electronics today INTERNATIONAL

APRIL 1978

45p

200 W AMPLIFIER PROJECT

FREE TANDY CATALOGUE

MOST BRITISH SALES ONLY

PET HOME COMPUTER
WHITE LINE FOLLOWER
CASINGS SURVEY

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

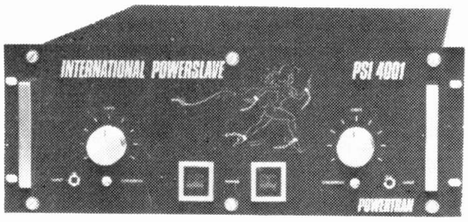
INTERNATIONAL POWERSLAVE 200 watt AMPLIFIER

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
BFR41	£0.30
BFR81	£0.30
MJ15003	£3.80
MJ15004	£4.10

SPECIAL OFFER PRICE for

Complete PSI4001 Kit
£205.00 + VAT

Complete PSI4002 Kit
£220.00 + VAT

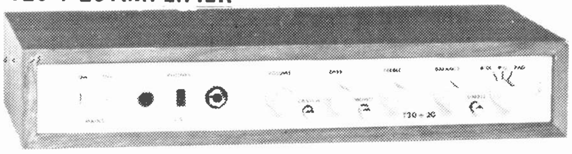
MANY MORE KITS ALSO AVAILABLE — ASK FOR OUR FREE CATALOGUE

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

De Luxe Linsley-Hood 75w Amplifier

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

T20 + 20 AMPLIFIER



20 + 20w AMPLIFIER COMPLETE KIT ONLY
Based on P.W. TEXAN **£33.10** + VAT

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

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 ⅛ 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!**

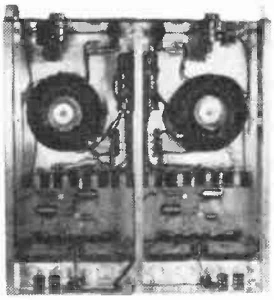
POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM

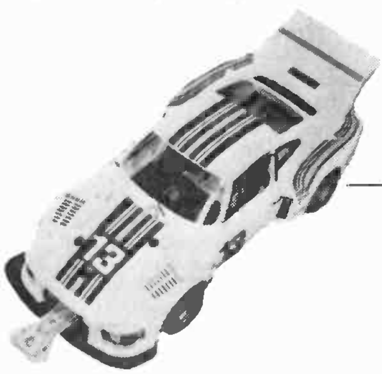
ANDOVER
(STD 0264) 64455

electronics today INTERNATIONAL

APRIL 1978 VOL 7 NO 4



Powerful stuff P.43



Porsche show P.23

Not a drop P.62

FEATURES

PROJECTS

NEWS

INFORMATION

OFFERS

INTERNATIONAL EDITIONS

AUSTRALIA Collyn Rivers Publisher
Les Bell Acting Editor

HOLLAND Anton Kriegsman Editor-in-chief

CANADA Steve Braidwood Editor
Graham Wideman Assistant Editor

GERMANY Udo Wittig Editor

ABC

EDITORIAL AND ADVERTISEMENT OFFICE
25-27 Oxford Street, London. W1R 1RF. Telephone 01-434 1781/2 Telex 8811896

Halvor W. Moorshead Editor
Ron Harris B.Sc Assistant Editor
Gary Evans Projects Editor
John Koblanski Project Development
Jim Perry Specials Editor
William King Editorial Assistant
Paul Edwards Technical Drawings
Margaret Hewitt Administration
Andrew Scott Office Manager
Kim Hamlin, Tim Salmon, Brenda Goodwin Reader Services
Mark Strathern (Manager), Tom Moloney Advertising

PUBLISHED BY Modmags Ltd., 25-27 Oxford Street, London W1R 1RF
DISTRIBUTED BY Argus Distribution Ltd. (British Isles)
Gordon & Gotch Ltd. (Overseas)
PRINTED BY QB Limited, Colchester

Electronics Today International is normally published on the first Friday of the month prior to the cover date.

NEW SEASON'S COMPONENTS

BRIDGE RECTIFIERS

SILICON 1 amp

Type	Order No.	Price
50V RMS	BR1/50	**£0.20**
100V RMS	BR1/100	**£0.22**
200V RMS	BR1/200	**£0.25**
400V RMS	BR1/400	**£0.36**

SILICON 2 amp

50V RMS	BR2/50	**£0.45**
100V RMS	BR2/100	**£0.48**
200V RMS	BR2/200	**£0.52**
400V RMS	BR2/400	**£0.58**
1000V RMS	BR2/1000	**£0.68**

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†
BP10 Modern Crystal and Transistor Set Circuits for Beginners 35p†
BP14 Second Book of Transistor Equivalents 95p†
BP15 Constructors Manual of Electronic Circuits for the Home 50p†
BP16 Handbook of Electronic Circuits for the Amateur Photographer 60p†
BP18 Boys and Beginners Book of Practical Radio and Electronics 60p†
BP22 79 Electronic Novelty Circuits 75p†
BP23 First Book of Practical Electronic Projects 75p†
BP24 52 Projects Using IC741 (or equivalents) 75p†
BP26 Radio Antenna Handbook for Long Distance Reception and Transmission 85p†
BP27 Giant Chart of Radio Electronic Semiconductor and Logic Symbols 60p†
BP29 Major Solid State Audio Hi-Fi Construction Projects 85p†
BP32 How to Build Your Own Metal & Treasure Locators 85p†
BP34 Practical Repair & Renovation of Colour TVs 95p†
BP35 Handbook of IC Audio Preamplifier & 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 15p†
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†
217 Solid State Power Supply Handbook 85p†
219 Solid State Novelty Projects 85p†
220 Build Your Own Solid State Hi-Fi and Audio Accessories 85p†
222 Solid State Short Wave Receivers for Beginners 95p†
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†**
No. 226 110 Operational Amplifier Projects for the Home Constructor Price **£2.50†**
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	5¼in	2¼in	1½in	**62p***
160	4in	4in	1½in	**62p***
161	4in	2¼in	1½in	**62p***
162	5¼in	4in	1½in	**74p***
163	4in	2½in	2in	**64p***
164	3in	2in	1in	**44p***
165	7in	5in	2½in	**£1.04***
166	8in	6in	3in	**£1.32***
167	6in	4in	2in	**86p***

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

No.	Length	Width	Height	Price
155	8in	5¼in	2in	**£1.40***
156	11in	6in	3in	**£1.80***
157	6in	4¾in	1¾in	**£1.25***
158	6in	5¼in	2½in	**£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	£0.95	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	£1.55*	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	£1.90*	72711	£0.32*
CA3028	£1.02*	MC1310P	£0.95*	UA723C	£0.45
CA3035	£1.70*	MC1312PQ		72723	£0.45
CA3036	£1.35*		£1.90*	UA741C	£0.24*
CA3024	£1.50*	MC1330P	£1.20*	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*	MC1456G	£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*	MC1496G	£0.98*	SN76013N	
CA3090	£4.25*				£1.75*
CA3123	£1.90*	NE536	£3.50*	SN76023N	
CA3130	£0.93*	NE515A	£3.50*		£1.75*
CA3140	£0.90*	NE540	£1.50*	SN76110	£1.50*
LM301	£0.39*	NE550	£0.95	SN76115	£1.90*
LM304	£1.60	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		NE562B	£3.95*	TAA621A	£2.00*
	£1.50	NE565A	£1.75*	TAA661A	£1.65*
LM320-12v		NE566	£1.50*	TAD100	£1.30*
	£1.50	NE567	£1.80*	TBA540Q	£2.20*
LM320-15v		UA702C	£0.46*	TBA641B	£2.25*
	£1.50	72702	£0.46*	TBA800	£0.80*
LM320-24v		UA703A	£0.25*	TBA810S	£1.05*
	£1.50	UA709C	£0.25*	TBA820	£0.80*
LM380-14v		72709	£0.46*	TBA920Q	£3.40*
	£0.85*	709P	£0.25*	TCA270S	£2.20*

PANEL METERS

4" RANGE
Size 4¾in x 3¼in x 1¾in

Value	No.	Price
0-50U	1302	**£6.70**
0-100UA	1303	**£6.70**
0-500UA	1304	**£6.70**
0-IMA	1305	**£8.40**
0-50V	1306	**£8.40**

2IN RANGE
Size 2¼in x 1¾in x 1½in

Value	No.	Price
0-50UA	1307	**£5.50**
0-100UA	1308	**£5.50**
0-500UA	1309	**£5.50**
0-IMA	1310	**£5.50**
0-50V	1311	**£5.50**

MR2P TYPE
Size 42 x 42 x30mm

Value	No.	Price
0-50UA	1313	**£5.40**
0-IMA	1315	**£5.40**

MIN. LEVEL METER
Size 23 x 22 x 26mm
Sensitivity 200UA
No. 1320 Price **£2.80**

Vu METER
Size 40 x 40 x 29mm
Sensitivity 130UA
No. 1321 Price **£2.00**

BALANCE/TUNING
Size 45 x 22 x 34mm
Sensitivity 100/0/100UA
No. 1319 Price **£2.00**

MINI MULTI-METER
Size 60 x 24 x 90mm
Sensitivity 1000 ohms/V
AC VOLTS 0-10, 50, 250, 1000
DC VOLTS 0-10, 50, 250, 1000
DC CURRENT 0-1-100mA
Resistance 0-150K ohms
No. 1322 Price **£7.50**

MINIATURE BALANCE/TUNING METER
Size 23 x 22 x 26mm
Sensivity 100/0/100MA
No. 1318 Price **£1.95**

TRANSFORMERS

MINIATURE MAINS Primary 240V
with two independent secondary windings

No.	Type	Price
2024	MT280 0-6V, 0-6V RMS	**£1.50***
2025	MT150 0-12V, 0-12V RMS	**£1.50***

MINIATURE MAINS Primary 240V

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

1 AMP MAINS Primary 240V

No.	Secondary	Price	
2026	6V-0-6V 1 amp	**£2.50**	P.&P. 45p
2027	9V-0-9V 1 amp	**£2.00**	P.&P. 45p
2028	12V-0-12V 1 amp	**£2.60***	P.&P. 55p
2029	15V-0-15V 1 amp	**£2.75***	P.&P. 66p
2030	30V-0-30V 1 amp	**£3.45***	P.&P. 86p

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

Voltages available by use of taps
4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 50, 25-0-25V.

No.	Rating	Price	
2031	½ amp	**£5.50***	P.&P. 86p
2032	1 amp	**£6.60***	P.&P. 86p
2033	2 amp	**£8.40***	P.&P. £1.10

G.P. SWITCHING TRANS.

TO18 SIM. TO 2N706/8

BSY27/28/95A. All usable devices. No open and shorts.
ALSO AVAILABLE IN PNP similar to 2N2906, BCY 70
20 for 50p, 50 for £1, 100 for £1.80, 500 for £8, 1,000 for £14.

When ordering please state NPN or PNP

JUST OUT — *NEW EDITION* BI-PAK CATALOGUE

Send for your copy now! Enclosing 65p† to cover postage and packing.

WORLD SCOOP! JUMBO SEMICONDUCTOR PAK

Transistors, Germ. and Silicon Rectifiers, Diodes
Triacs, Thyristors, ICs and Zeners

ALL NEW AND CODED
Approx. 100 pieces. Offering the amateur a fantastic bargain PAK and an enormous saving.
ORDER No. 16222 **£2.25**

ORDERING

PLEASE WORD YOUR ORDERS EXACTLY AS PRINTED, NOT FORGETTING TO INCLUDE OUR PART NUMBER AND YOUR NAME AND ADDRESS IN CAPS.

VAT

ADD 12½% TO PRICES MARKED *. ADD 8% TO OTHERS EXCEPTING THOSE MARKED †. THESE ARE ZERO RATED

POSTAGE AND PACKING

Please add postage as follows: Small orders 25p; Medium orders 50p; Large orders 75p. Minimum order £1.00.

BI-PAK

DEPT. ETI 4 P.O. BOX 6, WARE, HERTS
Components Shop: 18 Baldock Street, Ware, Herts.

news digest. . . . . . .

strike me

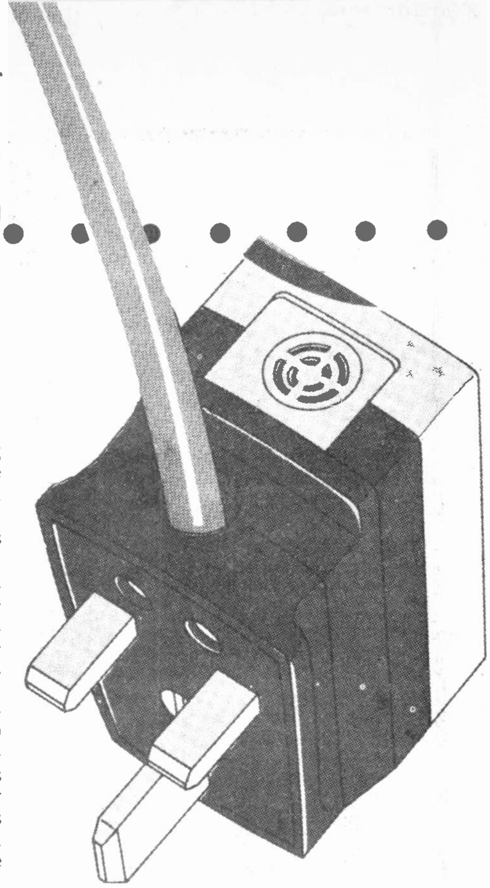
Straight out of Star Wars is a 'Strike Sight' computer from Ferranti.

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.

getting a buzz

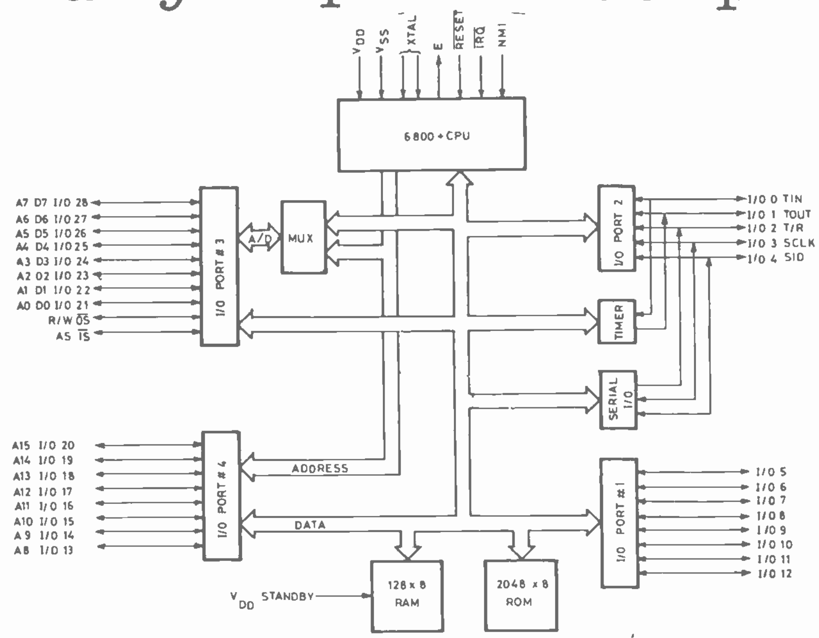


Wired like an ordinary plug and looking not much larger, the BUZZ PLUG may be fitted as a direct replacement for a standard plug.

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.

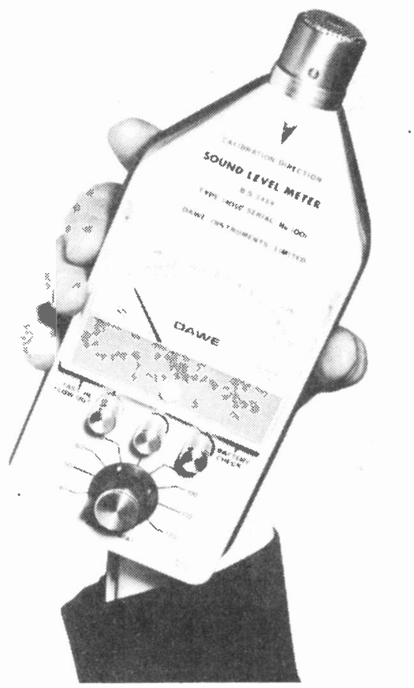
all yer mpus in one chip



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.

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.

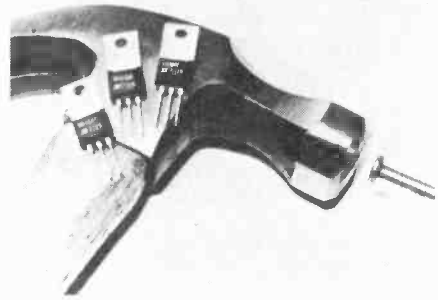
right hook

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.

....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.

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

digital dialing

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.

ETIPRINTS

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.

We think that ETIPRINTS are such a good idea that we have patented the system (Patent numbers 1445171 and 1445172).

ETIPRINTS 005 is now available, and joins 001-004 as part of the regular system.

Details of ordering the ETIPRINTS are shown below.

Lay down the ETIPRINT and rub over with a soft pencil until the pattern is transferred to the board. Peel off the backing sheet carefully making sure that the resist has transferred. If you've been a bit careless there's even a 'repair kit' on the sheet to correct any breaks!

ORDER TODAY

Send cheque or P.O (payable to ETI Magazine) to:-
ETIPRINT
ETI MAGAZINE,
25/27, OXFORD STREET, LONDON. W.I.R. 1RF.

75p **Inc. VAT and P & P.**

Please indicate clearly the ETI PRINTS you require. Those available at present are:

- **001** *With patterns for skeet, clock board A, and the compander from Nov 77 plus the spirit level, three-channel tone control, and the digital thermometer from Oct 77.*
- **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, IB metal locater and porch light from Feb. '78 plus 5 / 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.

. . . news

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 onomatpiac 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 compatable 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, castleing, timer and an eight digit alphanumeric read-out that flashes "congratulations" should you defeat it.

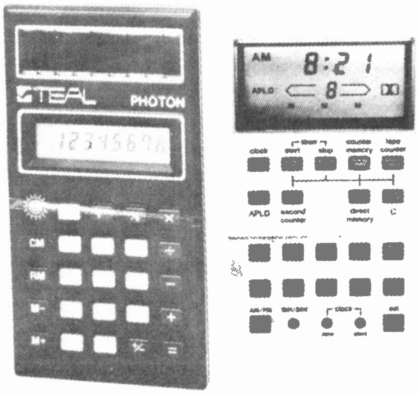
Parker Bros (who brought us Monopoly) are now micro-orientated with their code name sector. Two opponents command destroyers, trying to destroy a computer controlled submarine, which may be at any of the 4,800 locations. Digital read-out of speed, depth, headings, and range are included. Collisions may 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-

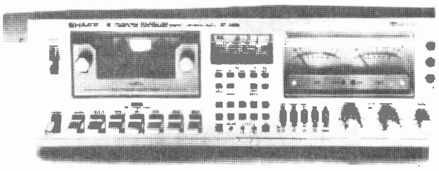
digest...

