0-022uf		
PLUGS AND SOCKETS DIN Connectors Pins Plugs Sockets Line Couplers 2 14p 10p 18p 3 14p 10p 18p 4 14p 10p 18p 5 (180) 14p 10p 18p 5 (240) 14p 10p 18p 6 14p 10p 18p 7 14p 10p 18p			T.T.L. Just a selection. Send for full list 7400 10p* 7430 16p* 7474 27p* 74121 27p* 7401 16p* 7441 30p* 7475 40p* 74123 49p* 7402 16p* 7442 32p* 7476 30p* 74141 65p* 7403 16p* 7443 30p* 7477 30p* 74145 82p* 7404 17p* 7447 50p* 7478 27p* 74151 49p* 7408 19p* 7448 65p* 7479 2-32* 74154 85p* 7410 16p* 7451 16p* 7490 30p* 74174 72p* 7413 27p* 7470 27p* 7492 41p* 74192 86p* 7420 16p* 7472 22p* 7493 41p* 74193 86p* 7427 28p* 7473 27p* 74107 27p* 74196 79p*			C. Mos 4000 18p* 4014 1-00* 4024 70p* 4051 86p* 4001 18p* 4015 97p* 4025 19p* 4052 86p* 4002 18p* 4016 53p* 4026 1-78* 4060 1-16* 4006 1-08* 4017 97p* 4027 30p* 4068 22p* 4007 19p* 4018 97p* 4028 87p* 4070 22p* 4009 82p* 4019 98p* 4029 1-18* 4071 22p* 4010 82p* 4020 1-08* 4040 1-88* 4081 22p* 4011 18p* 4021 97p* 4042 83p* 4082 22p* 4012 21p* 4022 88p* 4049 58p* 4510 1-24* 4013 58p* 4023 19p* 4050 33p* 4511 1-54*			POLYSTYRENE CAPACITORS 10pf 100pf 1000pf 10,000pf (0-01uf) 12pf 120pf 1200pf 15pf 150pf 1500pf 22pf 220pf 2200pf 33pf 330pf 3300pf 47pf 470pf 4700pf 8p each 56pf 560pf 5600pf 82pf 820pf 8200pf		
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RESISTORS Type Range 1/2 watt 5% Carbon film E12 Series 10R-1M 2p each 1/2 watt 5% Carbon film E24 Series 3-3R-10M 2p ea. 1 watt 5% Carbon film E12 Series 10R-1M 5p each			POTENTIOMETERS 5K 250K Lin and Log less Switch (inc. IK Lin) .27p 10K 500K Lin and Log Dual less Switch .75p 25K 1M Lin and Log with Switch .60p 50K 2M 10K, 100K, 500K, 1M Dual log with Switch .75p 100K 10K Log + 10K Antidiv less Switch .75p			TANTALUM BEAD CAPACITORS 0-1µf 35v 15p 10µf 25v 20p 0-22µf 35v 15p 15µf 35v 22p 0-47µf 35v 15p 22µf 16v 22p 1-0µf 35v 15p 47µf 16v 25p 2-2µf 35v 15p 100µf 3v 22p 4-7µf 35v 15p 0.01µf 6.3v 35p 10µf 16v 17p 100µf 0v 24p					
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microfile.....

Gary Evans tip toes through the micros

THE MICROPROCESSOR WAS a boon to those people who like organising conferences. Here was a device about which many people felt a keen "need to know."

News of conferences/seminars/lectures came thick and fast, one could have flitted from one event to the next without drawing breath.

A lot of these activities were aimed at the professional but a fair few were designed to appeal to the amateur. With the initial deluge behind us now it is interesting to note that not only are there fewer events but that the nature of those that take place, at least those aimed at the amateur, is changing.

In the early days the subject matter was almost solely concerned with details of the internal architecture of the MPU, max speeds of operation, PSU requirements etc. However, most amateurs, from the word go, thought of the MPU in terms of home computer systems. In this light, a lot of the details presented at these conferences were, essentially, boring. After all, whilst the LSI technology that gave birth to the MPU was essential if any low cost computer was to be envisaged, in essence, a good PSU is just as important to the operation of the overall system and we didn't see many talks on the detailed operation of power supplies — interesting as they might have been.

The realisation that what most people are interested in is personal computing means that today we are seeing more and more conferences dealing with this aspect of things.

Early February saw Microsystems 78, a three day event with one day devoted to Personal Computing.

With Dr Chris Evans (must be O.K. with a name like that — Chris I mean) in the chair, delegates were treated to a day of talks on all aspects of personal computing — talk of accumulators accumulating and stacks stacking was not to be heard.

Later in the year we have the second of the DIY Computer Shows organised by Online (more of that later) and no doubt there are many other events of this nature in the pipe line.

Initial PCW

Early February also saw a new magazine on the market. Personal Computing World is a welcome addition to the ranks of titles that appear on our newsagents shelves every month. Dealing, as it does, almost exclusively with personal computing it should act as some sort of focus for this new hobby — something we need.

While we at ETI hope we have been, and intend to remain with for instance our personal computing supplement in June, involved with personal computing — after all the American magazine Popular Electronics has a regular computing section in spite of the Plethora of computing mags — we acknowledge that with the greater space available to them, PCW fill a long felt need in these Islands.

We wish PCW luck.

For further information on the magazine contact:

PCW
62A Westbourne Grove London
W2

It should however be available from your local newsagent.

Video Writer

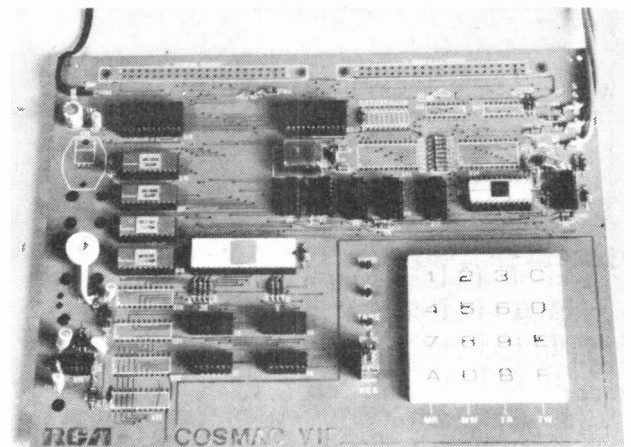
The COSMAC VIP (Video Interface Processor) pictured is a new computer kit from RCA.

Featuring the CDP 1802 MPU the VIP is specifically designed to allow easy generation of TV graphics and games. The VIP offers a versatile 4K operating system with facilities for storing and retrieving programs developed in the system's 2K RAM on cassette tape.

Using an interpretive language known as CHIP-8, 2 byte instructions entered via the VIP's hex keyboard, allow patterns to be generated on the screen, the generation of random bytes, the sounding of tones and allow subroutine nesting.

Expansion is possible and the hobbyist manual contains detailed information on use with music synthesizers, relays, printers and ASCII keyboards as well as program listings for twenty video games.

At present available only in a NSTC monochrome standard soon a PAL interface chip and programmable sound capability will be available. Further details from: RCA Solid State-Europe Sunbury-On-Thames Middlesex TW16 7HW



Be Rat-ional

If I hear the words Womp Rat once more I think I shall become an intergalactic hermit.