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."

Get a great deal from Marshall's

Call in and see us 9-5.30 Mon-Fri 9-5.00 Sat

Trade and export enquiries welcome.

A. MARSHALL (LONDON) LTD. DEPT. E.T.I.
LONDON — 40-42 Cricklewood Broadway, NW2 3ET Tel. 01-452 0161. Telex 21492
LONDON — 325 Edgware Road, W2 Tel. 01-723 4242/3.
GLASGOW — 85 West Regent Street, G2 2QD Tel. 041-332 4133
BRISTOL — 1 Straits Parade, Fishponds Rd., BS16 2LX Tel. 0272 654201

CATALOGUE NEW 1978 CATALOGUE ★

Our New 40 Page Spring '78 Catalogue is now available price 35p callers and 45p Post paid.

Top 400 Semiconductors from the largest range in the UK.
Express M.O. service by return post.

All prices are exclusive of VAT

All orders received are despatched same day on stock items

Prices correct at 3rd Feb., 1978, please add VAT to your order, postage & packing 40p

2N696	0.35	2N3703	0.15	2N6126	0.45	BC159	0.16	BD116	1.20	BFX85	0.35
2N697	0.30	2N3704	0.15	40361	0.50	BC160	0.35	BD131	0.51	BFX87	0.30
2N698	0.62	2N3705	0.15	40362	0.55	BC161	0.35	BD132	0.54	BFX88	0.30
2N699	0.55	2N3706	0.16	40363	1.30	BC167	0.12	BD135	0.37	BFX89	1.25
2N706	0.28	2N3707	0.18	40406	0.60	BC168	0.12	BD136	0.37	BFY50	0.25
2N706A	0.28	2N3708	0.13	40407	0.52	BC169	0.12	BD137	0.38	BFY51	0.25
2N708	0.28	2N3709	0.15	40408	0.75	BC170	0.18	BD138	0.38	BFY52	0.30
2N709	0.50	2N3710	0.16	40409	0.75	BC171	0.16	BD139	0.40	BFY53	0.34
2N718	0.27	2N3711	0.16	40410	0.75	BC172	0.14	BD140	0.40	BFY90	1.20
2N718A	0.50	2N3712	1.20	40411	2.85	BC177	0.20	BD239	0.40	BHY39	0.50
2N720A	0.80	2N3713	2.30	40594	0.80	BC178	0.20	BD240	0.45	BSX20	0.33
2N914	0.35	2N3714	2.45	40595	0.90	BC179	0.23	BD241	0.45	BSX21	0.32
2N916	0.30	2N3715	2.55	40673	0.75	BC182	0.11	BD242	0.50	BU105	1.40
2N918	0.38	2N3716	3.00	AC126	0.45	BC182L	0.14	BD243	0.60	BU205	2.20
2N929	0.25	2N3771	1.95	AC127	0.45	BC183	0.11	BD244	0.65	ME0402	0.20
2N930	0.26	2N3772	2.00	AC128	0.45	BC183L	0.14	BD245	0.65	ME0404	0.15
2N1131	0.30	2N3773	2.90	AC151V	0.40	BC184	0.12	BD246	0.66	ME0412	0.20
2N1132	0.37	2N3789	2.90	AC152V	0.50	BC184L	0.14	BD529	0.45	ME4102	0.10
2N1613	0.30	2N3790	3.10	AC153	0.55	BC207	0.16	BD530	0.50	ME4104	0.10
2N1711	0.30	2N3791	3.10	AC153K	0.55	BC208	0.16	BDY20	1.00	MJ481	1.55
2N1893	0.38	2N3792	3.50	AC176	0.50	BC212	0.14	BF115	0.38	MJ490	1.35
2N2102	0.98	2N3794	0.20	AC176K	0.65	BC212L	0.17	BF121	0.55	MJ491	1.85
2N2218	0.33	2N3819	0.36	AC187K	0.60	BC213	0.14	BF123	0.55	MJ2955	1.25
2N2218A	0.37	2N3820	0.38	AC188K	0.60	BC213L	0.16	BF152	0.25	MJE340	0.58
2N2219	0.35	2N3823	0.80	AD161	1.00	BC214	0.16	BF153	0.25	MJE370	0.58
2N2219A	0.36	2N3904	0.21	AD162	1.00	BC214L	0.17	BF154	0.25	MJE371	0.60
2N2220	0.35	2N3906	0.22	AF106	0.55	BC237	0.14	BF158	0.35	MJE520	0.45
2N2221	0.25	2N4036	0.67	AF109	0.75	BC238	0.12	BF160	0.30	MJE521	0.65
2N2221A	0.26	2N4037	0.55	AF124	0.65	BC239	0.15	BF161	0.60	MJE2955	1.50
2N2222	0.25	2N4058	0.20	AF125	0.65	BC251	0.16	BF166	0.40	MJE3055	0.95
2N2222A	0.25	2N4059	0.15	AF126	0.65	BC253	0.22	BF167	0.35	MP8111	0.35
2N2368	0.25	2N4060	0.20	AF139	0.69	BC257A	0.17	BF173	0.35	MP8112	0.40
2N2369	0.25	2N4061	0.17	AF186	0.50	BC258A	0.17	BF177	0.25	MP8113	0.45
2N2369A	0.25	2N4062	0.18	AF200	1.20	BC259B	0.18	BF178	0.25	MPF102	0.30
2N2646	0.75	2N4126	0.17	AF239	0.65	BC261A	0.24	BF179	0.30	MPSA05	0.25
2N2647	1.40	2N4289	0.20	AF240	1.14	BC262B	0.24	BF180	0.35	MPSA06	0.25
2N2904	0.36	2N4919	0.65	AF279	0.80	BC263C	0.30	BF181	0.35	MPSA12	0.40
2N2904A	0.37	2N4920	0.75	AF280	0.85	BC300	0.40	BF182	0.35	MPSA55	0.25
2N2905	0.37	2N4921	0.50	BC107	0.15	BC301	0.40	BF183	0.40	MPSA56	0.25
2N2905A	0.38	2N4922	0.55	BC108	0.15	BC303	0.50	BF184	0.38	MPSU05	0.50
2N2906	0.28	2N4923	0.70	BC109	0.15	BC307	0.15	BF185	0.35	MPSU06	0.56
2N2906A	0.35	2N5190	0.60	BC113	0.20	BC308	0.15	BF194	0.15	MPSU55	0.55
2N2907	0.25	2N5191	0.70	BC115	0.20	BC309C	0.15	BF195	0.15	MPSU56	0.60
2N2907A	0.25	2N5192	0.75	BC116	0.19	BC317	0.14	BF196	0.15	TIP29A	0.45
2N2924	0.15	2N5195	0.90	BC116A	0.20	BC318	0.13	BF197	0.17	TIP29C	0.60
2N2925	0.17	2N5245	0.34	BC117	0.22	BC327	0.20	BF198	0.18	TIP30A	0.49
2N3019	0.55	2N5294	0.40	BC118	0.20	BC328	0.19	BF200	0.35	TIP30C	0.65
2N3053	0.26	2N5295	0.40	BC119	0.30	BC337	0.19	BF225J	0.25	TIP31A	0.50
2N3054	0.60	2N5296	0.40	BC121	0.45	BC338	0.21	BF244	0.35	TIP 31C	0.66
2N3055	0.70	2N5298	0.40	BC132	0.30	BC547	0.12	BF245	0.40	TIP32A	0.55
2N3390	0.20	2N5447	0.15	BC134	0.20	BC548	0.12	BF246	0.75	TIP32C	0.75
2N3391	0.20	2N5448	0.15	BC135	0.20	BC549	0.13	BF254	0.24	TIP33A	0.80
2N3391A	0.20	2N5449	0.19	BC136	0.19	BCY30	1.00	BF255	0.24	TIP33C	1.10
2N3392	0.16	2N5457	0.32	BC137	0.20	BCY31	1.00	BF257	0.37	TIP34A	0.90
2N3393	0.15	2N5458	0.33	BC140	0.35	BCY32	1.00	BF258	0.45	TIP34C	1.20
2N3394	0.15	2N5459	0.29	BC141	0.40	BCY33	1.00	BF259	0.49	TIP35A	2.50
2N3439	0.88	2N5484	0.34	BC142	0.30	BCY34	1.00	BF459	0.50	TIP36A	2.80
2N3440	0.64	2N5486	0.38	BC143	0.30	BCY38	2.00	BFR39	0.28	TIP41A	0.70
2N3441	0.81	2N6027	0.60	BC147	0.12	BCY42	0.60	BFS21A	2.60	TIP41C	0.90
2N3442	1.35	2N6101	0.45	BC148	0.12	BCY58	0.25	BFS28	1.38	TIP42A	0.80
2N3638	0.16	2N6107	0.42	BC149	0.14	BCY59	0.25	BFS61	0.30	TIP42C	1.00
2N3638A	0.16	2N6109	0.50	BC153	0.27	BCY70	0.25	BFS98	0.30	TIP2955	0.65
2N3639	0.30	2N6121	0.38	BC154	0.27	BCY71	0.26	BFX29	0.35	TIP3055	0.55
2N3641	0.20	2N6122	0.41	BC157	0.14	BCY72	0.24	BFX30	0.35	TIS43	0.43
2N3702	0.13	2N6123	0.43	BC158	0.14	BD115	0.80	BFX84	0.35		

INTEGRATED CIRCUITS

CA3020	2.00	LM748-8	0.55
CA3020A	2.29	LM748N	0.55
CA3028B	1.29	LM1800	1.76
CA3028A	1.01	LM1808	1.92
CA3030	1.35	LM1828	1.75
CA3030A	2.00	LM3301N	0.85
CA3045	1.40	LM3302N	1.40
CA3046	0.89	LM3401	0.70
CA3048	2.23	LM3900	0.75
CA3049	1.80	LM3905	1.60
CA3050	2.42	LM3909	0.68
CA3053	1.62	MC1035	1.75
CA3080	0.75	MC1303	1.03
CA3080A	1.88	MC1304	1.40
CA3086	0.60	MC1305	1.40
CA3088	1.70	MC1310	1.91
CA3089	2.52	MC1327	1.54
CA3090	4.00	MC1330	1.00
CA3130	0.98	MC1350	0.90
LM301A	0.67	MC1351	1.20
LM301N	0.40	MC1352	1.10
LM304	2.45	MC1458	0.91
LM307N	0.65	NE555	0.40
LM308C	1.82	NE556	1.10
LM308N	0.85	NE565	1.30
LM309K	1.85	NE566	1.65
LM317K	3.00	NE567	1.80
LM318N	2.26	SAS560	2.50
LM323K	6.46	SAS570	2.50
LM339N	1.40	S042P	1.25
LM348N	1.50	76001N	1.30
LM360N	2.75	76003N	2.20
LM370N	2.50	76008K	1.50
LM371N	1.70	76013N	1.50
LM372N	1.70	76013ND	1.30
LM373N	2.80	76018K	1.50
LM374N	3.10	76023N	1.45
LM377N	1.75	76023ND	1.26
LM378N	2.25	76033N	2.20
LM379S	3.95	76110N	1.18
LM380-8	0.90	76115N	1.51
LM380N	0.98	76116N	1.66
LM381A	2.45	76131N	1.20
LM381N	1.60	76226N	1.56
LM382N	1.25	76227N	1.20
LM384N	1.45	76228N	1.41
LM386N	0.80	76530N	0.75
LM387N	1.05	76532N	1.40
LM388N	0.90	76533N	1.20
LM389N	1.00	76544N	1.44
LM702C	0.75	76545N	1.65
LM709C	0.65	76546N	1.44
LM709N	0.45	76550N	0.35
LM710C	0.60	76552N	0.52
LM710N	0.60	76570N	1.65
LM723C	0.85	76620N	0.90
LM723N	0.75	76650N	1.10
LM741C	0.65	76660N	0.60
LM741N	0.40	76666N	0.92
LM741-8	0.40	TAA320A	1.00
LM747N	0.90	TAA350A	2.48

TAA521	1.00
TAA522	1.90
TAA550	0.60
TAA560	1.75
TAA570	2.30
TAA611B	1.85
TAA621	2.15
TAA661A	1.50
TAA661B	1.50
TAA700	3.91
TAA930A	1.30
TAA930B	1.30
TAD100	1.95
TBA120	0.75
TBA400	2.00
TBA500	2.21
TBA500Q	2.30
TBA510	2.21
TBA510Q	2.30
TBA520	2.21
TBA520Q	2.30
TBA530	1.98
TBA530Q	2.07
TBA540	2.21
TBA540Q	2.30
TBA550	3.13
TBA550Q	3.22
TBA560Q	3.22
TBA570	1.29
TBA570Q	1.38
TBA641B	2.70
TBA651	2.20
TBA700	1.52
TBA700Q	1.61
TBA720Q	2.30
TBA750	1.98
TBA750Q	2.07
TBA800	1.25
TBA810	1.25
TBA820	1.25
TBA920	2.90
TBA920Q	2.99
TBA940	1.62
TCA160C	1.85
TCA160B	1.61
TCA270	2.25
TCA280A	1.30
TCA290A	3.13
TCA420A	1.84
TCA730	3.22
TCA740	2.76
TCA750	2.30
TCA760	1.38
TCA800	3.13
UAA170	2.00
UAA180	2.00

DIL SOCKETS

8 PIN	0.15
14 PIN	0.16
16 PIN	0.18
22 PIN	0.30
24 PIN	0.35
28 PIN	0.45
40 PIN	0.55

MICROPROCESSOR COMPONENTS

RAMS

2101-2N	3.00
2102-2N	2.10
2111-2N	3.00
2112-2N	3.00
74C920D	12.57

TRISTATE BUFFERS

DM81LS95	1.45
DM81LS96	1.45
DM81LS97	1.45
DM81LS98	1.45

2102.2N RAM
£1.93 each for 25 pcs

ROMS
MM5214 26.95

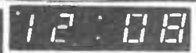
PROMS

74S287	5.33
MM5204Q	10.95
1702AQ	10.50
2708Q	35.00

SC/MP

8080A 8 BIT MICROPROCESSOR FAMILY

INS8080A	N Channel 40 Pin	£12.00
DP8224N	Clock Generator	£6.16
DP8228D	System Controller	£7.30
DP8212N	8 Bit Port	£3.08
1SP-8A/500D	SC/MP CPU chip	£12.00
1SP-8A/600N	N-channel CPU chip	£10.00



CLOCK MODULES DIGITAL

Built and tested — requires only switches and transformer to complete 12 or 24hr alarm modules

MA1002F 12hr. 5" display	£9.50
MA1002H 24hr. 5" display	£9.50
MA1010E 12hr. 84" display	£12.50
MA1010G 24hr 84" display	£12.50

CAR CLOCK MODULE

MA1003 Built and tested 12v supply and four-digit module. Crystal controlled **£14.50**
Data Sheet 5p + SAE

NATIONAL

"What is a microprocessor?" — a complete teach yourself course with cassettes + brochure **£9.95** incl. VAT & p&p

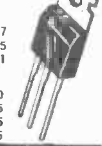
NEW SC/MP RETROFIT KIT
Now available from stock this new SC/MP/II Retrofit which enables existing SC/MP Intro Kit users to evaluate the new SC/MP/II Microprocessor **£18.40** excl. VAT p&p 75p.

TRIACS Plastic pack 400V

6 amp	0.70	16 amp	1.10
8 amp	0.75	20 amp	1.70
12 amp	0.85	25 amp	2.00

THYRISTORS Plastic C106/116

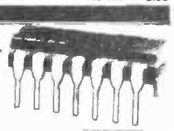
4 amp 100V	0.35	8 amp 100V	0.43	12 amp 100V	0.57
4 amp 200V	0.40	8 amp 200V	0.49	12 amp 200V	0.65
4 amp 400V	0.49	8 amp 400V	0.62	12 amp 400V	0.81



VOLTAGE REGULATORS

500MA T0202 positive 5, 12, 15, 24V	1.10
500MA T0202 negative 5, 12, 15, 24V	1.05
1 amp T0220 positive 5, 12, 15, 24V	1.35
1 amp T0220 negative 5, 12, 15, 24V	2.85

TTL FROM NATIONAL, ITT, TEXAS, SIGNETICS, ETC.



7400	0.16	7412	0.21	7438	0.55	7460	0.21	7485	1.85	74118	0.90	74160	1.41				
7401	0.16	7413	0.51	7440	0.21	7470	0.46	7486	0.41	74119	1.80	74161	1.41				
7402	0.16	7414	1.80	7441	1.03	7472	0.38	7490	0.61	74121	0.49	74162	1.41				
7403	0.16	7416	0.61	7442	0.78	7473	0.43	7491	0.98	74122	0.45	74163	1.41				
7404	0.26	7417	0.61	7445	1.35	7474	0.43	7492	0.61	74123	0.58	74164	1.23				
7405	0.26	7420	0.21	7446	1.23	7475	0.58	7493	0.61	74141	1.03	74165	1.23	74182	1.08	74192	1.62
7406	0.74	7423	0.39	7447	1.17	7476	0.51	7494	0.74	74145	1.06	74167	3.70	74184	2.46	74193	1.62
7407	0.74	7425	0.39	7448	1.17	7480	0.45	7495	0.78	74151	1.11	74174	1.52	74185	2.46	74196	1.17
7408	0.29	7427	0.39	7450	0.29	7481	1.10	7496	1.03	74153	1.11	74175	1.35	74188	2.00	74197	1.17
7409	0.29	7430	0.21	7451	0.21	7482	0.67	7497	4.60	74154	1.85	74176	1.23	74189	3.99	74198	2.93
7410	0.21	7432	0.39	7453	0.21	7483	1.33	74100	1.15	74155	1.11	74180	1.77	74190	1.91	74199	2.93
7411	0.29	7437	0.55	7454	0.21	7484	0.85	74107	0.43	74157	0.98	74181	3.70	74191	1.91		

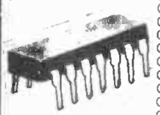
OPTO ELECTRONICS

Full range of Opto devices in our New Catalogue
LEDS TIL209 **0.12** 100 + pcs
3mm Red **0.18** Green **0.25** Yellow **0.25**
5mm Red **0.21** Green **0.26** Yellow **0.25**
Many more types — listed in our new catalogue — Solar cells, light switches, etc.