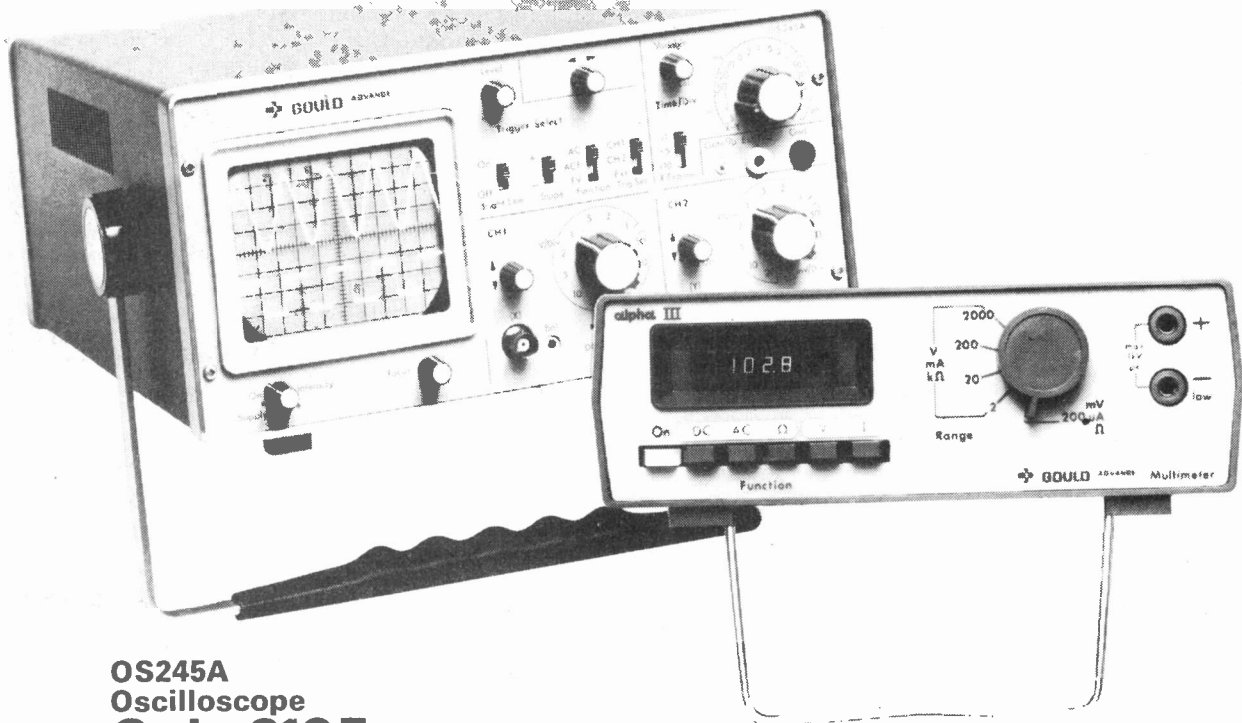
The response to my offer to provide a BASIC listing of a game program last month has been overwhelming.

I thought that I might, if lucky, get a few requests for the game and so did not bother to ask for an SAE. The result — to avoid being lynched by an overworked reader services department — I had to address a good few envelopes myself. A short Microfile this month because writer's cramp has set in.

It was impossible to give personal replies to the letters — no Microfile if I had, no eating or sleeping either — but please anybody who offered us game programs of any sort — take this as a blanket request to send them in to me at ETI.

ETI

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videocraft

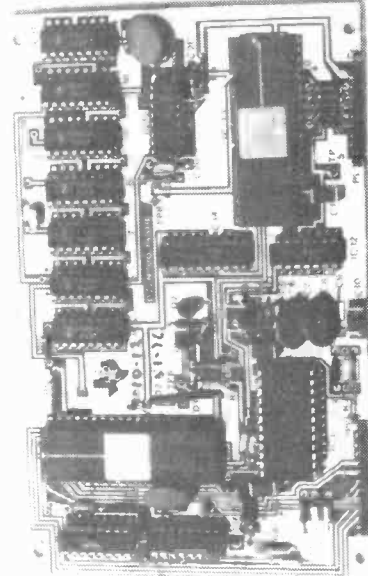
Half price Teletext

You can now buy Texas **Tifax** module Teletext decoder complete with matching cable connected keyboard, power supply, interface board and complete instructions for installation in most common television receivers for only £180 +VAT and £2.50 postage, packing and insurance.

Since the interface is connected directly to the television's video output circuitry, picture quality is excellent with pure colours — much more so than is possible from decoders which feed the aerial socket.

Due to the compact nature of the **Tifax** module, installation within most receiver cabinets is no problem. Facilities include seven colours, upper and lower case alphanumeric, graphics, time coded display, and newsflash and subtitle inserted in TV picture.

To enable us to supply the correct interface board and instructions, we must know your television set make and model and, if possible, chassis type.



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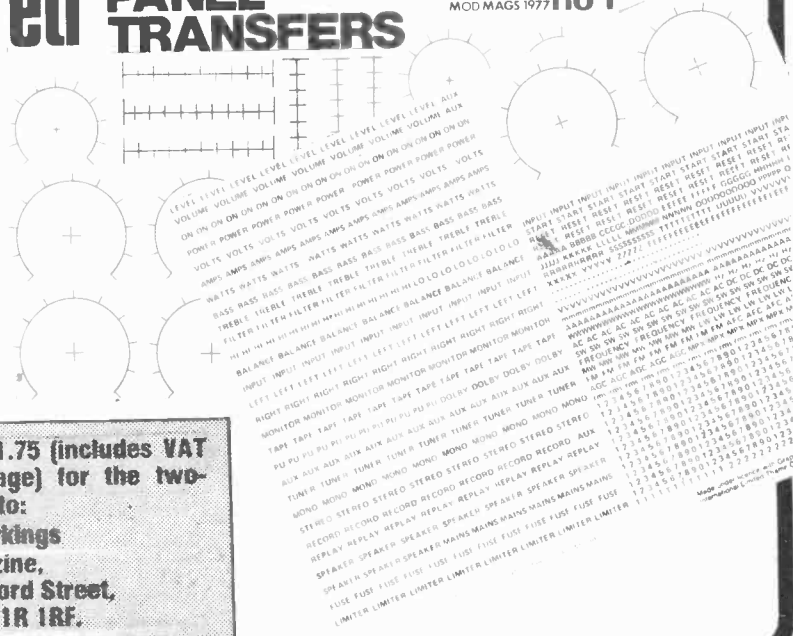
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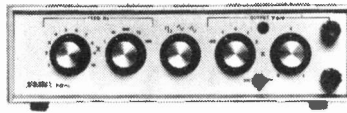


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tech tips

Proper Identification for T.V. Game Chip

E. Parr

Many of the T.V. game circuits, whether ready built or as a magazine project, use the popular GI 8500 chip. The standard circuit gives white players, ball and court on a black background. The circuit described below gives a grey background, one white and one black player and a white ball and court. This is aesthetically more pleasing and has the advantage of making the squash game less confusing.

The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

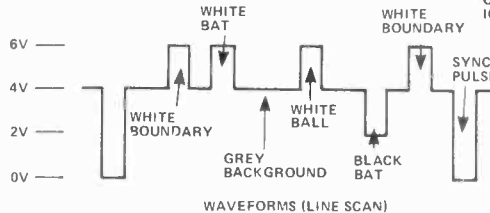
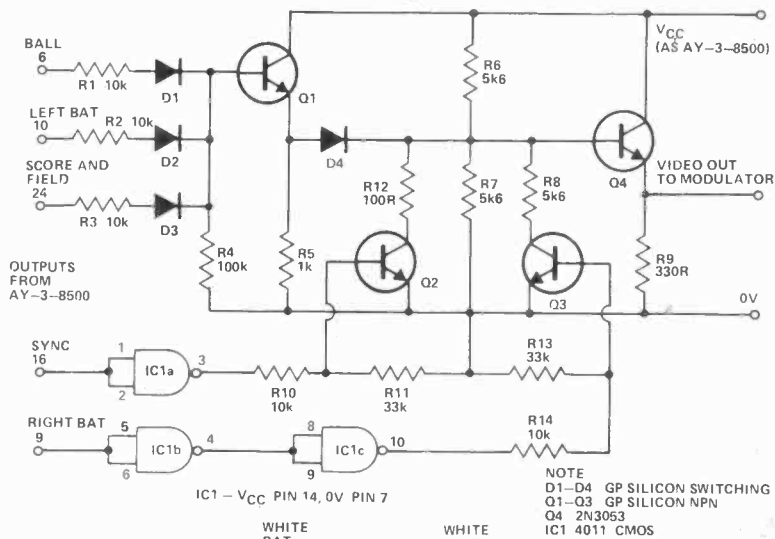
The three signals from the 8500 requiring a white output are Ball (pin 6), left player (pin 10) and the score and field (pin 24). These are "Or'ed" together by Q1 to produce a white level defined by the ratio of R1-R3 and R4. The white level on Q1 takes the output on Q1 to white via diode D4.

The one black signal is the right bat (pin 9). This is buffered by two stages of a CMOS 4011 chip, and turns on Q4. This takes the output to a black voltage defined by R6, R7, R8. If a white and black signal occur together

(as happens when the bats cross in squash) the white from Q1 will predominate.

The sync output from pin 16 is inverted and turns on Q3 pulling the output down to sync level, 0V.

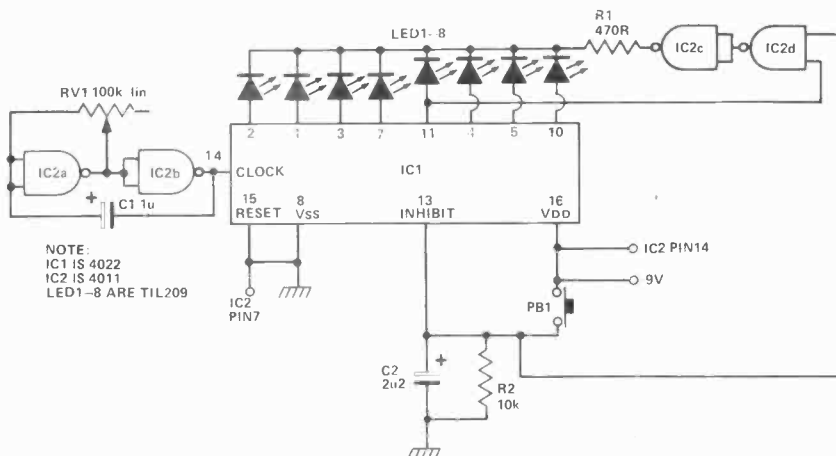
With the values shown and a supply of 9V the open circuit output voltages are White 6V, Grey 4V, Black 2V and sync bottom 0V. The output is positive going video.



Pot Shot

A. Kenny

This is a circuit for a game of the shooting gallery variety. IC2a and b form an astable multivibrator clocking IC1 which causes LEDs 1-8 to flash in turn LED 5 is the "target" LED and the object of the game is to depress PB1 just as LED 5 comes on. If this is done, the whole display is blanked for a few seconds signifying a hit. Otherwise, the LED which was lit remains lit. When the push button is released, C2 discharges through R2 taking 8 pin 13 low again and the LEDs will start to flash again.



Tech-Tips is an ideas forum and is not aimed at the beginner. We regret we cannot answer queries on these items.

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 25-27 Oxford St., London W1R 1RF.

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BC149	10p	BF196	10p	2N3704	10p
BC157	10p	BF197	12p	2N3705	10p
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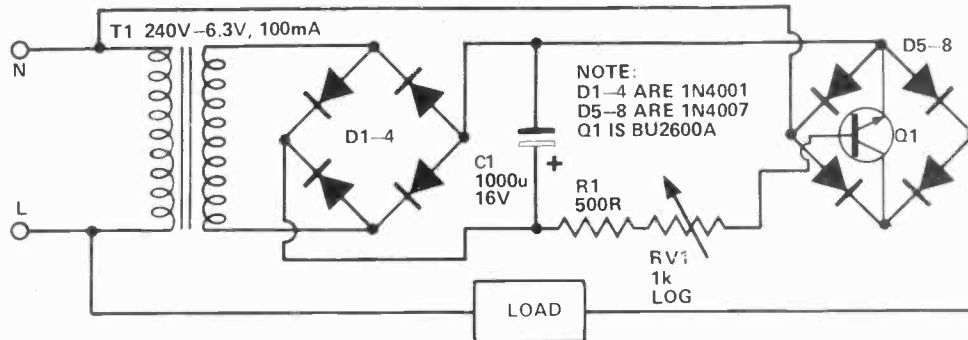
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Speed Controller

J. Harris



Some AC motors judder badly at low speeds when controlled by triacs, using phase control. This circuit gives very smooth operation with no RFI.

Q1 acts as a 'variable resistor' in the mains supply, with diodes D5-8 ensuring unidirectional current flow through the transistor.

Bias to the transistor is supplied by the mains transformer and controlled by RV1. Q1 must be able to withstand peak mains voltage ($\sim 350V$).

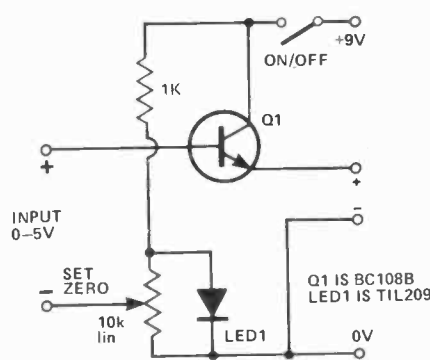
Increasing Regulator Outputs

D. Self

It is often necessary to arrange an integrated circuit 3-terminal voltage regulator to give a higher output voltage than that set by the regulator alone. The normal way of doing this is to connect the "common" terminal to the mid-point of a potential divider hung between the regulated output and ground. The regulator voltage now appears across the top divider resistor; hence, if for example equal divider resistors are used, the output voltage is twice that maintained by the regulator between its common terminal and output.

The problem with this method is that most IC regulators (eg the 78-series) have a small quiescent current (approx 10mA) flowing out of the common terminal to ground. The magnitude of this current is not closely controlled, and hence the total output voltage becomes somewhat unpredictable due to this extra current flowing in the bottom half of the divider. Low divider resistor values help, but there are likely to be the complications of heat dissipation and inefficiency.

The circuit above avoids the problem by using transistor Q1 to generate a low impedance at the regulator common terminal by emitter-follower action, while trans-

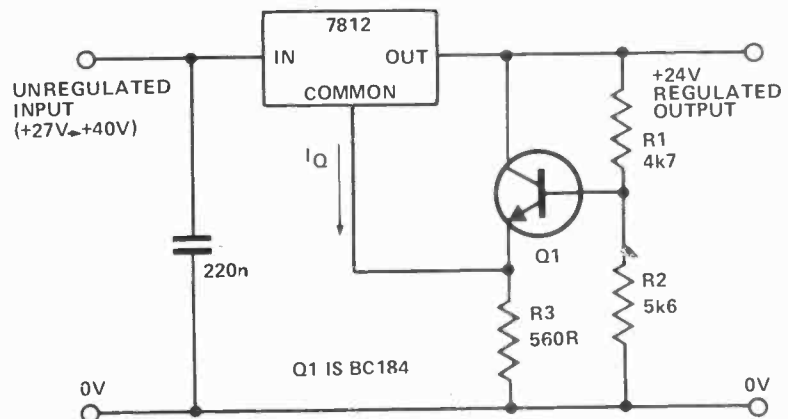


More Ohms Per Volt

R. Soar

This circuit is designed to improve the performance of a low cost 1k/volt multimeter on the 0.5V DC range.