DISPLAYS 7 Segment

	Single	Double	Display
DL704	2.00	3.00	3" Red
DL707	2.00	3.00	.3" Red
DL747	2.50	3.40	5" Red
DL750	2.50	3.40	.5" Red

CMOS & LOW POWER SCHOTTKY



CD4000	0.24	CD4018	1.15	CD4041	0.96	CD4059	5.45	CD4081	0.25	74LS02	0.24	74LS138	1.27
CD4001	0.24	CD4019	0.70	CD4042	0.96	CD4060	1.27	CD4082	0.25	74LS04	0.27	74LS151	1.13
CD4002	0.24	CD4020	1.27	CD4043	1.15	CD4063	1.25	CD4085	0.81	74LS08	0.24	74LS157	1.17
CD4006	1.34	CD4021	1.15	CD4044	1.06	CD4066	0.80	CD4086	0.81	74LS10	0.24	74LS160	1.40
CD4007	0.24	CD4022	1.10	CD4045	1.59	CD4067	4.25	CD4089	1.77	74LS13	0.65	74LS161	1.50
CD4008	1.10	CD4023	0.24	CD4046	1.52	CD4068	0.25	CD4093	0.91	74LS32	0.25	74LS162	1.50
CD4009	0.64	CD4024	0.84	CD4047	1.15	CD4069	0.25	CD4094	2.13	74LS42	1.01	74LS163	1.50
CD4010	0.64	CD4025	0.24	CD4049	0.64	CD4070	0.66	CD4095	1.19	74LS74	0.48	74LS164	1.52
CD4011	0.24	CD4027	0.64	CD4050	0.64	CD4071	0.25	CD4096	1.19	74LS75	0.60	74LS173	2.35
CD4012	0.24	CD4028	1.02	CD4051	1.06	CD4072	0.25	CD4510	2.00	74LS76	0.40	74LS174	1.20
CD4013	0.60	CD4029	1.30	CD4052	1.06	CD4073	0.25	CD4511	2.30	74LS85	1.45	74LS175	1.20
CD4014	1.15	CD4030	0.64	CD4053	1.06	CD4075	0.25	CD4516	2.00	74LS86	0.48		
CD4015	1.15	CD4031	2.53	CD4054	1.32	CD4076	1.17	CD4518	2.00	74LS90	1.00		
CD4016	0.64	CD4035	1.34	CD4055	1.50	CD4077	0.66	CD4520	2.00	74LS92	0.90		
CD4017	1.15	CD4037	1.10	CD4056	1.50	CD4078	0.25	74LS00	0.24	74LS107	0.44		

74LS

74C MOS

74C00	.26	74C85	1.90
74C02	.26	74C86	.68
74C04	.26	74C90	.91
74C08	.26	74C107	1.30
74C10	.26	74C151	2.62
74C20	.26	74C157	2.35
74C30	.26	74C160	1.18
74C32	.26	74C161	1.18
74C42	.92	74C162	1.18
74C48	2.30	74C163	1.18
74C73	.58	74C164	1.04
74C74	.59	74C173	.95
74C76	.58	74C174	.95

LOW PROFILE SKTS

		18 Pin	.27
		22 Pin	.30
8 Pin	0.15	24 Pin	.35
14 Pin	0.16	28 Pin	.45
16 Pin	0.18	40 Pin	.55

MICROPROCESSOR SYSTEMS

SC/MP INTROKIT £68.61 exc. VAT
Budget introduction to SC/MP microprocessing — Board, CPU, Memories, Crystal, etc. Built-in debugging. Complete with explanatory data and applications — National Semiconductors.

KEYBOARD KIT £65.84 exc. VAT
Budget VDU for Teletype substitute, the calculator type keyboard provides manual I/O commands to Introkit. Full instruction and data supplied with each kit. Complete kit easily mates with cassette recorder.

SC/MP

DATA PACK £1.50
46 instruction set
8 bit tristate bus I/O
12 bit tristate address
512 bytes rom
256 bytes ram

NEW FROM MOTOROLA 6800

A build-it-yourself microcomputer designed around the Motorola M6800 Family
Kit contains CPU (MC6800), 256 x 8 RAM (2 x MCM6810 AP), 2 x P.I.A. (MC6820), 1 x ACIA (MC6850), Hex-Keyboard, Hex-display interface to audio cassette, plus all additional components. Easily expanded. Single 5V supply needed. 72 basic instructions.

Telephone orders with credit cards — £10 minimum

D2 KIT £190 +VAT

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 Feburary 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 cassettee the software you want. Presumably in the future, taoes 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. Commodoare 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

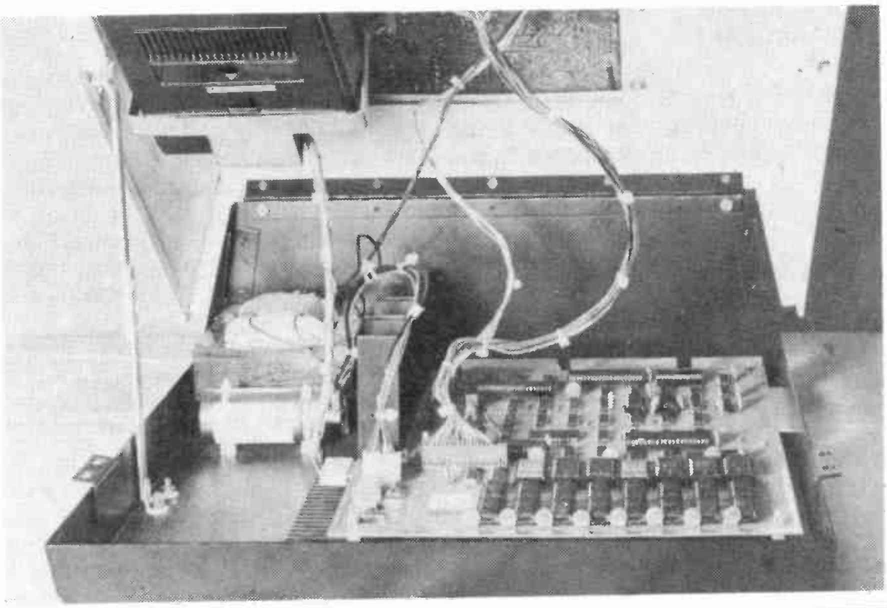


Fig. 2. Our first sight of the insides. It's a real pleasure to open up and discover a "prop" already in place to hold up the top. Notice neat cabling and connecting plugs, making for cheap efficient assembly and service.

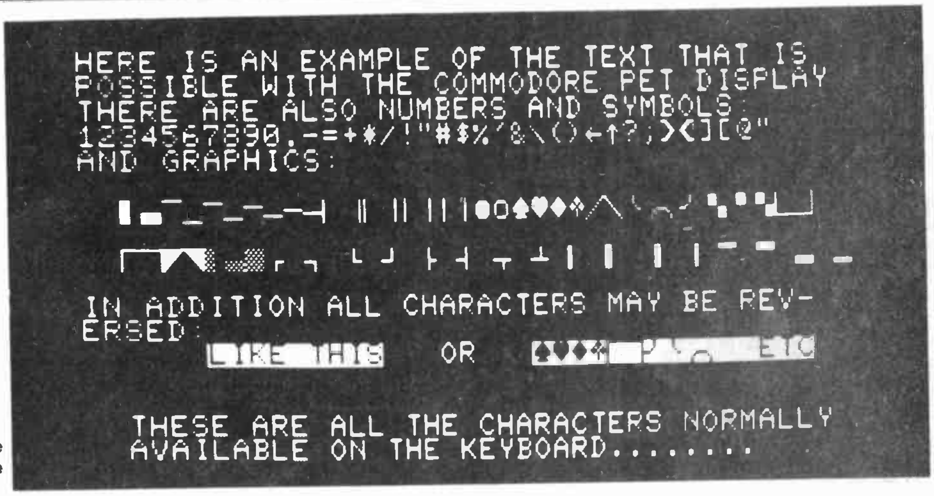


Fig. 3. Here we've detached some of the parts from their mountings so we didn't have to draw a block diagram. Video monitor board is above.

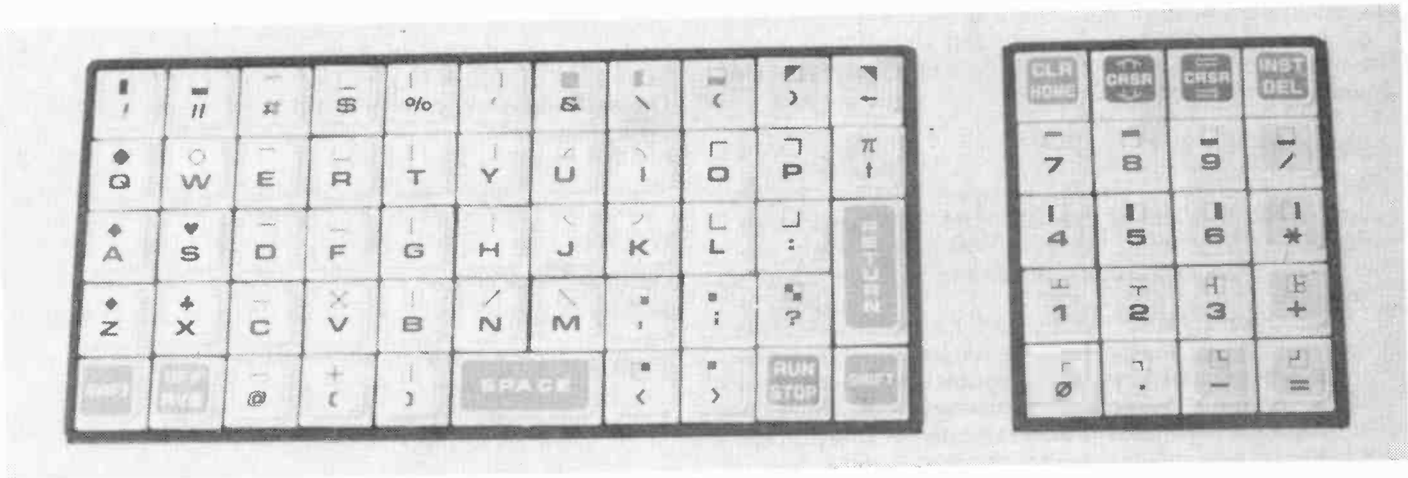


Fig. 4 The two PET keyboards. We found it quite handy to have a separate numeric pad.

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 that anticiapted.

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 paralel 0 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 manufactureer 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 thier 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 APL⅛).

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 mnenonics 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 seres 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 same 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 wholse 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 intro duce 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 sone 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.

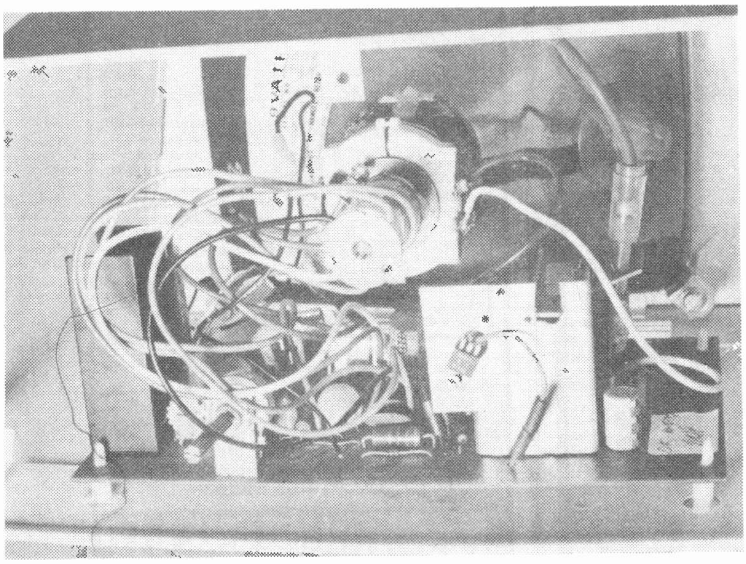
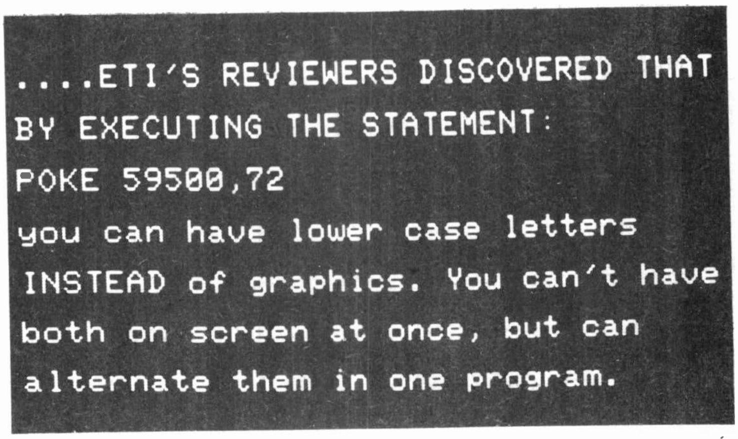


Fig. 5. Peeking in the back of the video monitor (left) reveals a fairly standard set of works.



ETI MARKET

CBM 5R39

£14.95 ALL INC.

We've said this before, but you asked for it. Last time the 5R39 proved very successful, and orders were being received long after the offer period expired. Since then there has been a steady 'lobby' to bring back the beast — and so we have finally capitulated!

In case you missed it then (WHY?) the 5R39 is a fully rechargeable scientific calculator with all the facilities required for serious work. Its unusual keyboard layout makes it ideal for everyday use too, and with no batteries to buy (charger INCLUDED in price) it's irresistible!

FEATURES: **sin, cos, tan and inverse, change sign, exchange register, x^2, y^x, $\log_e$, $\log_{10}$, $\sqrt{x}$, $\sqrt{y}$, rectangular and polar co-ordinates, e^x, 10^x, standard deviation and mean value, two memories, summation to memory, $1/x$, parenthesis, full arithmetic functions. Algebraic logic is employed.**

TO CALCULATOR OFFER
ETI MAGAZINE
25-27 OXFORD STREET
LONDON W1R 1RF

Offer closes April 30th

Name ....

Address ....

....

....

ETI ALARM CLOCK

£14·50

THE LONG-RUNNING OFFER ON A DIGITAL ALARM CLOCK HAS BEEN ONE OF OUR MOST SUCCESSFUL EVER! OUR PRICE **INCLUDES** VAT AND POST & PACKING.

Our clock shows the time 18mm high on bright Planar Gas Discharge displays (there is a brightness control on the back). The dot on the left of the display shows AM/PM and the flashing (1Hz) colon shows that the alarm and clock are working. A bleeper alarm sounds until the clock is tipped forwards. Then the 'snooze' facility can give you 5 minutes sleep before the alarm sounds again, and then another 5 minutes etc., until you switch the alarm off. The clock also features a mains-failure indicator, and is 12hr — the alarm being 24 hour.

We have a large number of units in stock for this offer but please allow 28 days for delivery.

CLOCK OFFER
ETI MAGAZINE
25-27 OXFORD STREET
LONDON W1R 1RF

I enclose cheque/P.O. for £14.50 (payable to ETI) for an Alarm Clock. Please write your name and address on the back of your cheque to speed processing of your order.

NAME ....

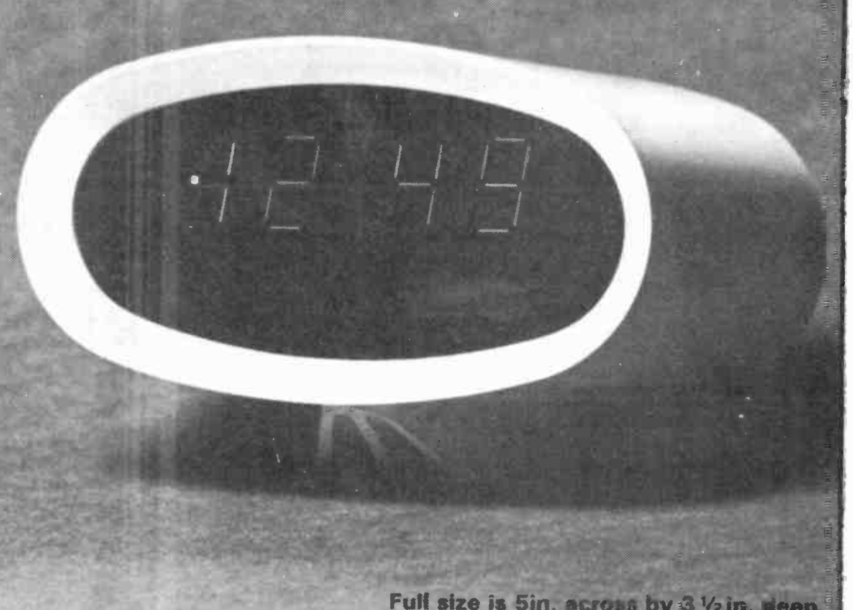
ADDRESS ....

....

....

....

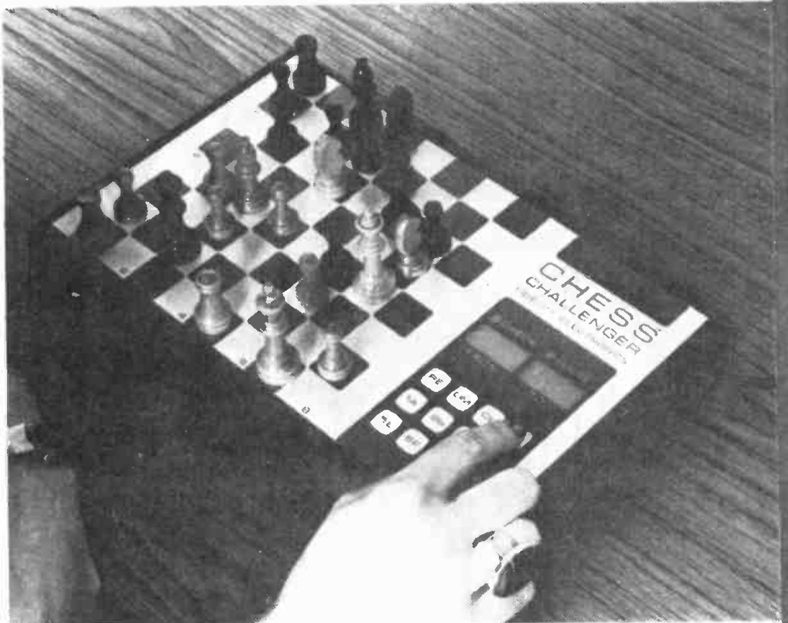
Those not wishing to cut their magazine may order on their own notepaper.



Full size is 5in. across by 3 ½in. deep.

PLACE CHESS CHALLENGER

£99.95 INC



Play the Chess Challenger with anything less than a clear mind and it will beat you. Embarrassing but true. You punch in your move on the keyboard next to the board, and the reply appears on four LED displays. We ran this a while back at £115, but have now managed to knock down the price AGAIN, and present it to you at what is definitely our final offer!

Ideal for the chess tyro to improve his game, or for the more experienced player to get some practice in.

To: Chess Challenger Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed by payment of £99.95

Name . . . .

Address . . . .

. . . .