The BC108 emitter follower provides an impedance transformation with a gain of 250 or more, so that the effective input impedance of the multimeter is now 250k/volt. The LED provides a fixed reference voltage for the set zero control, which compensates for the voltage drop across the transistor.



ferring the voltage derived from a relatively high-resistance divider network. The value of R3 is not critical, but must be low enough to accept the

highest likely quiescent current without causing Q1 to turn off.


The circuit shows a practical 24 Volt supply using a 7812 regulator.

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Motorola CMOS Databook (Vol. 5 Series B)	£3.50
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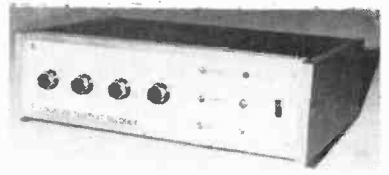
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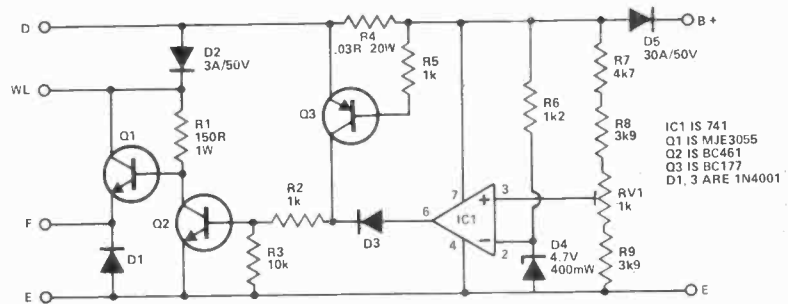
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Car Voltage Regulator

C. Gibbons

This circuit provides solid state control of battery charging. The field winding of the dynamo is initially energized via the ignition light as in a conventional system. Current flowing down the WL lead passes through Q1 to the F lead then to the field coil. Once the engine has started, current from the dynamo passes through D2 to Q1. The ignition light goes out because the WL lead rises in voltage to that of the battery. Current also passes through D5 to the battery. The battery voltage is sensed by IC1, which is wired as a comparator, once the voltage of the non inverting input, rises above that of the inverting input (Held at 4.6 volts by D4) the output goes high. Current then flows through D3 and R2 to the base of Q2 turning it on. This then pulls down the base of Q1 turning it off and cutting off the current to the field winding. The output from the dynamo then drops bringing down the battery voltage. This holds the battery voltage con-



stant. The battery voltage is adjusted by RV1 to approximately 13.5 volts.

Under cold weather starting the battery voltage drops very low. Once the engine has started the internal resistance of the battery is also very low, which would draw excessive current from the dynamo causing possible damage. To limit the current R4 is inserted in the main power lead from the dynamo, the resistance of R4 is chosen so that at maximum current

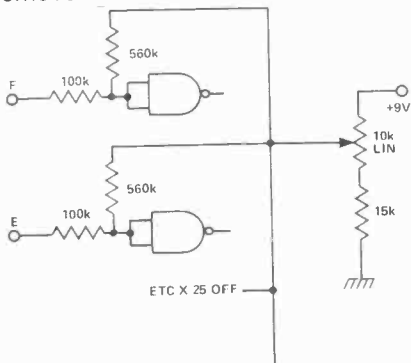
(Typically 20 amps) 0.6 volts is developed across it, this then turns on Q3. When Q3 turns on current flows from the power rail through R2 to the base of Q2 turning it on, which in turn, turns off Q1 and cuts off current to the field winding. The output from the dynamo then drops.

No changes have to be made to the existing wiring. The circuit can be housed in an old regulator box, Q1, Q2 and D5 should be mounted on a heat sink.

Organ Modification

I. Cole

One of the problems with the ETI Touch Organ (December 76) is that peoples skin resistance varies enormously and with the 4M7 pull up resistors as specified, when a person with moist skin touches the keyboard the note is sustained for several seconds even when the finger is removed.

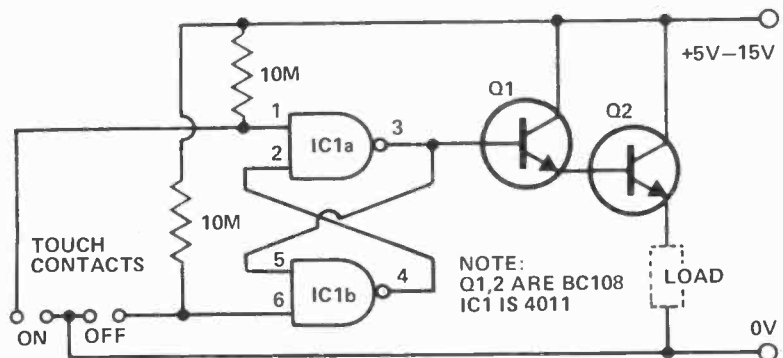


This modification provides a solution in the form of a sensitivity control.

The pull up resistors are removed and replaced by 560k resistors stood vertically on the board. The free ends of the resistors were then joined with a piece of rigid wire and connected to the wiper of the "sensitivity" pot.

Low Current Touch Switch

D. Ian



The cost of many CMOS ICs is now lower than a mechanical on/off switch. Using only one half of a 4011, plus a couple of general purpose transistors, a touch operated switch can be constructed which is ideal for many battery powered projects.

Assuming that the inputs to the remaining half of the 4011 are tied low, the current drawn in the off state

is almost negligible and battery life is hardly affected.

Touching the 'on' contacts with a finger brings pin 3 high, turning on the darlington pair and supplying power to the load (transistor radio etc). Q1 must be a high gain transistor, and Q2 chosen for the current required by the load circuit.

electronics tomorrow.....

by John Miller-Kirkpatrick

6800 Update

RECENTLY RECEIVED from a Motorola distributor is an M6800 series shortform catalogue entitled 'Micro-processor News — September 1977'. This catalogue lists Motorola's MPU products ranging from integrated circuits to EXORcisers and Polyvalent Development System components.

In the area of chips Motorola have announced some interesting new goodies. Their 1024 x 4 MCM6614, static RAMs come in 200, 300 and 450ns versions. Motorola's 128 x 8 bit static RAM, the MCM6810 is now also offered in 250, 360 or 450 ns versions. On the subject of memories there is the MCM68708 10 24 x 8 EPROM (basically a 2708) and the pre-announcement of the 2716 product, the MCM68716.

New Interfaces

Motorola have not been any slower than other MPU manufacturers in getting onto the LSI interface chip bandwagon. LSI technology allows many functions to be integrated on one chip to give high density, low cost interfaces to I/O devices which would otherwise require multi-TTL chip solutions. An example is the MC6843 Floppy Disk Controller which performs the complex interface between an M6800 system and a range of Floppy Disk drives.

The MC6845 is Motorola's CRT controller chip which performs the 6800 to CRT interface with so many programmable options that one set of options is bound to fit your requirements. It features programmable dots per character, lines per character, characters per row, rows per screen, sync generation and cursor generation. It even features an on-chip light pen register to allow the use of presumably some form of photo diode or transistor to recognise a particular character location on the CRT. This would allow the use of a non-keyboard entry device for a low cost MPU system. If the MPU is programmed to display its complete character set at the bottom of the screen whenever it expects a keyboard entry then the light pen can be used to choose the input character from those displayed — System 68 VDU revisited?

Continuing through the catalogue we pass the various auxiliary circuits which include a GPIA General



New Total Development System M68 TDS from Motorola.

Purpose Interface Adaptor, Modems, DMA Controller, Bus transceivers and a thing called a 'Triple Bi-directional Bus Extender/Switch' (TB-DBES?) or MC6881/3449. After this it becomes simple to understand the new two-chip M6800 (MC6802 + MC6846) and the two-board computer (MEK D2 kit).

By now you are prepared for the Polyvalent Development System (PDS) which fills the gap between low-cost and on-a-board microcomputers, and the sophisticated aids for designing microprocessor systems. As its name suggests the PDS is really a family of sub-systems that can be selected to provide the required options and can then be used to analyse the system. This is Motorola's description of their PDS, which looks to me like a rich man's System 68. One version of the PDS is called the Autonomous Development System (you guessed it — ADS for short) which includes the PDS master board interfaced to a keyboard and 5 inch CRT monitor, the kit with monitor is the M68ADS1 or M68ADW1 without the CRT. I am not sure that I could recommend these kits as cost effective MPU tools at over £900 if System 68 costs about £300! But congratulations to Motorola for seeing the problem of high-cost TTYs and trying to overcome the problem.

On page 16 of the catalogue you are introduced to the MC68CIM1 (CIM stands for Audio-Cassette Interface Module). This is used to interface any ordinary audio-cassette recorder with any of the PDS configurations (SAC, MEB, ADS). The data is recorded on the cassette according to the Kansas City Standard (CUTS), in the playback mode the clock is recovered from the signal and used to clock the receiving ACIA in the PDS, this feature copes with cassette speed variations of up to 30% without producing errors. The MC68CIM1 is a module consisting of several chips on a PCB (isn't it about time someone produced a single chip CUTS interface to plug on to any 8 bit data bus?), if anybody knows of one please let us know.

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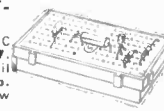
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TV games power unit stabilized 7.7V 100mA £3.25. 3-way models with switched output and 4-way multi-jack — 3/4 1/2 6V 100mA £2.92. 6/7 1/2 9V 150mA £3.30. 100mA radio models with press stud connectors. 9V £2.85. 6V £2.85. 4 1/2V £2.85. 9V+9V £4.50. 6V+6V £4.50. 4 1/2V+4 1/2V £4.50. Cassette recorder mains unit 7 1/2V 100mA with 5 pin din plug £2.85. Fully stabilised model switched output of 3/6 7/2 9V 400mA stabilised £6.40. Car connector 12V DC input. Output 9V 300mA £1.80. Output 7 1/2V 300mA £1.80.

BATTERY ELIMINATOR KITS

Send see for free leaflet on range.

100mA radio types with press stud battery terminals. 4 1/2V £1.80. 6V £1.80. 9V £1.80. 4 1/2V+4 1/2V £2.50. 6V+6V £2.50. 9V+9V £2.50.

Cassette type 7 1/2V 100mA with din plug £1.80. Transistor stabilised 8-way type for low hum. 3/4 1/2 6V 7 1/2 9V 150mA £3.20. 1 Amp model £6.40. Heavy duty 13-way types 4 1/2 6 7 7 1/2 8 1/2 11 13 14 17 21 25 28 34 42V. 1 Amp £4.85. 2 Amp £7.95.

Car Converter kit. Input 12V DC output 6/7 1/2 9V DC 1A transistor stabilised £1.95. Stabilised power kits 3-18V 100mA £3.60. 3-30V 1A £9.95. 3-60V 1A £10.95. 3-60V 2A £13.95.

BULK BUY OFFERS

Minimum purchase of one item £10. SN76023N 79p. ZN414 84p. 4.43MHz crystals 65p. 741 8 diode 22p. NE555 8 diode 36p. Dalo pens 58p. 2N3055 53p. BD131 30p. BC107 7p. BC109 7p. BC212 8p. 1N4002 42p. Bridge rectifiers 200V piv — 1A 26p, 2A 33p. Electrolytics axial 200mF 40V 36p.

CUT PRICE TELETEXT

Labgear CM7026 ready to use, attractively cased complete unit which just plugs straight into the aerial socket of the set, giving full colour and requiring no modification to the TV. Remote control page selection £323.

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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 PCB and full instructions £13.75

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741 Op. Amp I.C. 8 pin diode 24p (5 for £1.00)

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400V Plastic isolated tab 3A 63p

6 5A with trigger** 80p

8 5A** 79p

12A 84p

16A 105p

20A 165p

25A 190p

DIAC 21p

C106D 5A/400V SCR 50p

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4007 18p 4016 51p 4049 50p 4516 150p

4011 18p 4017 91p 4050 50p 4519 56p

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12-0 12V 100mA 95p*

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0.2" Green L.E.D. 21p

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7401	8p	7490	33p*
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All the above valves are untested, except for heaters, and no guarantee of percentage of emission is given. Sorry, no returns.
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BYX38/300 Stud Rectifiers, 300V at 2.5A, for 60p
BOY72 Transistors, 4 for 50p
BSX20 (VHF osc/mult.), 3 for 50p
BC107 (metal can) 4 for 50p
BC108 (metal can) 4 for 50p
PBC108 (plastic BC108), 5 for 50p
BF152 (UHF amp/mixed), 3 for 50p
2N3819 Fet, 3 for 60p
BC148 NPN SILICON, 4 for 50p
BC158 PNP SILICON, 4 for 50p
BAY31 Signal Diodes, 10 for 35p
741C RCA OP Amps 4 for £1.00
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ALL BELOW — ADD 8% VAT

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DIECAST BOXES: We still stock these but, owing to frequent price rises from our suppliers, and costly postal charges, it has been found impossible to publish up-to-date prices on these items. Please ring or write (with SAE) for latest mail order prices.
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PLASTIC PROJECT BOXES, with screws on lids (in black ABS) with brass inserts
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Slider Switches 2 pole make and break (or can be used as 1 pole change-over by linking the two centre pins), 4 for 50p

ALL BELOW — ADD 12 1/2 % VAT

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TV Plugs (metal type), 4 for 50p
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3-pin Din Plugs, 4 for 50p
Din 3-pin Line sockets, 15p each
Din Speaker Skts, 2-pin, 4 for 30p
Dublier Electrolytics, 50µF 450V, 2 for 50p
Dublier Electrolytics, 100µF 275V, 2 for 50p
Plessey Electrolytics, 470µF 63V, 3 for 50p
TCC Electrolytics, 1000µF 30V, 3 for 60p
Dublier Electrolytics 5000µF 35V, 50p each
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ALL NEW CATALOGUE

To celebrate our new range of ICs, components, coils, filters, FM and AM modules etc., we are presenting an entirely new catalogue, which is free if you send an A4 SAE (15p stamp on it pse), and the front page from one of our old catalogues. This offer ceases on May 31st 1978, when the normal price of 45p will apply. The new catalogue contains radio and wireless features centred on our new developments with Sprague, Telefunken and RCA, with the TDA1083 MW/LW/FM/Audio all-in-one IC system, the TDA1062 4 stage IC tunerhead, the CA3189E IF system, the Hitachi HA11219 FM noise blanking system and other radical new technology announced in the past few months. We are certain this will be of great value and interest to anyone concerned with radio and RF design.

The rest of our new range includes resistors, capacitors and many items that now complete our range for the electronics enthusiast and designer. We naturally carry the very latest in radio semiconductors, and are pleased to report many new developments in the past six months, that are now readily available, with technical backup, from Ambit. But quite apart from our technical capability, we think you will find our prices attractive, and our product always first quality.

Examples from the range of components, modules etc.:
Resistors 1/4 watt types in E12 series, 1 ohm to 10M ohms (Mullard/Iskra/piher) 15p/10 Minimum order 10 per value please. Minimum resistor-only order £1.50
Ceramic plate and disc capacitors: only miniature and compact types eg. 10nF: 35p/10
CA3189E: RCA's new IF system, £2.75 inc. detector coil and 22uH choke
TDA1083: Sprague/Telefunken AM/FM/Audio IC. 800mW output max £2.55
TDA1062: Telefunken FM tunerhead IC, good for 200MHz, £2.75
Modules as previously advertised, plus these new ones: EF5803, 93189, EF5400, MPX decoder: 91196B: The superior HA1196 now with a 2W monitor amplifier, and optional adjacent or alternate channel notching facility, as well as a 55kHz low pass filter, pilot tone filters etc. £16.45
New from TOKO: CFM2 series 4 section ladder filters for 455kHz 6 & 12kHz versions £1.35 each, CFM2 2 section mechanical filters for 455kHz, same size as CFS series filters! Plus others.....