Offer subject to availability
Allow 28 days for delivery

TRANSFORMERS

Panel Meters, Bridge Rectifiers, Power Supply Units
Multimeters - Semi Conductors - Timers - Safebloc

Miniature & Sub Miniature

Volts	Milli-amps	Ref. No.	Price £	P&P
3-0-3	200	238	**1.95**	.55
0-6,0-6	1A 1A	212	**2.60**	.55
9-0-9	100	13	**1.85**	.40
0.9,0.9	330 330	235	**1.95**	.40
0-8-9,0-8-9	500 500	207	**2.35**	.55
0-8-9,0-8-9	1A 1A	208	**3.50**	.55
0-15,0-15	200 200	236	**1.95**	.40
0-20,0-20	300 300	214	**2.35**	.70
20-12-0-12-20	700(DC)	221	**3.10**	.70
0-15-20,0-15-20	1A 1A	206	**4.20**	.85
0-15-27,0-15-27	500 500	203	**3.65**	.70
0-15-27,0-15-27	1A 1A	204	**4.75**	.85

12 AND/OR 24 VOLT
Pri 220-240 Volts

Amps 12V	Amps 24V	Ref.	Price £	P&P
0.5	0.25	111	**1.95**	.55
1.0	0.5	213	**2.30**	.70
2	1	71	**2.90**	.70
4	2	18	**3.75**	.70
6	3	70	**5.35**	.85
8	4	108	**6.25**	1.00
10	5	72	**6.95**	1.00
12	6	116	**7.85**	1.00
16	8	17	**9.25**	1.10
20	10	115	**12.75**	1.30
30	15	187	**16.60**	1.30
60	30	226	**22.90**	1.60

30 VOLT (Pri 220-240V)
Sec 0-12-15-20-24-30V

Amps	Ref No.	Price £	P&P
0.5	112	**2.45**	.70
1.0	79	**3.05**	.70
2.0	3	**4.80**	.85
3.0	20	**5.80**	1.00
4.0	21	**6.85**	1.00
5.0	51	**7.75**	1.00
6.0	117	**9.50**	1.00
8.00	88	**11.35**	1.30
10.0	89	**12.00**	1.30

CATALOGUE 30p

50 VOLT (Pri 220-240V)
Sec 0-19-25-33-40-50V

Amps	Ref. No.	Price £	P&P
0.5	102	**3.20**	.70
1.0	103	**4.20**	.85
2.0	104	**6.10**	1.00
3.0	105	**7.85**	1.00
4.0	106	**9.80**	1.10
6.0	107	**14.95**	1.30
8.0	118	**15.75**	1.50
10.0	119	**20.50**	2.00

60 VOLT (Pri 220-240V)
Sec 0-24-30-40-48-60V

Amps	Ref. No.	Price £	P&P
0.5	124	**3.40**	.70
1.0	126	**4.65**	.85
2.0	127	**6.50**	1.00
3.0	125	**9.15**	1.10
4.0	123	**11.25**	1.30
5.0	40	**11.80**	1.30
6.0	120	**14.75**	1.40

AUTO TRANSFORMERS
Input/Output Tapped 0-115-210-240V

VA (Watts)	Ref. No.	Price £	P&P
20	113	**2.25**	.70
75	64	**3.50**	.70
150	4	**5.35**	.85
Input/Output Tapped 0-115-210-220-240V			
300	66	**7.15**	1.00
500	67	**10.75**	1.30
1000	84	**17.00**	1.40

Also 1500/2000/3000VA

MAINS ISOLATING (Centre Tapped & Screened)
Pri 120/240 Sec 120/240V

VA (Watts)	Ref. No.	Price £	P&P
60	149	**5.75**	.85
100	150	**6.40**	1.00
200	151	**10.00**	1.10
250	152	**11.95**	1.30
350	153	**14.45**	1.40
1000	156	**35.00**	3.00

Please add VAT at 8%
Barclaycard and Access facilities available
Trade and Education Welcome

BAYDIS 54a Mortimer Street
Herne Bay, Kent
Herne Bay 64586

Complete digital clock kits

TEAK or PERSPEX CASE

ALL PRICES INCLUDE POST, PACK AND VAT

Features:

- 4 LED digits ½" high, red
- 12-hour display with AM/PM indication
- Mains frequency accuracy
- Easy-to-build : all components included
- Beautiful real wood case or Perspex; White, Black, Red, Blue, Green
- Flashes to indicate power cuts

Non alarm £12.50
Alarm £15.50

NON-ALARM
Complete Kit including case . . . £12.50
Ready built . . . £14.50
Module Kit excluding case . . . £9.50
Ready Built . . . £10.00

ALARM
Pulsed Alarm tone. Automatic Brightness control. 9 minute Snooze. Simple setting
Complete Kit including case . . . £15.50
Ready Built . . . £17.00
Module Kit excluding case . . . £13.00
Ready Built . . . £13.50

TIMER FACILITY: Stopwatch use up to 9 min. 59 secs. . . . extra 50p

EXCELLENT VALUE GUARANTEED
- National Semi. 5 Function LCD Watch. Backlight **£15.95**
- NOVS 850 Calculator £3.78. Adaptor £2.70.

DISPLAYS: FND 500 ½" LED **£1.19** each, 6 for **£6.48**.
NSB 5430 ½" red LED stick of 4 **£4.32** 5LTO2 ½" green phosphor stick of 4 **£5.40**

CLOCK CHIPS: 50253N Alarm 12/24 hr 4/6 digit . . . **£5.67**
50362N Calendar clock **£7.75** MM5385N 12 hr. 4 digit. Alarm **£4.32**
6 Decade Up/Down Counters: 50395/6/7 . . . **£9.45**
MICROPROCESSOR: Z80 CPU . . . **£22.68**
Z80 CTC . . . **£15.70** 1702A UV Erazable PROM . . . **£11.35**
Z80 PIO . . . **£15.70** 2102NA IK Static RAM . . . **£2.70**
UV PROM Erazer **£103.00** + £5.00 p&p 4KX1 16 pin Dyn. RAM **£7.05**

RECHARGEABLE BATTERY SET. Super Value . . . **£8.10**
Includes: 4 AA (1.2v) Nickel Cadmium batteries (separately £1.08 each)
3/6/9v switched Universal Mains Adaptor with 4 plug connector for most calculators (separately £3.78) plus battery holder

ALPHA CLOCK KITS ½" Green Display. Perspex Case
Alarm . . . **£15.50** Non-Alarm . . . **£12.50**

Send payment with order. SAE for details.

Buy it with Access

BARON
SOUTHVIEW HOUSE
6 GOWER ROAD
ROYSTON, HERTS.
Phone: Royston (0763) 43695

BARCLAYCARD

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

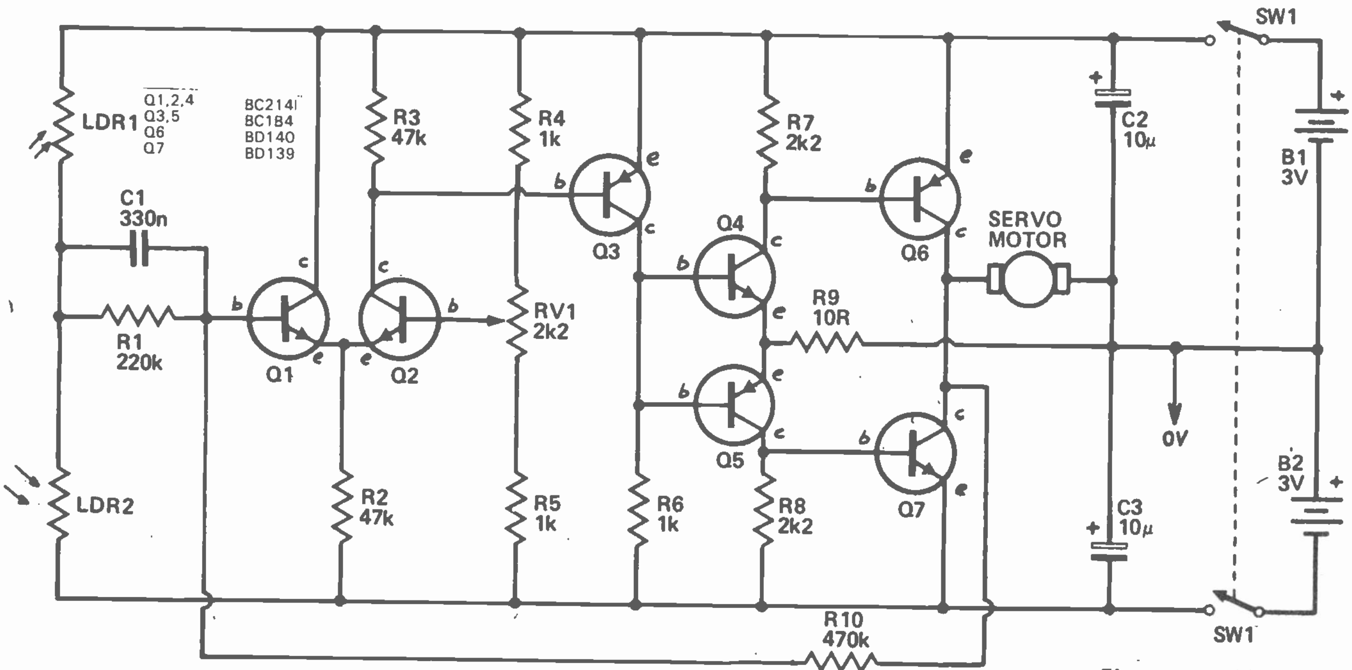


Figure 1. (Above) Circuit diagram of the white line follower unit.

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.

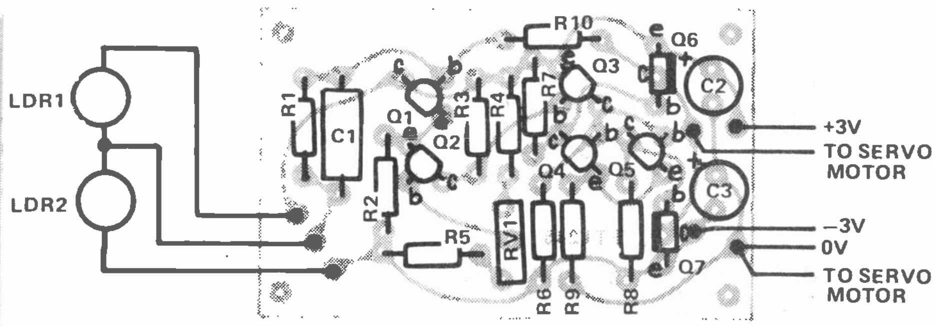


Figure 2. Component overlay. See text for details of mounting the board and servo motors within the model.

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

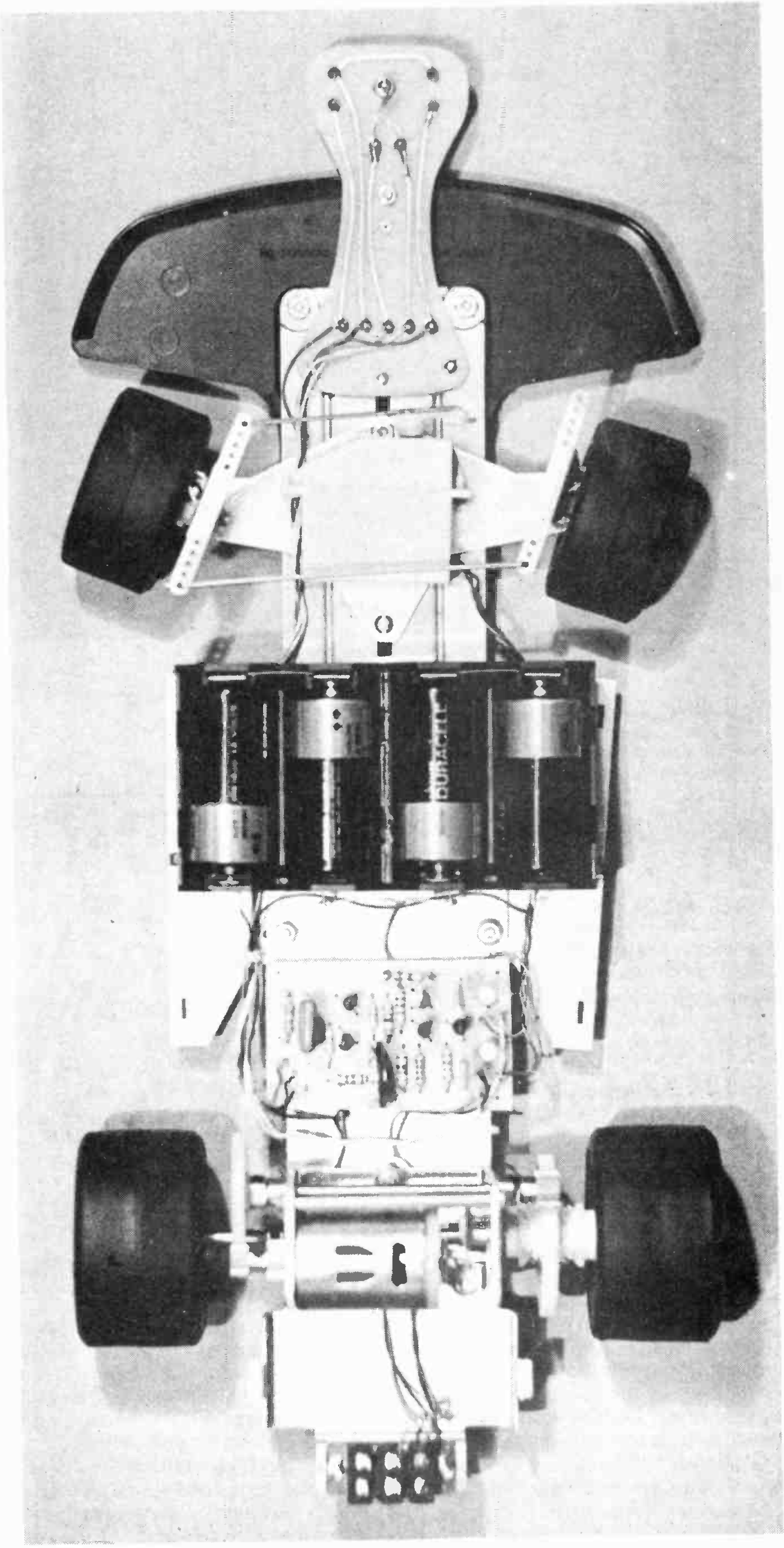
C1	330u Polyester
C2,3	10u 10 V Electrolytic

SEMICONDUCTORS

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

MISCELLANEOUS

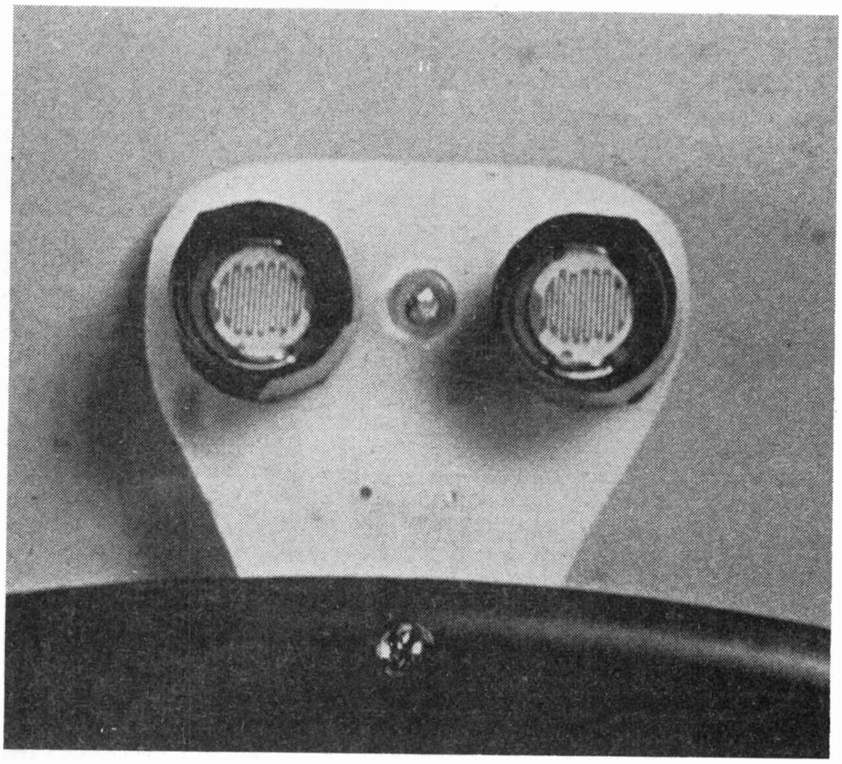
PCB as pattern, 3V bulb, 2-pole on/off switch, servo motor and car (see text)



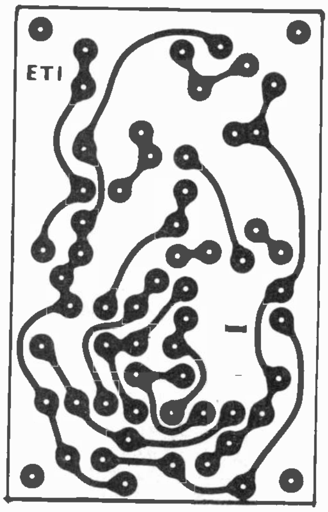
On the right the Porsche with its lid off. The PCB is mounted behind the drive motor, which is sitting between the rear wheels. The servo is sited between the front wheels, and the board upon which we put the LDRs and bulb can be seen on the front of the chassis.

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.



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

NOW—A VDU BOARD

WITHOUT KEYBOARD AND NO DISPLAY

A double-sided board with plated through holes 12½" x 8" (4 Eurocard size). 960 Characters in a 40x24 line format. 64 ASCII characters. Flashing cursor. 32 control functions available. Adjustable bauld rate. Provision for a keyboard. Serial input and output. Requires + 5V and — 12V and any modified television or video monitor. Board is crystal controlled to give a rock steady display.
Supplied in kit form (All components supplied) **£95.** P&P £1.75. Assembled and tested **£125.** P&P £1.75.

MARCONI VALVE VOLTMETER TF428B
NOW £12.50 ea.

FURZEHILL EX-MINISTRY AUDIO GENERATOR 0-20KHZ
Sinewave output. Metered. 600 Ohms. Size 16x10x9" deep. Standard mains now at **£15** each

EX-MINISTRY MARCONI 0-6 WATTS
Multi Range. Multi Impedance POWER METERS. **£25** each

ITT-CREED
Punches and Prints on ⅞" paper. Complete with Power Supply. Solid State. Size 15x11¾x22" deep **£32.50.**

★ I.C. BOARD PACK
50 I.C.s and other useful components for
£1 P&P 75p

★ SEMICONDUCTOR PACK
Guaranteed full spec. devices make up this pack. (No large quantities warrant individual advertising)
50 devices for **£1** P&P 40p
Highly Recommended

MARCONI R.F. POWER METER
Type TF 1152A/1 (CT419)
2 ranges 10 watts fsd and 25 watts fsd. 50 ohms
£75 each

TRIPODS WITH PAN AND TILT HEAD
will take 56lb load
£22.50

TRANSFORMERS — All 240V 50HZ INPUTS
Type A170 17V 250MA. 7.5.0 7.5V 250MA 0-20V 5 Amps 0.4V5 Amps 011 5V Amps **£2** each. P&P £1.25.
Type C 19-0-19V 250MA. 8-0 8V 250MA 0-7 5V Amps 0-1 4V 5 Amps **£1.25** each P&P £1.25.
All brand new APT Surplus.