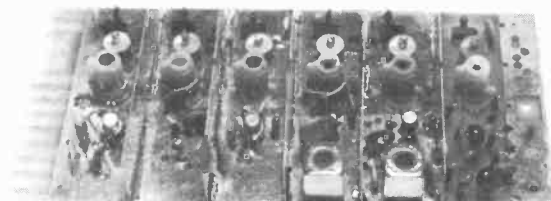
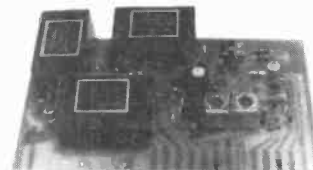
ambit INTERNATIONAL
2 GRESHAM ROAD BRENTWOOD ESSEX

ELECTRONICS TODAY INTERNATIONAL — APRIL 1978

The EF5400, a 4 stage varicap tunerhead, tuning 88-108MHz with a bias swing of just 2.8 volts DC. A single IC provides all functions, including PIN diode AGC drive, balanced mixer, RF amplifier. All this and edge connection too! £9.75 built.



Always in the leading group, here is Ambit's 73189 IF system, optional 2 or 3 pole linear phase IF filters, 2xMOSFET IF AGC stage, with the CA3189E. £16.25 built and aligned.



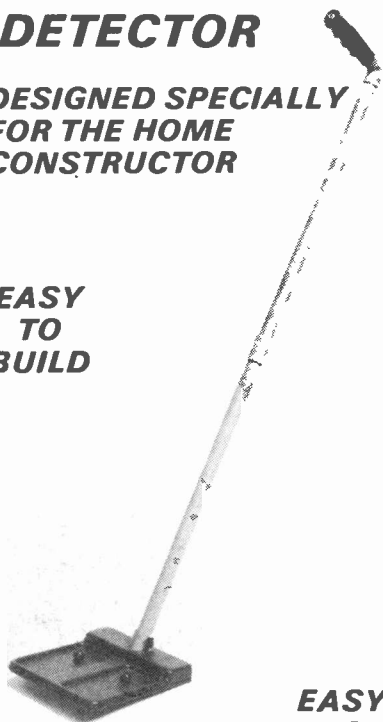
The EF5803 here is shown less the tinplate shielding can normally supplied
The EF5803: the ultimate? 2x low noise MOSFET RF stages with AGC, MOSFET mixer, very loose stage coupling for super high Q. Amplified local osc output. Used in conjunction with the 73189 system, provides 35dB S/N with a 0.63uV PD input. And all these modules are British Made. EF5803: £19.75.

Prices exclude VAT. Postage 25p per order. Catalogue (see text) 45p. Telephone (0277)216029. Parking outside the front of our building.

SECOND GENERATION INDUCTION BALANCE METAL DETECTOR

DESIGNED SPECIALLY
FOR THE HOME
CONSTRUCTOR

EASY
TO
BUILD



EASY
TO
USE

- A second generation Induction Balance system with improved Variable-Tone detection.
 - Designed by professionals for easy assembly by amateurs but with very good performance.
 - The search coils are fully assembled and adjusted for you.
 - Coils pre-assembled and tested wedge shaped search field
- Uses include:
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 - ★ Finding lost metallic items.
 - ★ Locating waterpipes and cables under floorboards on in walls.
 - ★ Checking old timber for nails before cutting, etc., etc., etc., etc.

KIT - COMPLETE WITH PRE-ASSEMBLED SEARCH COILS

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Plus £1-00p+p Plus £1-32 VAT

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Communication Measurement Ltd
15 MALLINSON OVAL, HARROGATE, YORKS.

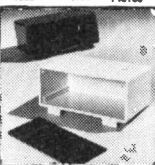
GREENBANK CUT PRICE CMOS

Cut prices for Amateur users and Export only. Note: Industrial Users — No % discount available on these prices, instead use franchised distributors standard prices, list available on request. Mostly Motorola, RCA

4000	15p	4050	52p	40107	60p	4514	£2.65
4001	17p	5051	75p	40108	£3.30	4515	£2.99
4002	17p	5052	75p	40109	£1.02	4516	£1.06
4006	£1.05	4053	75p	40181	£3.30	4517	£3.82
4007	18p	4054	£1.20	40182	£1.40	4518	£1.02
4008	92p	4055	£1.34	40182	£1.40	4519	51p
4009	50p	4056	£1.34	40183 TMA	£1.40	4520	£1.06
4010	50p	4057	£25.70			4521	£1.06
4011	19p	4059	£4.80	40194	£1.10	4522	£1.06
4012	18p	4060	£1.15	40257	£1.40	4524	N/S
4013	55p	4061	£15.87	4160	£1.06	4526	£1.06
4014	99p	4062T	£10.00	4161	£1.06	4527	£1.52
4015	95p	4063	£1.09	4162	£1.06	4528	99p
4016	52p	4064	N/S	4163	£1.06	4529	£1.14
4017	99p	4065	N/S	4174	£1.06	4530	85p
4018	99p	4066	57p	4175	95p	4531	£1.45
4019	60p	4067	£3.80	4194	£1.17	4532	£1.27
4020	£1.02	4068	22p	4408	£6.59	4534	£5.13
4021	94p	4069	22p	4409	£6.59	4536	£3.69
4022	96p	4070	22p	4410	£5.75	4537L	£13.23
4023	20p	4071	21p	4411	£3.58	4538	£1.25
4024	76p	4072	21p	4412N	£17.14	4539	91p
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4026	£1.80	4075	23p	4415V	£7.50	4543	£1.90
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4034	£1.96	4089	£1.50	4450	£2.67	4558	£1.14
4035	£1.20	4093	63p	4461	£2.67	4559	£3.69
4036	£2.45	4094	£1.90	4452	TBA	4560	£1.84
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4039	£2.45	4097	£3.72	4700	£1.75	4566	£1.59
4040	£1.05	4098	£1.10	4501	17p	4568	£2.38
4041	85p	4099	£1.90	4502	81p	4569	£2.57
4042	81p	40061	N/S	4503	75p	4572	25p
4043	94p	40100	2.50	4505	£5.71	4580	£5.74
4044	90p	40101	£1.61	4505	51p	4581	£2.62
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4046	£1.30	40103	£2.12	4508	2.48	4583	76p
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FEATURES: Complete pre-amplifier in single pack — Multi-function equalization — Low noise — Low distortion — High overload — two simply combined for stereo.

APPLICATIONS: Hi-Fi — Mixers — Disco — Guitar and Organ — Public address

SPECIFICATIONS:

INPUTS: Magnetic Pick-up 3mV, Ceramic Pick-up 30mV, Tuner 100mV, Microphone 10mV, Auxiliary 3-100mV, input impedance 47k Ω at 1kHz

OUTPUTS: Tape 100mV, Main output 500mV R.M.S.

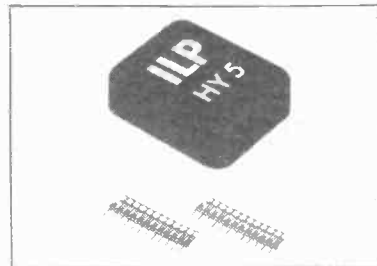
ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz, Bass \pm at 100Hz

DISTORTION: 0.1% at 1kHz, Signal/Noise Ratio 68dB

OVERLOAD: 38dB on Magnetic Pick-up, **SUPPLY VOLTAGE** \pm 16-50V

Price £5.22 + 65p VAT P&P free

HY5 mounting board B1 48p + 6p VAT P&P free.



HY30 15 Watts into 8 Ω

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 1 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

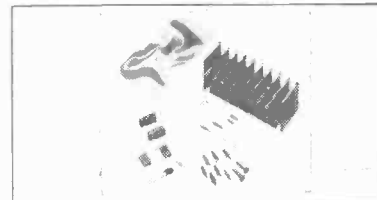
SPECIFICATIONS:

OUTPUT POWER: 15W R.M.S. into 8 Ω , **DISTORTION:** 0.1% at 15W

INPUT SENSITIVITY: 500mV, **FREQUENCY RESPONSE:** 10Hz-16kHz — 3dB

SUPPLY VOLTAGE \pm 18V

Price £5.22 + 65p VAT P&P free.



HY50 25 Watts into 8 Ω

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

SPECIFICATIONS: **INPUT SENSITIVITY:** 500mV

OUTPUT POWER: 25W RMS in 8 Ω **LOAD IMPEDANCE:** 4-16 Ω , **DISTORTION:** 0.04% at 25W at 1kHz

SIGNAL/NOISE RATIO: 75dB, **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB

SUPPLY VOLTAGE \pm 25V, **SIZE:** 105.50 x 25mm

Price £6.82 + 85p VAT P&P free



HY120 60 Watts into 8 Ω

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

SPECIFICATIONS:

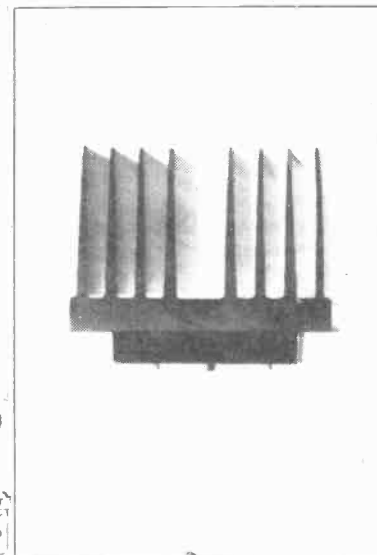
INPUT SENSITIVITY: 500mV

OUTPUT POWER: 60W RMS into 8 Ω , **LOAD IMPEDANCE:** 4-16 Ω , **DISTORTION:** 0.04% at 60W at 1kHz

SIGNAL/NOISE RATIO: 90dB, **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB, **SUPPLY VOLTAGE** \pm 35V

Size: 114 x 50 x 85mm

Price £15.84 + £1.27 VAT P&P free.



HY200 120 Watts into 8 Ω

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 — Loadline protection — Integral Heatsink — No external components

APPLICATIONS: Hi-Fi — Disco — Monitor — Power Slave — Industrial — Public address

SPECIFICATIONS:

INPUT SENSITIVITY: 500mV

OUTPUT POWER: 120W RMS into 8 Ω , **LOAD IMPEDANCE:** 4-16 Ω , **DISTORTION:** 0.05% at 100W at 1kHz

SIGNAL/NOISE RATIO: 96dB, **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB, **SUPPLY VOLTAGE** \pm 45V

SIZE: 114 x 100 x 85mm

Price £23.32 + £1.87 VAT P&P free.

HY400 240 Watts into 4 Ω

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω ! 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

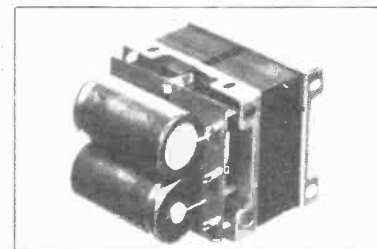
SPECIFICATIONS:

OUTPUT POWER: 240W RMS into 4 Ω , **LOAD IMPEDANCE:** 4-16 Ω , **DISTORTION:** 0.1% at 240W at 1kHz

SIGNAL/NOISE RATIO: 94dB, **FREQUENCY RESPONSE:** 10Hz-45kHz — 3dB, **SUPPLY VOLTAGE** \pm 45V

INPUT SENSITIVITY: 500mV, **SIZE:** 114 x 100 x 85mm

Price £32.17 + £2.57 VAT P&P free.



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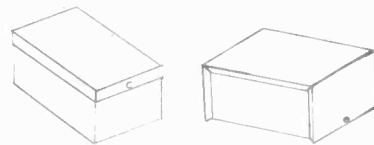
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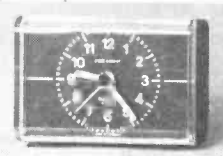
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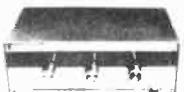
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7422	7491	65p	80p	4069	20p																															
7423	7492	45p	80p	4070	20p																															
7425	7493	35p	80p	4071	20p																															
7426	7494	80p	80p	4072	20p																															
7427	7495	55p	90p	4073	20p																															
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7433	74104	40p	170p	4081	19p																															
7437	74105	40p	400p	4082	20p																															
7438	74107	28p	120p	4083	20p																															
7440	74109	45p	90p	4084	20p																															
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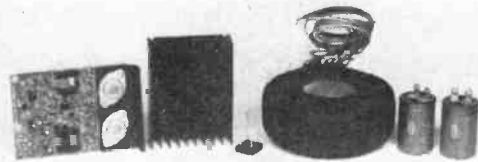
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150V: 0.033 0.047 0.068 0.1 0.15 0.22 0.33 0.47 0.68 1 1.5 2.2 3.3 4.7 6.8 10 15 22 33 47 68 100 150 220 330 470 500 680 1000 1500 2200 3300 4700 5000
DUBILIER: 1000V: 0.01 0.015 0.022 0.033 0.047 0.068 0.1 0.15 0.22 0.33 0.47 0.68 1 1.5 2.2 3.3 4.7 6.8 10 15 22 33 47 68 100 150 220 330 470 500 680 1000 1500 2200 3300 4700 5000

POLYESTER RADIAL LEAD: Values in μ F. 250V
0.01 0.015 0.022 0.033 0.047 0.068 0.1 0.15 0.22 0.33 0.47 0.68 1 1.5 2.2 3.3 4.7 6.8 10 15 22 33 47 68 100 150 220 330 470 500 680 1000 1500 2200 3300 4700 5000
FEED THROUGH CAPACITORS: 1000pf 350V 8p

ELECTROLYTIC CAPACITORS: Axial lead type (Values are in μ F)
63V: 0.47 1.0 1.5 2.2 2.5 3.3 4.7 6.8 8 10 15 22 27 33 39 47 50 56 63 75 82 91 100 120 150 200 250 300 330 360 400 450 500 560 630 750 820 910 1000 1200 1500 2000 2500 3000 3300 3600 4000 4500 5000
75V: 1.0 1.5 2.2 2.5 3.3 4.7 6.8 8 10 15 22 27 33 39 47 50 56 63 75 82 91 100 120 150 200 250 300 330 360 400 450 500 560 630 750 820 910 1000 1200 1500 2000 2500 3000 3300 3600 4000 4500 5000
100V: 1.5 2.2 2.5 3.3 4.7 6.8 8 10 15 22 27 33 39 47 50 56 63 75 82 91 100 120 150 200 250 300 330 360 400 450 500 560 630 750 820 910 1000 1200 1500 2000 2500 3000 3300 3600 4000 4500 5000
250V: 2.2 3.3 4.7 6.8 8 10 15 22 27 33 39 47 50 56 63 75 82 91 100 120 150 200 250 300 330 360 400 450 500 560 630 750 820 910 1000 1200 1500 2000 2500 3000 3300 3600 4000 4500 5000
TAG-END TYPE: 70V: 2000 98p; 470V: 121p; 50V: 10.000 255p; 300V 75p; 40V: 4000 70p; 250V: 65p; 25V: 4700 48p; 2000 37p; 470V: 2000+5000 95p; 325V: 200+100+50+100 190p.