★POT PACK. All Brand New Modern Single and Ganged. Our choice 7 for **25p.** P&P 48p.
Ex-ministry OSCILLOSCOPE. CT436. Double beam. DC 6MHZ **£120** each.
SOLARTRON CD 1212 SB 40 meg **£100.** DB 24 meg twice **£135.**
Many other types available.
MARCONI SIGNAL GENERATORS. Freq. range 10-470MHZ Type TF80 1B3/S **£160** each.
MARCONI TF142F DISTORTION FACTOR METER giving percentage distortion on a directly calibrated dial and includes any spurious components up to 30kHZ **£29.50** each.
MARCONI PORTABLE FREQUENCY METER TF 1026/11 100 to 160MHZ. Very fine condition **£25.**
TF1026/4M 2-4 GHZ **£35** each.

TRANSISTORS/DIODES/ RECTIFIERS, ETC.
Guaranteed all full spec. devices. Manufacturers Markings.
At **5p** each.
BC147; 2N3707; BC172B; BC261; BC251B; BC348B; BC171A/B; BC413; D10; BC182; BC212; BAX13; 1N937; BA102BE; BZX83; 2N4047; TIS61; 2N5040.
At **10p** each BFX85; 1N4733A; SN7451N; BYX10-1; 5KV 0.36A.
TIP30 — **20p** ea. TIP34A — **50p** ea. BD538 — **40p** ea. Heavy Duty Bridge Rectifier — **20p** ea. TBA810S — **75p** ea. CA3123E — **£1** ea.
BDY55 — **£1** ea. TIP318 — **12p** ea. 2N3055 — **40p** ea.
2N5879 with 2N5881 Motorola 150W Comp pair **2** ea.
BD535/BD538 Comp pair — **75** pr.
BYZ10 **10p** ea. LM733CN **20p** ea. TBA560CQ **£2** ea. 1N4436T-T03 Flat mount 10A 200piv **£1** ea.
★Linear Amp 709 — **25p** ea.
High Speed Voltage Comparator 710 — **15p** ea.
P&P Extra on all items.
Finned heat sink — single T03 - size 4¾in x 3in x 1¼in **50p** ea. P&P 75p.

PICK-A-PACK— 50 PENCE A POUND
From Our Pick-A-Pack area weight up your own components. No restrictions on what you take.

PHOTOMULTIPLIER Type 931A **£4** ea. P&P 75p. Other types available.
★POTENTIOMETERS — All **5p** ea. P&P extra. Metal bodies AB Linear. PCB Mount Brand new. 250K ganged. 100K ganged concentric shafts.
★BEEHIVE TRIMMERS 3 30pt Brand New 10 off **40p** P&P 15p. 100 off **£3.50** P&P 75p. 500 off **£15** P&P £1.25. 1,000 off **£25** P&P £1.50.
LARGE RANGE OF ELECTROSTATIC VOLT-METERS. From 0.300V 2 **£3,** or 250KV Max. General guide 5KV 3½. **£5.** Thereafter **£1 per KV.** P&P 75p.
DON'T FORGET YOUR MANUALS. S.A.E. with requirements.
TUBE Type DB7 36 — Replacement for Telequipments S31 **£11** ea. P&P £1.50.
E.H.T. TRANSFORMERS 20KV 2KVA **£70** ea.
240KV SINGLE PHASE 20KVA Output 2x2 5KV **£85.**
240V SINGLE PHASE. 1KVA Output 40KV 25MA **£175.**
Many other EHT Transformers and EHT Capacitors available.

EX-DYNAMCO Oscilloscopes INVERTORS 30V Input 6KV Output. Size 2" x 4½" x 1½". Complete with circuit £10 ea. P&P £1.

MINIATURE — OXLEY PATCH PANELS — BRAND NEW

EX-DYNAMCO. 10x10 complete with pins **£8** ea. P&P 50p.

TELEPHONES. Post Office style 745. Black or two-tone **£6.50** ea. Modern style 706. Black or two-tone grey **£4.50** ea. P&P £1 each. Old black style **£1.50** ea. P&P £1.
★HANDSETS only 706 style **£1.75** ea. Older style **£1** P&P 75p.
TELEPHONE EXCHANGES. Eg. 15-way automatic (exchange only) from **£95.**
MODERN FANS. 4¾ x 4½ x 1½" 110 volts. Superbly quiet. 6 blades **£4.50** ea. P&P 75p.
PAPST Fan 240V available at **£7.50** ea. P&P 75p.
TUBES. All Brand New Boxed
Electrostatic deflection.
Type GEC 924F 3½" dia. (Replacement for Telequipment D33 & Solartron 1016 scopes) **£25** ea. P&P £1.50.
Type GEC 924E 3½" dia (Replacement for Solartron 1015 scope) **£17.50** ea. P&P £1.50.
★1000f Feed thru Capacitors **10 for 30p.** P&P 15p.
HIVAC Miniature NEONS.
App 60V Brand New 10 off **20p** P&P extra.
GRATICULES 12x14cm high quality plastic **15** ea. P&P 10p.
MARCONI TF1041B Valve Voltmeter **£25** ea.
MARCONI TF338B Attenuator 600 ohms **£12** ea.
PHILIPS Cassettes Model 2200. Play only **£9** ea. P&P £1.50.
PROGRAMMABLE TIMER 5 decade (Photography) **£8** ea.

MULLARD & BRIMAR OSCILLOSCOPE TUBES BRAND NEW BOXED—ALL RECTANGULAR
D14-121 Green 50MHZ Y 4 4.2V CM **£45** ea. As above but P7 Phosphor **£35** ea.
D13-46GM P7 **£35** ea.
D13-51GH Green **£65** ea.
D10-210GH/32 **£40** ea.
Carriage all tubes **£1.75** ea.

SOLID STATE TIMEBASES
By LARGE BRITISH MANUFACTURERS
These are a Plug-in Modular Timebase covering 0-2 microsecs per cm to 5 secs per cm in 23 steps. Tunnel Diode triggering. 8 Front Panel Controls. 37 Transistors/FETs — all plug-in Silver anodised front panel. Size 4x5½x10½" deep. Guaranteed absolutely brand new in original manufacturer's packaging. Complete with extremely comprehensive copy of manual **£17.50** ea. P&P £2.

COSSOR OSCILLOSCOPE CAMERAS
Brand New Boxed with 4 film packs & Manual **£12** ea. Carriage £2.75.

FRESH MINISTRY RELEASE
Solartron CT316 oscilloscope
DC — 6 megs. Size 8½" x 11" x 20"
Sorry **£37.50** this time

NEW INTAKE OF TEKTRONIX 545A
Oscilloscope with CA plug-in
(Dual Beam — 24 megs)
£220 each

BACK IN STOCK — CREED 7B TELEPRINTERS

THE CHEAPEST WAY OF GETTING A FULL ALPHA/NUMERIC PRINTOUT FROM YOUR MICRO

Large Ministry purchases enables us to offer these at **£25 each**
In good working condition. Requires 110 Volts DC. Requires ASC11/ BAUDET convertor for coupling to your microprocessor. These units are Processor tested before dispatch. Circuits included. Adequately packed to guarantee safe arrival for £3.25.

DESKS with Punch Reader. Printer and Keyboard. Some ASC11. Various models from **£200.**

½" MAG TAPE
Approx. 2,000 ft. **NOW 25p each.** P&P £1. Or 5 for £1 carr. £2.75.

FOR THE VDU BUILDER tube M28-13GH. 23x17cm at **£12** ea. Base connections supplied.
Heads for **PERDEC 6000/7000** — enquiries.

One only Digital Equipment Corporation Processor Board KD11F with DLV11 and Back plane. Can be demonstrated working **£680.**

TELETYPE ASR 33 from **£450.**
TELETYPE KSR33 £275.
NON-STANDARD KSR33 eg basic ASC11-20MA loop — but small print 0 to 9 above standard 0 to 9, some of the symbols having been relocated. **£250.**

TELETYPE 35 RO Cased **£95.**
TELETYPE 35 RO with 20MA interface. Few only **£120** ea.

LITTON SYSTEM — Must go — **£375** or offer.

Minimum Mail Order £2. Excess postage refunded. **Unless stated — please add £2.75 carriage to all units**
VALUE ADDED TAX not included in prices — Goods marked with ★ 12½ % VAT, otherwise 8%
Official Orders Welcomed. Gov./Educational Depts., Authorities, etc., otherwise Cash with Order.
Open 9 a.m. to 5.30 p.m. Mon. to Sat.

Buy it with Access

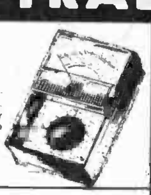
CHILTMEAD LTD

BARCLAYCARD

7/9 ARTHUR ROAD, READING, BERKS (near Tech. College, King's Road). Tel. Reading 582605.

SERVICE TRADING CO

WHY PAY MORE?!



MULTI RANGE METERS Type MF15A. A.C./D.C. volts 10, 50, 250, 500, 1000. Ma. 0-5, 0-10, 0-100. Sensitivity 2000V. 24 range, diameter 133 × 93 × 46mm. Price **£6.50** plus 50p P&P (**£7.56** inc. VAT & P)

TRIAC.

Raytheon tag symmetrical Triac. Type Tag 250/500v. 10 amp 500 piv Glass passivated plastic triac. Swiss precision product for long term reliability **£1.25** P&P 10p (**£1.46** inc. VAT & P) (inclusive of date and application sheet). Suitable Diac **22p.**

0 to 60 MINUTES CLOCKWORK TIMER.

Double pole 15 amp 230AC. Contacts (no dial). **£1.50.** P&P 30p (**£1.94** inc. VAT & P).

MERCURY SWITCH

Size 27mm x 5mm. 10 for **£5.00** (inc. VAT **£5.72**) Min quantity 10.

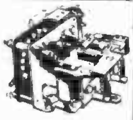
CONTACTOR

Mfg. by Hendrey Relays, type C2839 220/250 AC ops. Contact 4C/O at 20 amp at 440 volts AC, price **£6.00** P&P 75p (**£7.29** inc. VAT & P).

230 VOLT AC FAN ASSEMBLY

Powerful continuously rated AC motor complete with 5 blade 6½" aluminium fan. New reduced price **£3.00** P&P 65p (**£3.94** inc. VAT & P).

21-WAY SELECTOR SWITCH with reset coil



The ingenious electro mechanical device can be switched up to 21 positions and can be reset from any position by energising the reset coil. 230/240v. A.C. operation. Unit is mounted on strong chassis. Complete with cover. Price **£5.50** P&P 75p (**£6.75** inc. VAT & P).

VORTEX BLOWER AND VACUUM UNIT

Dynamically balanced to tally enclosed 9" rotor with max. air delivery of 1.5 cubic metres per min. Max. static pressure 600mm W.G. Suction or blow from 2 side-by-side 37mm I.D. circular apertures fitted to base of unit. Powerful continuously rated 115v a.c. motor mounted on alloy base with fixing facilities. Dimensions: Length 22cm x width 25cm x height 25cm.

These units are ex-equipment but have had minimum use. Fully tested prior to despatch. Price **£12** + £1.50 P&P (**£14.58** inc. VAT & P). Suitable transformer for 230/240v a.c. **£6** + £1 P&P (**£7.56** inc. VAT & P).

CENTRIFUGAL BLOWER

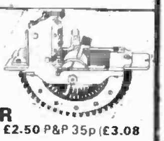
Mfg. by Smiths Industries 230/240v a.c. Miniature Model Series SE7200. Size 95mm x 82mm x 82mm. Aperture 38mm x 31mm. 12 c.f.m. **£2.75.** Post **50p** (**£3.51** inc. VAT & P).
Smith type FFB 1906 022 220/240v A.C. Aperture 10x4½cm overall size 16x14cm Price **£3.75** p&p 75p (inc. VAT **£4.86**). Other types available phone for details.

NI-CAD BATTERIES

		Height (mm)	Width (mm)	Length (mm)
23 AH 1.2v Plastic Case	£4	214	79	27
35 AH 1.2v Metal	£6.50	219	75	29
40 AH 1.2v Plastic Case	£8	275	80	35

Postage 30p per unit

UNISELECTOR SWITCH



4 bank, 25 way 75 ohm coil, 36-48v D.C. operation. Ex. **new** equipment. **£4.25,** P&P 75p. Total price inc. VAT. **£5.40.**

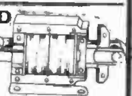
MINIATURE UNISELECTOR

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).
50 for **£10.00** post paid (**£10.80** inc. VAT & P).
Type 3 115M 906T 10 for **£2.50** post paid (**£2.70** inc. VAT & P).
Unimax USA. 10 for **£4.00** plus 50p P&P (min. order 10) (**£4.86** inc. VAT & P).

NEW HEAVY DUTY SOLENOID



Mfg. by Magnetic Devices. 240v A.C. 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 1½lb pull. Size of feet 1⅜"×13/16". Price **£1.00** Post 25p (**£1.35** inc. VAT & P).

24 VOLT D.C. SOLENOIDS

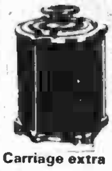
UNIT containing: **1 heavy duty solenoid approx. 25 lb. pull** at 1 in. travel. 2 solenoids of approx. 1 lb. pull at ½ in. travel. 6 solenoids of approx. 4 oz. pull at ½ in. travel. Plus 1 24V D.C. 1 heavy duty 1 make relay. Price: **£3.00** Post £1.00 (**£4.32** inc. VAT & P).

ABSOLUTE BARGAIN

240 A.C. SOLENOID OPERATED FLUID VALVE

Rated 1 p.s.i. will handle up to 7 p.s.i. Forged brass body, stainless steel core and spring ½ in. b.s.p. inlet outlet. Precision made. British mfg. PRICE **£2.75** Post 50p (**£3.57** inc. VAT & P).

VARIABLE VOLTAGE TRANSFORMERS



Carriage extra

INPUT 230 v. A.C. 50/60
OUTPUT VARIABLE 0/260v. A.C.
BRAND NEW. All types.
200W (1 Amp) fitted A/C volt meter **£12.50**
0.5 KVA (Max. 2½ Amp) .. **£15.00**
1 KVA (Max. 5 Amp) **£19.50**
2 KVA (Max. 10 Amp) **£32.00**
3 KVA (Max. 15 Amp) **£39.50**
4 KVA (Max. 20 Amp) **£60.00**

LT TRANSFORMERS

0-12v/24v at 1 amp. **£2.50** p&p 50p (**£3.24** inc. VAT & P)
0-15v at 1 amp + 0-15v at 1 amp (30v 1 amp) **£2.50** p&p 50p (**£3.24** inc. VAT & P)
25-0-25v at 2½ amp. **£4.50** p&p 75p (**£5.67** inc. VAT & P)
0-12v/24v. 10 amp. **£12.35** p&p £1.50 (**£14.96** inc. VAT & P)
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)
0-6v/12v/17v/18v/20v at 20 amp. **£14.00** p&p £1.50 (**£16.74** inc. VAT & P)
0-6v/12v at 20 amp. **£11.85** p&p £1.00 (**£13.88** inc. VAT & P)
Other types in stock, phone in enquiries.

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 tropicalised. Length 13.5cm., width 11cm., weight 15lbs. Special price **£6.00,** carr. £1.00 (**£7.56** inc. VAT & P).

COMPRESSOR, precision built by Emerson USA.

Horizontally opposed twin head diaphram 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**).

STROBE! STROBE! STROBE!

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. Price **£18.00** post £1 (**£20.56** inc. VAT & P). Specially designed case and reflector for Hy-Light **£8.25** Post £1.00 (**£9.99** inc. VAT & P).

ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft. 40 watt £7.75 (callers only). **2ft. 20 watt £5.50.** Post 60p. (For use in stan bi-pin fittings). Mini **12in. 8 watt £2.50.** Post 25p. (**£2.97** inc. VAT & P). 9in. 6watt **£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).

XENON FLASH GUN TUBES

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

RELAYS

Wide range of AC and DC relays available from stock. Phone or write in your enquiries.

230/240V A.C. Relays: Arrow. 2 c/o. 15 amp **£1.50** (**£1.84** inc. VAT & P).
T.E.C. open type 3 c/o. 10 amp **£1.10** (**£1.40** inc. VAT & P). Mag Devices 2 c/o. 20 amp **£1.50** (**£1.84** inc. VAT & P). Omoron or Keyswitch 1 c/o. 7 amp **£1.00** (**£1.30** inc. VAT & P).

D.C. Relays: Open type 9/12V 3 c/o 7 amp **£1.00** (**£1.30** inc. VAT & P). Sealed 12V 1 c/o 7 amp octal base, **£1.00** (**£1.30** inc. VAT & P). Sealed 12V 2 c/o 7 amp octal base, **£1.25** (**£1.56** inc. VAT & P). Sealed 12V 3 c/o 7 amp 11-pin. **£1.35** (**£1.67** inc. VAT & P). 24V. Sealed 3 c/o 7 amp 11-pin **£1.35** (**£1.67** inc. VAT & P) (amps = contact rating). P&P on any Relay 20p.
Other types available — phone for details.

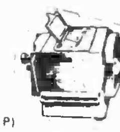
RESET COUNTER

230 volts AC 3 digits mfg. Veeder 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. resetable **£3.00** P&P 25p (**£3.51** inc. VAT & P).

BIG INCH

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

INSULATION TESTERS (NEW)



Test to I.E.E. spec. Rugged metal construction, suitable for bench or field work, constant speed clutch. Size L. 8 in., W. 4 in., H. 6 in., weight 6 lb.
500 VOLTS 500 megohms
£49.00 Post 80p (**£57.78** inc. VAT & P)
1000 VOLTS 1000 megohms
£46.00 Post 80p (**£60.26** inc. VAT & P)
SAE for leaflet.

VAT AT CURRENT RATE MUST BE ADDED TO ALL ORDERS FOR THE TOTAL VALUE OF GOODS INCLUDING POSTAGE UNLESS OTHERWISE STATED

ACCOUNT CUSTOMERS MIN. ORDER £10.00

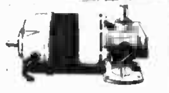
GEARED MOTORS

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

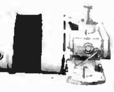
(Type 1) 71 r.p.m. torque 10 lb. in.
Reversible 1/70th h.p. cycle .38 amp. This U.S.A. motor is offered in with transformer for 230/240v AC. input. Price type **£6.25** Post 75p (**£7.56** inc. VAT & P), or less transformer **£3.75** Post 65p (**£4.75** inc. VAT & P). (Type 3) 71 r.p.m. 230 volt A.C. Continuously rated. Non reversible **£6.50** Post 75p (**£7.83** inc. VAT & P).

FRACMO



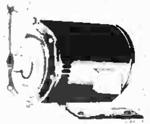
56rpm 50lbs inch 240vAC reversible 0.7 amp sharplength 35mm dia 16mm, weight 6 kilos 600 grams. Price **£15.00** P&P £1.50 (**£17.82**).

PARVALUX GEARED MOTOR



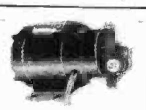
Type SD18 24v AC reversible 30 rpm 50lbs inch Price **£15.00** P&P £1.50 (£17.82 inc. VAT)

A.E.G. WATER PUMP



200/240v. a.c. motor, 2850 rpm, 480w approx. 1/3 hp, driving a centrifugal pump with 1½" inlet and outlet delivering approx. 40 galls. 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).

REVERSIBLE MOTOR 230V A.C.

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

DC Amps type 65C5 0-2A 0-5A 0-20A 0-50A 0-100A AC Amps type 62T2 0-1A 0-5A 0-50A. DC Volts type 65C5 0-15V 0-30V. AC Volts type 62T2 0-150V 0-300V. All at **£3.50** P&P 50p **£4.32** inc. VAT.

'VENNER TYPE' ERD TIME SWITCH

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

Type S251 200/250 v a.c. 2 on 2 off every 24 hours. 20 amps contacts with override switch diam. 4" x 3". price **£6.00** P&P 50p **£7.02** inc. VAT & P. Also available with solar dial.

A.E.G. TIME SWITCH

200/250V A.C. 1 on/1 off every 24 hrs. 80 amps 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** 1/5/10/25/50/100/250/500/1k 1.5k/2.5k/5k ohm **£5.50.** Post 35p (**£6.32** inc. VAT & P).
Black Silver Skirted knob calibrated in Nos. 1-9, 1½ in. dia brass bush. Ideal for above Rheostats, **24p ea.**

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).

ALL MAIL ORDERS, ALSO CALLERS AT:
57 BRIDGMAN ROAD, CHISWICK, LONDON, W4 5BB. Phone: 01-995 1560
Closed Saturdays.

SERVICE TRADING CO.

SHOWROOMS NOW OPEN
AMPLE PARKING

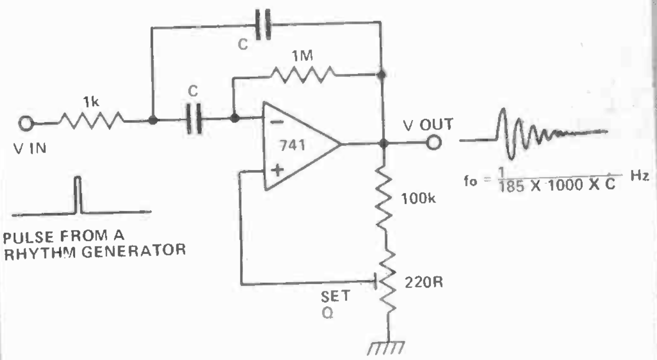
PERSONAL CALLERS ONLY
9 LITTLE NEWPORT STREET, LONDON, WC2H 7JJ.
Tel.: 01-437 0576

OP~AMPS PART 3

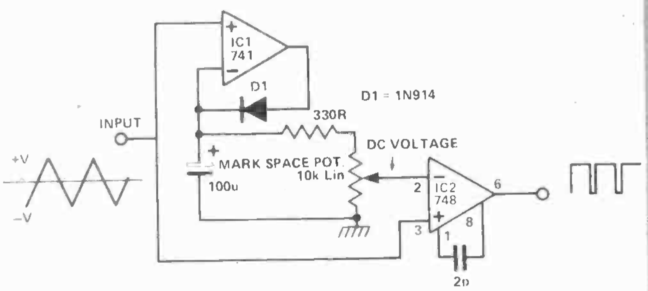
Continuing along Tim Orr's circuit strewn path through op-amps

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.



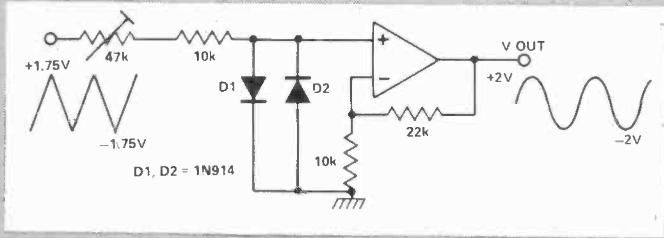
Variable Markspace Squarewave Generator with Automatic Level Adjustment

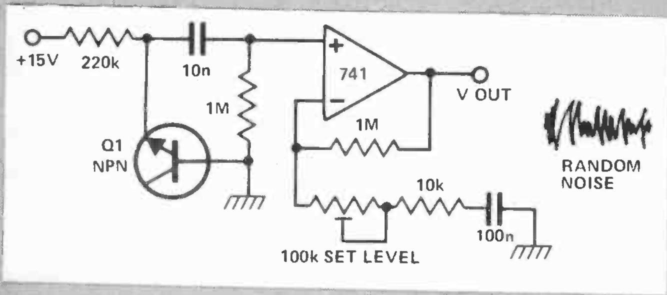


By putting a triangle wave into one input of a comparator and a manually controlled DC level into the other, it is possible to generate a variable ratio mark/space square wave. However, if the amplitude of the triangle varies then so will the markspace ratio. Alternatively, if you want the manual control 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.



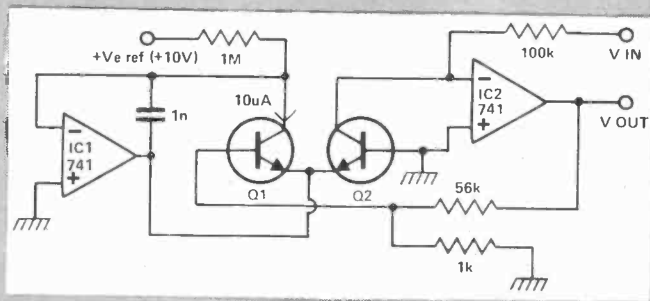


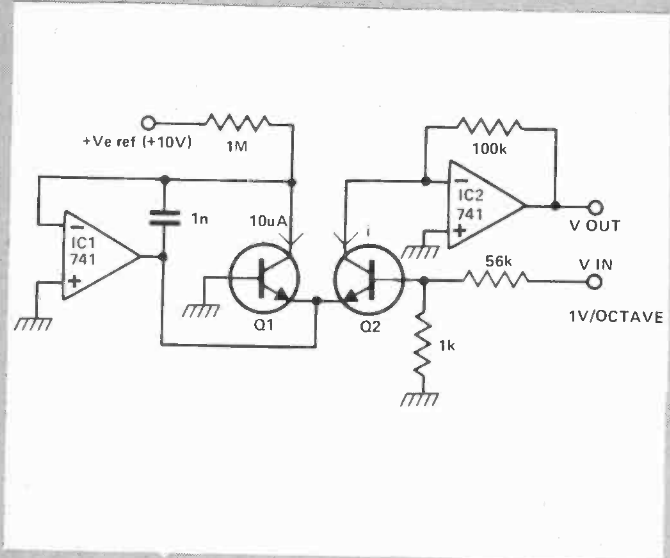
Noise Generator

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

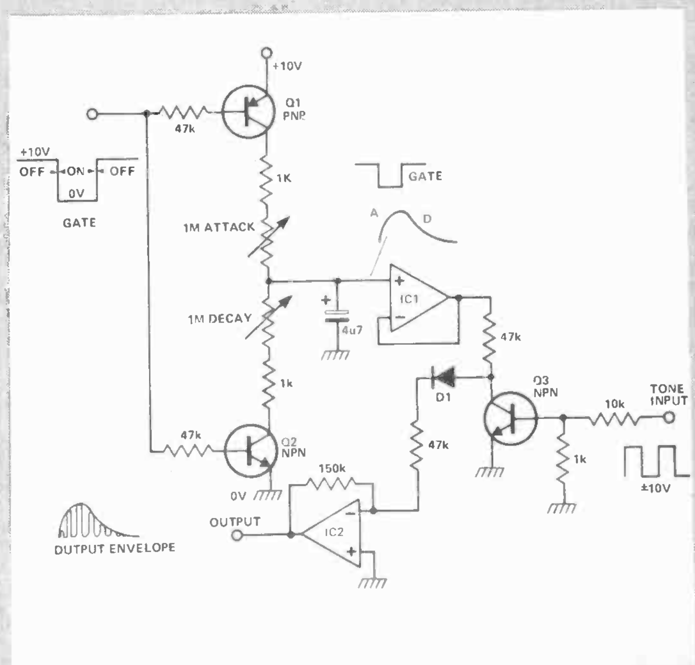
The circuit shown converts a linear input voltage into an exponential current or voltage. This type of circuit is used in music synthesisers to change linear control voltages into musical intervals. That is, if the circuit were used to control an oscillator, input increments of 1 V would change the pitch by one octave. The exponential characteristics of a transistor are exployed 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 mV/° C) and so the reason for using a matched pair is to use the first transistor, Q1, to provide temperature compensation for the second.

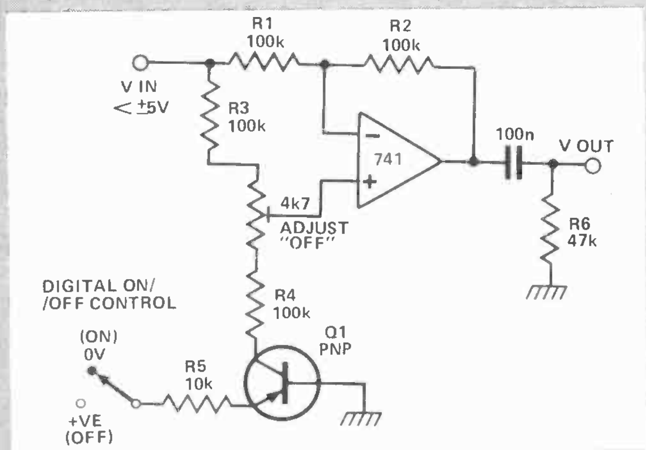
Musical Envelope Generator and Modulator

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.



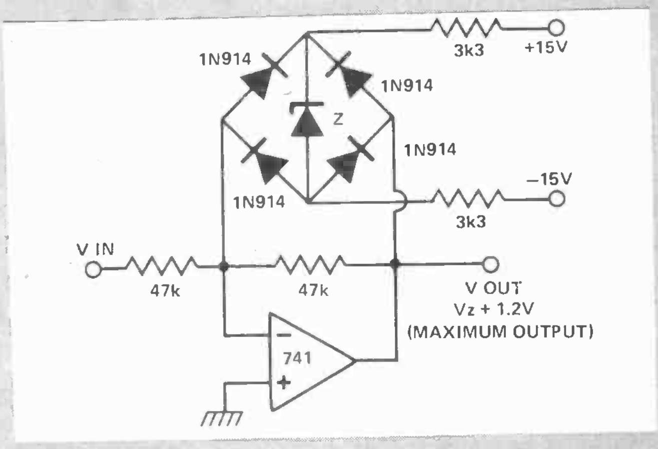


Transistor Used To Turn An Op Amp On Or Off

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 voltage 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 IC1 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.

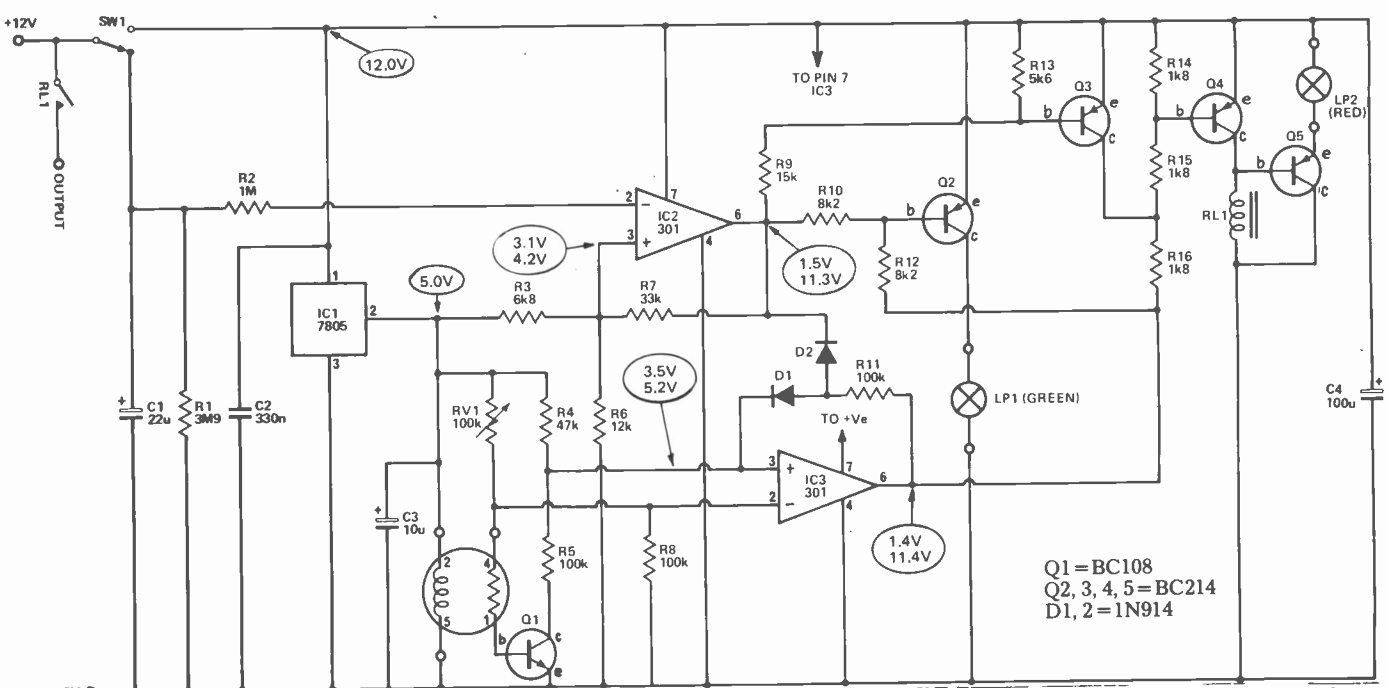


Fig 1. Full circuit diagram of the marine gas alarm.

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.

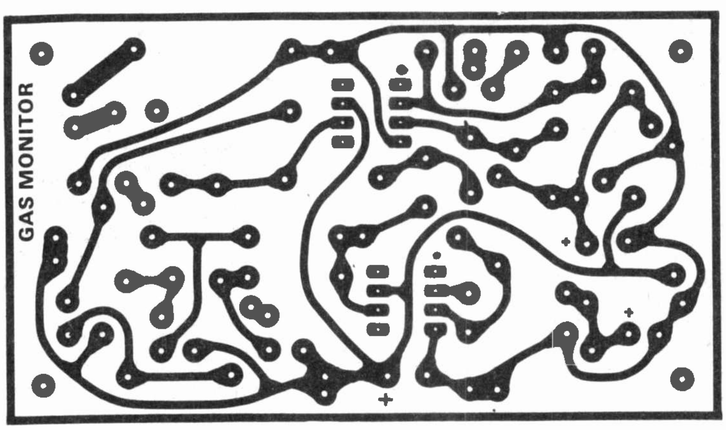


Fig 2. PCB pattern foil side shown full size (52 x 92 mm).

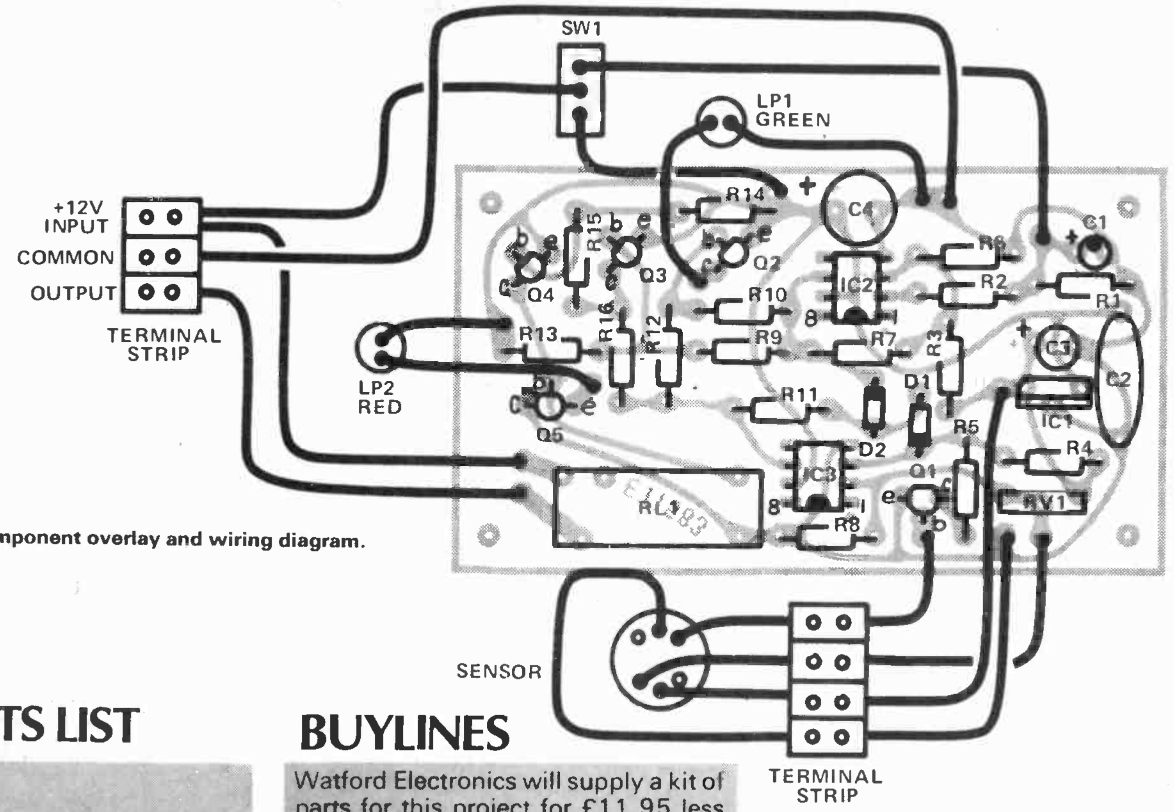


Fig 3. Project component overlay and wiring diagram.