TANTALUM BEAD CAPACITORS: 35V: 0.1 μ F 0.22 0.33 0.47 0.68 1.0 2.2 3.3 4.7 6.8 10 15 22 33 47 68 100 150 220 330 470 500 680 1000 1500 2200 3300 4700 5000
20V: 1.5 16V: 10 μ F 13p each 22 25p. 47 μ F 100 40p each. 10V: 22 μ F 33 47 6V: 47 68 100 3V: 68 100 μ F 20p each

MYLAR FILM CAPACITORS: 100V: 0.001 0.002 0.005 0.01 μ F 5p 0.015 0.02 0.04 0.05 0.056 μ F 6p 0.1 μ F 0.15 0.2 7p. 50V: 0.47 μ F 10p

CERAMIC CAPACITORS 50V: Range: 0.5pF to 10.000pF 3p 0.015 μ F 0.022 μ F 0.033 μ F 4p 0.1 μ F 4p 0.1 μ F 6p

SILVER MIC: Values in pF: 3.3 4.7 6.8 10 12 18 22 33 47 50 68 75 82 85 100 120 150 220 9p each 250 300 330 360 390 600 820 16p each 1000 1800 2000 2200 20p each

CERAMIC TRIMMER CAPACITORS: 2 7/8 4 15pF 6 25pF 8 30pF 20p

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404	20	484	95	74166	141	4026	180	748C	36	
405	22	485	110	74167	198	4027	55	753	150	
406	38	486	36	74170	248	4028	90	8038CC*	355	
407	38	489	30	74172	625	4029	100	AY 10212	90	
7408	20	490	36	74173	175	4030	58	AY 15050	241	
409	20	491	80	74174	113	4033	145	AY 15051	125	
410	15	492	53	74175	90	4034	196	AY 16721	6195	
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412	23	494	85	74177	116	4042	81	AY 38505*	750	
413	37	495	70	74180	142	4043	96	AY 38600*	85	
414	74	496	82	74181	299	4044	95	AY 51234*	295	
416	35	497	262	74182	127	4045	145	AY 51230*	490	
417	39	4100	125	74183	225	4046	130	AY 51317A	630	
420	16	4104	62	74185	146	4047	99	CA3014*	137	
421	33	4105	62	74188	650	4048	58	CA3018*	82	
422	24	4107	33	74190	140	4049	52	CA3020	170	
423	32	4109	54	74191	140	4050	52	CA3023	170	
425	30	4110	54	74192	140	4054	120	CA3028A*	95	
426	36	4111	70	74193	140	4055	134	CA3035	140	
427	36	4116	198	74194	140	4056	134	CA3036	180	
428	38	4118	90	74195	110	4060	115	CA3043	190	
430	16	4120	115	74196	118	4067	380	CA3046	406	
432	32	4121	28	74197	118	4068	CA3048	200	ROM2513*	700
433	40	4122	48	74198	248	4069E	22	CA3075	175	
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443	115	4136	56			4078	21	CA3130*	200	
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454	17	4151	75	4012	18	4518	102	LM348	120	
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474	32	4159	225	4018	99	4539	110	LM3900	65	
475	42	4160	116	4019	60	4553	449	LM3909N	70	
476	30	4161	116	4020	102	4558	101	LM3911	125	

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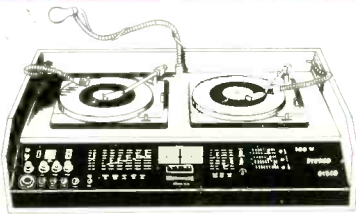
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MCFC6040*	97
MK50253*	550
MK50362*	550
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MM2112 2A*	298
NE518A	210
NE555*	36
NE560B*	90
NE560*	325
NE561*	410
NE562*	410
NE565A*	185
NE566*	180
NE567V*	187
NE57*	450
RA2102 2A*	210
SGM2513*	700
SG3402*	255
SN7233N	125
SN76003N	240
SN76013	240
SN76023	140
SN76033N	200
SN76115	215
SN76227N	175
TA6621A*	228
TA6661A	155
LM3004	170
LM301A	39
LM318	195
LM324	98
LM339	55
LM348	120
LM379	38
LM380A	98
LM382	170
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LM3900	65
LM3909N	70
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ZN14	110

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AC126*	19	BC170	18	BF196	12	OC45*	35	Z1X503	19	ZN3702	10
AC127*	18	BC171	11	BF197	15	OC46*	35	Z1X504	25	ZN3703	11
AC128*	18	BC172	10	BF198	18	OC47*	35	Z1X531	28	ZN3704	10
AC129*	18	BC173	10	BF199	30	OC70*	30	Z1X550	25	ZN3705	11
AC141*	24	BC174	18	BF200	30	OC71*	30	Z1X551	25	ZN3706	10
AC142*	24	BC175	16	BF201	30	OC72*	30	Z1X552	25	ZN3707	10
AC143*	24	BC176	16	BF202	30	OC73*	30	Z1X553	25	ZN3708	10
AC144*	24	BC177	16	BF203	30	OC74*	30	Z1X554	25	ZN3709	11
AC145*	24	BC178	18	BF204	30	OC75*	30	Z1X555	25	ZN3710	11
AC146*	24	BC179	18	BF205	30	OC76*	30	Z1X556	25	ZN3711	11
AC147*	24	BC180	18	BF206	30	OC77*	30	Z1X557	25	ZN3712	11
AC148*	24	BC181	18	BF207	30	OC78*	30	Z1X558	25	ZN3713	11
AC149*	24	BC182	18	BF208	30	OC79*	30	Z1X559	25	ZN3714	11
AC150*	24	BC183	18	BF209	30	OC80*	30	Z1X560	25	ZN3715	11
AC151*	24	BC184	18	BF210	30	OC81*	30	Z1X561	25	ZN3716	11
AC152*	24	BC185	18	BF211	30	OC82*	30	Z1X562	25	ZN3717	11
AC153*	24	BC186	18	BF212	30	OC83*	30	Z1X563	25	ZN3718	11
AC154*	24	BC187	18	BF213	30	OC84*	30	Z1X564	25	ZN3719	11
AC155*	24	BC188	18	BF214	30	OC85*	30	Z1X565	25	ZN3720	11
AC156*	24	BC189	18	BF215	30	OC86*	30	Z1X566	25	ZN3721	11
AC157*	24	BC190	18	BF216	30	OC87*	30	Z1X567	25	ZN3722	11
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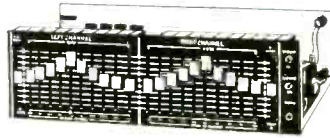
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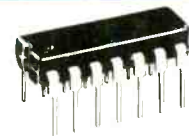
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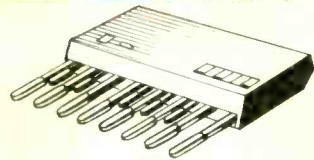
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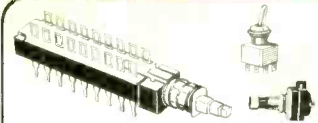
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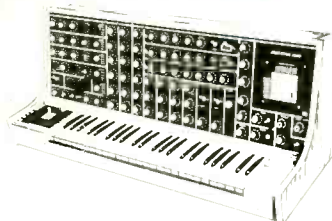
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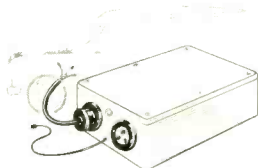
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