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

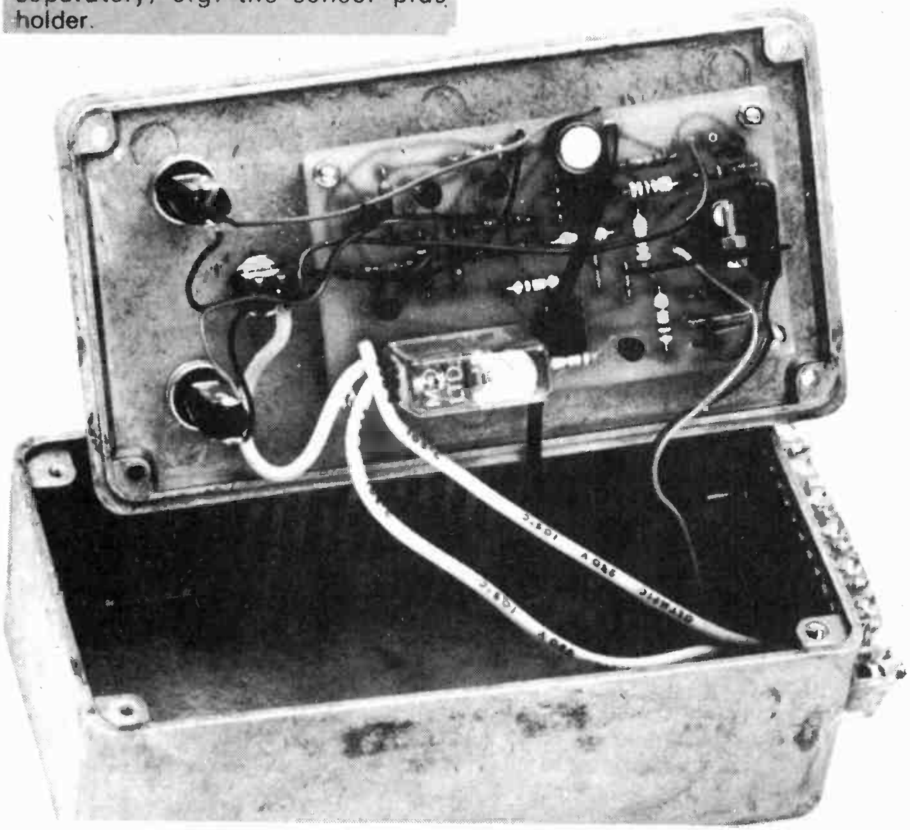
MISCELLANEOUS

Relay to suit application (min res 100R). PCB as pattern, box etc.

BUYLINES

Watford Electronics will supply a kit of parts for this project for £11.95 less box which should be selected to suit the constructor's particular application, i.e. the expense of a die cast box would not be warranted unless the device needs to be waterproof.

Watford will also supply all parts separately, e.g. the sensor plus holder.



TECHNICAL BOOKS FROM ETI

CALCULATORS

- ADVANCED APPLICATIONS FOR POCKET CALCULATORS — J. Gilbert — £4.20

COMPUTER & MICROPROCESSORS

- MICROPROCESSORS AND MICROCOMPUTERS — B. Sowick — £18.00
- BUILD YOUR OWN WORKING ROBOT — D. Heiseman — £3.35
- DIGITAL ELECTRONIC CIRCUITS AND SYSTEMS — N. M. Morris — £3.50
- INTRODUCTION TO DIGITAL FILTERING — Bogner — £9.40
- MICROPROCESSOR/MICROPROGRAMMING HANDBOOK — B. Ward — £4.10
- TRANSISTOR TABELLE — Includes physical dimensions & their pin assignments — £4.10
- MICROPROCESSORS — D. C. McGlynn — £8.40
- INTRODUCTION TO MICROPROCESSORS — Aspinall — £5.35
- MODERN GUIDE TO DIGITAL LOGIC — Processors — Memories and Interfaces — £4.30
- LOGIC DESIGN PROJECTS USING STANDARD ICs — J. Wakerly — £5.10
- PRACTICAL DIGITAL DESIGN USING ICs — J. Greenfield — £12.50

COMMUNICATION

- COMMUNICATION SYSTEMS INTRO TO SIGNALS & NOISE — B. Carlson — £7.50
- DIGITAL SIGNAL PROCESSING, THEORY & APPLICATIONS — L. R. Rabiner — £23.80
- ELECTRONIC COMMUNICATION SYSTEMS — G. Kennedy — £8.50
- FREQUENCY SYNTHESIS, THEORY & DESIGN — Mannassewitsch — £20.40
- PRINCIPLES OF COMMUNICATION SYSTEMS — H. Taub — £8.10

COOKBOOKS

- TV TYPEWRITERS COOKBOOK — £7.40
- CMOS COOKBOOK — £8.00
- TTL COOKBOOK — £7.55
- ACTIVE FILTERS — £11.00
- IC TIMER COOKBOOK — £7.50
- IC OP-AMP COOKBOOK — £9.40

ELECTRONICS

- BEGINNERS GUIDE TO ELECTRONICS — Squires — £2.65
- BEGINNERS GUIDE TO TRANSISTORS — Reddihough — £2.55
- APPLICATIONS OF OPERATIONAL AMPLIFIERS — Graeme (Burr Brown) — £8.30
- BASIC MATHS COURSES FOR ELECTRONICS — H. Jacobowitz — £1.85
- BUILD IT BOOK OF MINIATURE TEST INSTRUMENTS — R. Haviland — £3.55
- DESIGNING WITH TTL INTEGRATED CIRCUITS — Texas Instruments — £9.05
- DESIGNING WITH OPERATIONAL AMPLIFIERS — Burr Brown — £13.75
- ELECTRONIC ENGINEERS REFERENCE BOOK 4th Edition — L. W. Turner — £27.70
- SOLID STATE CIRCUIT GUIDE BOOK — B. Ward — £2.25
- TRANSISTOR CIRCUIT DESIGN — Texas — £9.35
- ELECTRONIC COMPONENTS — M. A. Colwell — £2.45
- ELECTRONIC DIAGRAMS — M. A. Colwell — £2.45
- ELECTRONIC FAULT DIAGNOSIS — I. R. Sinclair — £3.20
- ELECTRONIC MEASUREMENT SIMPLIFIED — C. Hallmark — £2.20
- ELECTRONICS AND PHOTOGRAPHY — R. Brown — £2.30
- ELECTRONICS SELF TAUGHT — Ashe — £4.40
- ESSENTIAL FORMULAE FOR ELECTRICAL AND ELECTRICAL ENGINEERS — N. M. Morris — £1.65
- EXPERIMENTS WITH OPERATIONAL AMPLIFIERS — Clayton — £3.40
- FIRE AND THEFT SECURITY SYSTEMS — B. Wels — £2.00
- HOW TO READ ELECTRONIC CIRCUIT DIAGRAMS — B. Brown — £1.95
- HOW TO BUILD PROXIMITY DETECTORS AND METAL LOCATORS — J. Shields — £3.35
- HOW TO USE IC CIRCUIT LOGIC ELEMENTS — J. Streater — £3.65
- INTEGRATED ELECTRONICS — J. Millman — £7.70
- HOW TO BUILD ELECTRONIC KITS — Capel — £2.10
- LINEAR INTEGRATED CIRCUIT APPLICATIONS — G. Clayton — £5.00
- FUNCTION CIRCUITS DESIGN & APPLICATIONS — Burr Brown — £15.95
- 110 ELECTRONIC ALARM PROJECTS — R. M. Marston — £3.45
- 110 OPERATIONAL AMPLIFIER PROJECTS FOR THE HOME CONSTRUCTOR — R. M. Marston — £2.95
- 110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR — R. M. Marston — £2.95
- 110 COSMOS DIGITAL IC PROJECTS FOR THE HOME CONSTRUCTOR — R. M. Marston — £3.20
- 110 INTEGRATED CIRCUIT PROJECTS FOR THE HOME CONSTRUCTOR — R. M. Marston — £3.25
- 110 THYRISTOR PROJECTS USING SCRs — R. M. Marston — £2.95
- MICROELECTRONICS — Hallmark — £3.90
- MODERN ELECTRONIC MATHS — Clifford — £6.70
- MOS DIGITAL ICs — G. Flynn — £4.60
- OPERATIONAL AMPLIFIERS DESIGN AND APPLICATIONS — G. Tobey (Burr Brown) — £7.40
- OP-AMP CIRCUIT DESIGN & APPLICATIONS — I. Carr — £4.00
- HANDBOOK OF IC CIRCUIT PROJECTS — Ashe — £2.30
- INDEXED GUIDE TO MODERN ELECTRONIC CIRCUITS — Goodman — £2.30
- BEGINNERS GUIDE TO INTEGRATED CIRCUITS — Sinclair — £3.15
- PRACTICAL ELECTRONIC PROJECT BUILDING — Ainslie and Colwell — £2.45
- PRACTICAL SOLID STATE D.C. SUPPLIES — T. D. Towers — £6.20
- PRACTICAL TRIAC/SCR PROJECTS FOR THE EXPERIMENTER — R. Fox — £2.25
- PRINCIPLES OF TRANSISTOR CIRCUITS — S. Amos — £4.75
- PRINTED CIRCUIT ASSEMBLY — Hughes & Colwell — £2.45
- RAPID SERVICING OF TRANSISTOR EQUIPMENT — G. King — £2.95
- SEMICONDUCTOR CIRCUIT ELEMENTS — T. D. Towers — £6.40
- UNDERSTANDING ELECTRONIC CIRCUITS — R. Sinclair — £4.10
- UNDERSTANDING ELECTRONIC COMPONENTS — R. Sinclair — £4.10
- UNDERSTANDING CMOS INTEGRATED CIRCUITS — R. Melen — £3.90

SEMICONDUCTOR DATA

- INTERNATIONAL TRANSISTOR SELECTOR — T. D. Towers — £5.25
- INTERNATIONAL FET SELECTOR — T. D. Towers — £4.35
- POPULAR VALVE/TRANSISTOR SUBSTITUTION GUIDE — £2.25
- RADIO VALVE AND SEMICONDUCTOR DATA — A. M. Ball — £2.60
- MASTER TRANSISTOR/INTEGRATED CIRCUIT SUBSTITUTION HANDBOOK — £5.60

RADIO, TELEVISION AND AUDIO

- AUDIO HANDBOOK — G. King — £6.50
- BEGINNERS GUIDE TO AUDIO — L. R. Sinclair — £3.20
- CASSETTE TAPE RECORDERS — J. Earl — £5.25
- FOUNDATIONS OF WIRELESS AND ELECTRONICS — M. G. Scroggie — £4.45
- COLOUR TELEVISION THEORY — Hudson — £6.20
- WORLD RADIO TV HANDBOOK NEW 1978 (A complete Directory of Radio, TV Stations) — £7.50
- RADIO, TV AND AUDIO TECHNICAL REFERENCE BOOK — Amos — £24.85
- SOLID STATE COLOUR TV CIRCUITS — G. R. Wilding — £6.35
- TV TECHNICIANS BENCH MANUAL (new edition) — Wilding — £5.10
- HI-FI LOUDSPEAKERS AND ENCLOSURES — Cohen — £8.20
- BEGINNERS GUIDE TO RADIO — King — £3.15
- TAPE RECORDER SERVICING MANUAL
  - VOL I 1968-70 Gardner — £8.50
  - VOL II 1971-74 Gardner — £8.50
- HOW TO BUILD SPEAKER ENCLOSURES — Badmaieff — £3.10
- FM RADIO SERVICING HANDBOOK — King — £4.80
- BEGINNERS GUIDE TO AUDIO — Sinclair — £3.10
- MASTER HI-FI INSTALLATION — King — £2.80

TEST EQUIPMENT & OSCILLOSCOPES

- BASIC ELECTRONIC TEST PROCEDURES — I. M. Gottlieb — £2.45
- THE OSCILLOSCOPE IN USE — Ian Sinclair — £3.10
- PRACTICAL TEST EQUIPMENT YOU CAN BUILD — W. Green — £2.25
- TEST INSTRUMENTS FOR ELECTRONICS — M. Clifford — £2.40
- WORKING WITH THE OSCILLOSCOPE — A. Saunders — £1.95
- SERVICING WITH THE OSCILLOSCOPE — G. King — £5.60
- RADIO TELEVISION AND AUDIO TEST INSTRUMENTS — King — £5.90

HOW TO ORDER

Please note that our prices include postage and packaging. Make cheques etc payable to ETI Book Service. Payment in sterling only please

Orders should be sent to:

ETI Book Service
P.O. Box 79
Maidenhead
Berks.

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 flop-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.

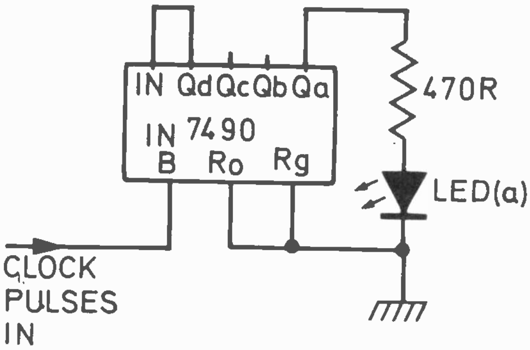


Figure 2. Connections for frequency division by ten — note that the symbol does not show the true pin positions.
Figure 3. Connections for BCD counting, with reset switch. The reset pin must be kept at logic zero for counting, and taken to logic 1 for reset, so that an inverter must be used along with the push-button switch.

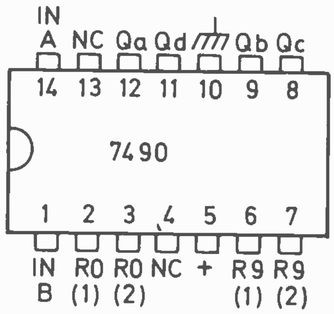
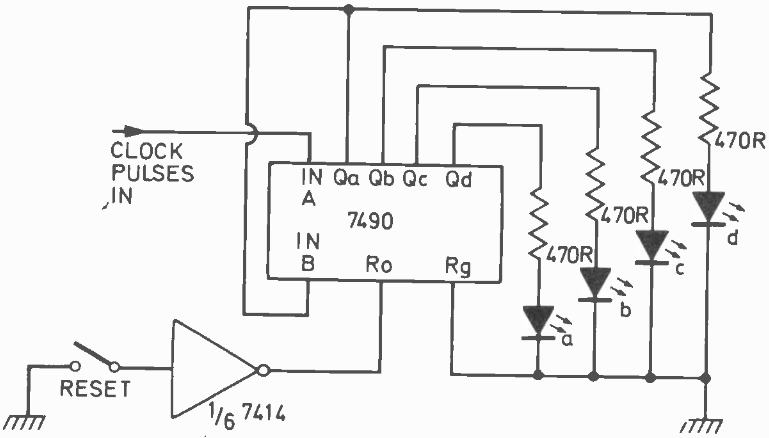


Figure 1. Pinout of 7490 Decade counter.



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 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.

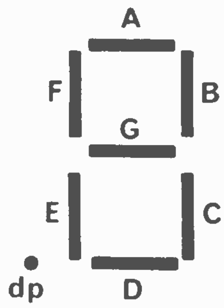


Figure 5. Arrangement of segments in a seven-segment display. The decimal point, which may be on the other side of the figure, is always energised separately, often from a range switch.

BY EXPERIMENT PART 7

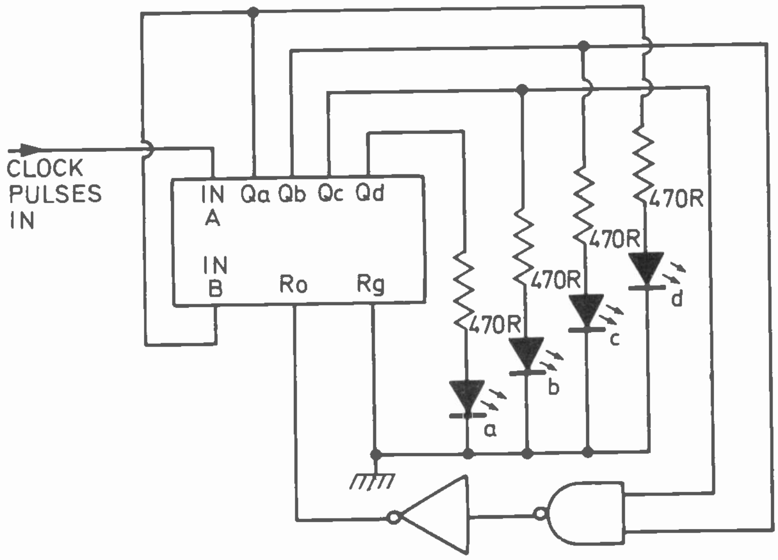


Figure 4. A terminated count. At some stage in the count, the gate will force the counter to reset. When does this happen?

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 seve-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

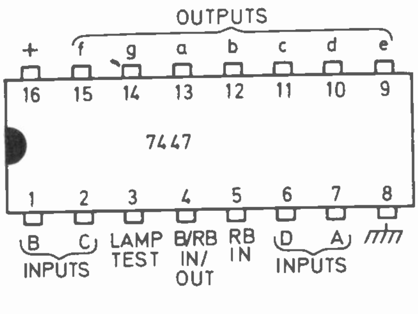


Figure 8. Pinout of 7447 BCD to 7-segment decoder-driver.

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 eay, 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 resistors, 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

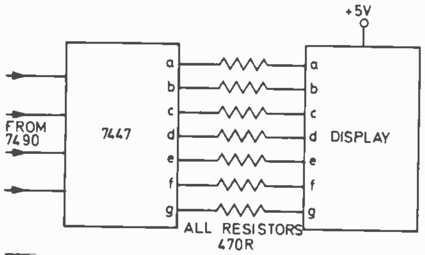


Figure 9. Connection of 7447 to display — not that the arrangement on the board is tidy as the diagram would suggest!

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 occuring 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

ETI

CLOCKS

A fine range of Electronic Digital Clocks

- ★ Unik Time Led Alarm Clock **£9.95**
- ★ Cassia LCD Battery Alarm Clock (see Kramer advert for picture) **£19.95**
- ★ Beta LCD Battery Alarm Clock with stop watch facilities .. **£16.95**
- ★ Casio LCD Calculator with Alarm Clock, Stop Watch, etc. **£19.95**
- ★ ETI Alarm Clock offer, available from Metac **£13.50**

WATCHES

The largest range of exclusive Electronic Watches anywhere

Our Price

- ★ Solar Watch, superb, 6 function LCD, with Seiko Module. Batteries are re-charged by daylight **£44.00**
- ★ Casio 6 digit, LCD Chronograph **£26.95**
- ★ Lambda 6 digit, 10 function, LCD Chronograph **£28.50**
- ★ CBM 4 digit, 5 function, LCD with very large clear display **£21.50**
- ★ Texas & Fairchild, Tritium, LCD 5F man's S/S **£26.00**
- ★ Unik LCD 6 digit, 5 function, S/S bracelet **£21.50**
- ★ Unik LCD 6 digit, 5 function, leatherette strap **£14.50**
- ★ Ladies Watches (Timeband, CBM, National, etc.)
  4 digit, 5 function, LCD Auto cal, back light, leatherette .. **£16.00**
  - leather **£23.00**
  - silver **£26.00**
  - gold **£29.00**

SPECIAL OFFER

Man's 4 digit 5 function LCD, slim with metal bracelet **£12.95**

All watches, clocks and calculators carry the full manufacturer's guarantee and are supplied with a 10-day money back assurance.

BATTERIES

Metac carry a full range of watch batteries .... **70p each**

CALCULATORS

Casio

AQ810 LCD Alarm Calculator **£19.95**
(2 timers, Alarm Clock: 5 functions plus memory, pocket size) 2,000 hrs. batts.

CQ1 Desk Calc, Clock, Stop Watch, green display **£29.95**

MQ2 Pocket Watch (size of Combe Case) LCD 5F Calc.: 2 alarms, Timer-alarm, 6 function Watch, Auto Cal., 12 months batt. life. Superb silver case **£34.95**

LC822 LCD Pocket Calc 5F plus mem, 2,000 hrs. batt. ... **£10.95**

LC87 LCD Pocket Calc., credit card size, **3/16in thick,** 2,000 hrs. batt. life, 5F plus mem plus leather case **£16.95**

THE METAC DIGITAL CLOCKS

★ **COMPLETE KIT** ★

- Pleasant green display · 12/24 Hour readout
- Silent Synchronous Accuracy · Fully electronic
- Pulsating colon · Push-button setting
- Building time 1 Hr. · Attractive acrylic case
- Easy-to-follow instructions · Size 10.5 x 5.7 x 8 cm
- Ready drilled PCB to accept components

KIT PRICE
£9.75
+ 78p VAT
MODEL 100

METAC CLOCK KITS are also available from:

Henry's, 404 Edgware Road, London, W2
Marshall's, 85 West Regent St., Glasgow
Watford Electronics, 33 Cardiff Rd., Watford, Herts.

C-SCOPE TOP QUALITY METAL DETECTORS

Plus accessory items. **PRICES £29.65 to £81.00**
Now available from our Uxbridge & Daventry shops
Officially franchised C-Scope distributors

METAC STOCK LIST

RESISTORS

½W 5% carbon film
1Ω to 10 MΩ
E24 series
Price **2p each**

PRE-SETS VARIABLE RESISTORS

100 ohm	**10p**
4K7 ohm	**10p**
47K ohm	**10p**
10K ohm	**10p**
100K ohm	**10p**
1M ohm	**10p**

ZENER DIODES

400MW 5%

2.7 volts	10 volts
3.0	12
3.3	15
3.6	20
7.5	30
8.2	68
	72

Price 10p each

DISPLAYS

2'' LED Lamp	**16p**
.1'' LED Lamp	**13p**
DL707 Comm. Anode .3''	**70p**
DL704 Comm. Cath. .3''	**80p**
HP Comm. Anode .3''	**90p**
Comm. Anode .5''	**£1.15**
Futaba 5LTo1 Display	**£4.96**

	Price
Diodes IN 4001 1 amp 70V	**5p**
Bridge Rect W04 1 amp 400V	**30p**
Transistors, NPN Plastic 180V .8W	**10p**
Mercury Gravity Switch	**50p**

Switches

Push-button on/off	**22p**
Push-button on/off reed	**60p**
Slide switch on/off/on	**25p**
Slide switch on/off	**25p**

Battery Eliminator, 9V 100MA **£3.25**
(Suitable Calculators, TV Games, etc.)

Watch Batteries, all types ... **70p**

Sockets

40 pin DIL	**50p**
28 pin DIL	**35p**
24 pin DIL	**30p**
16 pin DIL	**18p**
14 pin DIL	**15p**
8 pin DIL	**10p**

Transformers, various values
Many other electronic components in stock at our shops

Dual Opto-Isolators, MCT6 **£2.00**

CMOS

		CD4024	0.80	CD4048	0.58	CD4081	0.23
		CD4025	0.23	CD4049	0.58	CD4082	0.23
		CD4026	1.78	CD4050	0.58	CD4085	0.74
CD4000	0.17	CD4027	0.58	CD4051	0.94	CD4086	0.74
CD4001	0.18	CD4028	0.92	CD4052	0.94	CD4089	1.60
CD4002	0.17	CD4029	1.18	CD4053	0.94	CD4093	0.92
CD4006	1.20	CD4030	0.58	CD4054	1.20	CD4094	1.94
CD4007	0.18	CD4031	2.30	CD4055	1.36	CD4095	1.08
CD4008	1.00	CD4032	1.02	CD4056	1.36	CD4096	1.08
CD4009	0.58	CD4033	1.44	CD4059	4.93	CD4097	3.85
CD4010	0.58	CD4034	1.97	CD4060	1.15	CD4098	1.13
CD4011	0.20	CD4035	1.22	CD4063	1.13	CD4099	1.90
CD4012	0.23	CD4036	3.29	CD4066	0.63	CD4502	1.24
CD4013	0.58	CD4037	0.98	CD4067	3.85	CD4510	1.41
CD4014	1.04	CD4038	1.10	CD4068	0.23	CD4511	1.72
CD4015	1.04	CD4039	3.20	CD4069	0.23	CD4514	2.84
CD4016	0.58	CD4040	1.11	CD4070	0.51	CD4515	3.24
CD4017	1.04	CD4041	0.86	CD4071	0.23	CD4516	1.40
CD4018	1.03	CD4042	0.86	CD4072	0.23	CD4518	1.25
CD4019	0.58	CD4043	1.01	CD4073	0.23	CD4520	1.19
CD4020	1.28	CD4044	0.96	CD4075	0.23	CD4527	1.64
CD4021	1.04	CD4045	1.45	CD4076	1.34	CD4532	1.39
CD4022	0.94	CD4046	1.37	CD4077	0.45	CD4555	0.90
CD4023	0.23	CD4047	1.04	CD4078	0.23	CD4556	0.90

TV GAMES

- ★ 4-game black & white **£12.95**
- ★ 5-game colour, 4 players & mains adaptor **£34.50**
- ★ 6-game colour with gun **£26.00**
- ★ Battery eliminators **£3.25**

SPEC.
BATTERY OPERATED WITH MAINS ADAPTOR SOCKET. SOUND. 2 BAT SIZES. 2 BALL SPEEDS. 2 BALL ANGLES. GAMES: TENNIS. FOOTBALL. SKEET & TARGET ON GUN GAMES.

TV GAMES

All games have superb plastic case. Are fully guaranteed, and are beautifully packed in a presentation carton.
Mail order customers please include **90p** P&P

GIVE YOURSELF A TREAT
Why not pay us a visit and see for yourself the full range of top-quality watches: clocks: treasure tracers: electronic ignition: TV games and battery eliminators.

EXPORT ENQUIRIES WELCOME

Metac-Electronics & Time Centres

Shops open 9 to 5.30 daily

Barclay and Access welcome
Send card number with order

Buy it with Access

BARCLAYCARD

MAIL-ORDER
DEPT. PB
HIGH STREET
DAVENTRY
NORTHANTS

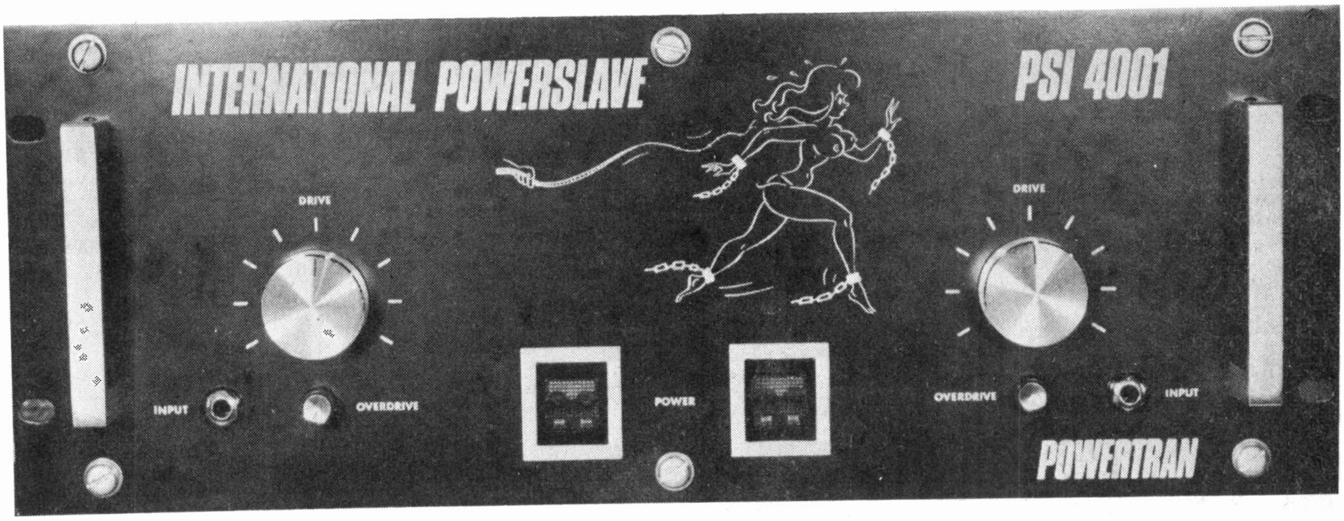
SERVICE CENTRE
METAC
SERVICE CENTRE
MIDDLE MARCH
INDUSTRIAL EST.
DAVENTRY
NORTHANTS

SHOP
DAVENTRY
67 HIGH STREET
DAVENTRY
NORTHANTS
Tel. (032 72) 76545

SHOP
UXBRIDGE
NEW ARCADE
HIGH STREET
UXBRIDGE
MIDDX
(0895) 56961

SHOP
LONDON
327 EDGWARE RD.
LONDON, W2
Tel. 01-723 4753
10 mins. walk Marble Arch, close to Henry's, Lasky's, Marshal's, etc., etc.

200W AUDIO AMPLIFIER



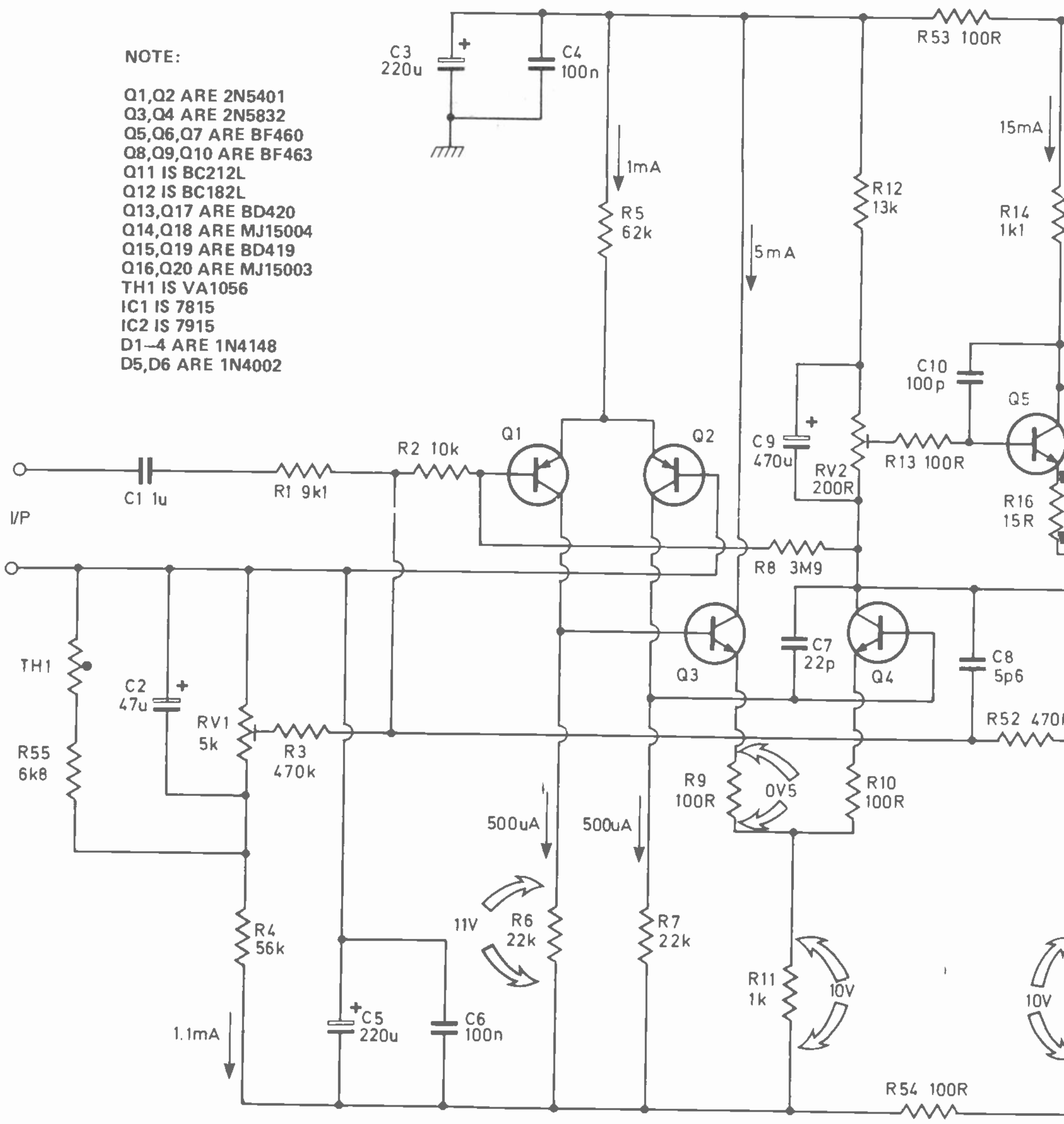
NO LITTLE TIME AGO we published a project for a 100 W guitar amplifier. It has since proved to be our popular project *ever,* and shows no signs of lying down to die in a respectable manner.

The main complaint about this machine has been that it is not powerful *enough* — something which our burst eardrums have repeatedly failed to grasp. In an attempt to please all the people all the time (as usual) we decided to re-do a design completely, uprating the spec to 200W, and generally improving the quality as far as we could to make the amplifier suitable for high quality domestic usage.

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.

SPECIFICATION

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%**
20 W	**1 kHz**	**0.025%**
	10 kHz	**0.060 %**
2 W	**1 kHz**	**0.027%**
	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**



HOW IT WOR

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.

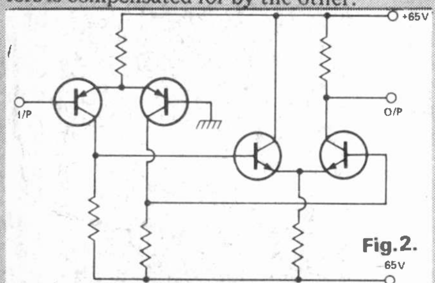


Fig.2.

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 darlingtons. 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

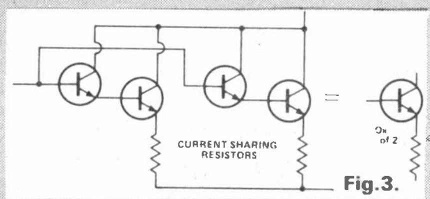


Fig.3.

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

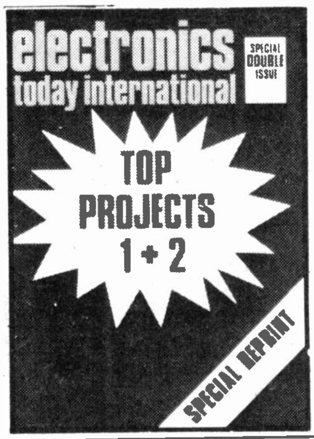
ETI SPECIALS

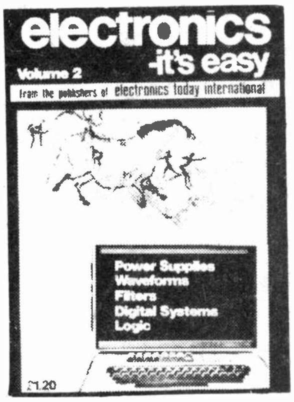
TOP PROJECTS No. 1 + No. 2

A massive 180 page book containing all the projects originally described in our first two Top Projects Books -- originally published in October 1974 and June 1975 -- which are now out of print.

Projects include Master Mixer 100W Guitar Amp, Low Power Laser, Printimer, Transistor Tester, Mixer Preamp., Logic Probe, Simple Amp, Ni-Cad Battery Charger, Loudhailer, Scope Calibrator, Electronic Ignition, Automatic Car Theft Alarm, Turn Indicator Canceller, Brake Light Warning, LM380 Circuits, Temperature Alarm, Aerial Matcher, UHF TV Preamp, Metal Locator, Four Input Mixer, Super Stereo, IC Power Supply, Rumble Filter, IC Tester, Ignition Timing Light, 50W Stereo Amp PLUS MANY MORE

£2.50 + 25p P&P





ELECTRONICS — IT'S EASY

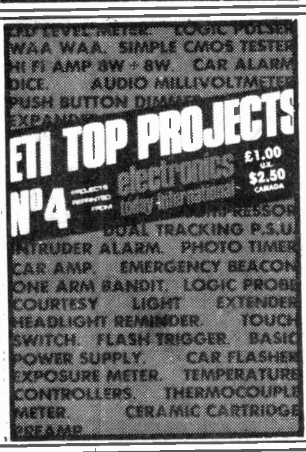
Our successful beginners series came to an end some time ago now, and the whole series is available from us in reprint form. The three books between them contain all the information presented in the series, (sometimes in more detail!) and together form an excellent starting point for anyone interested in learning the art of electronics. Each volume costs.

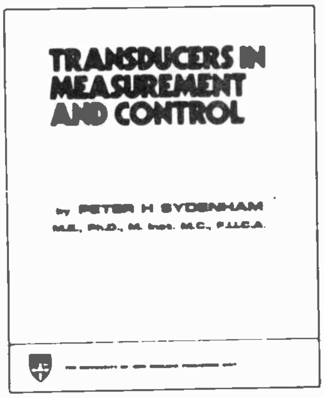
£1.20 + 25p P&P

TOP PROJECTS No. 4

Published October, 1976. This includes Sweet-Sixteen Stereo Amp, Waa-Waa, Audio Level Meter, Expander-Compressor, Car Anti-Theft Alarm, Headlight Reminder, Dual-Tracking Power Supply, Audio Millivoltmeter, Thermocouple Meter, Intruder Alarm, Touch Switch, Push-Button Dimmer, Exposure Meter, Photo Timer, Electronic Dice, High Power Beacon, Temperature Controller, Electronic One-Armed Bandit, plus many more

£1.00 + 25p P&P





TRANSDUCERS IN MEASUREMENT AND CONTROL

This book is rather an unusual reprint from the pages of ETI. The series appeared a couple of years ago in the magazine, and was so highly thought of by the University of New England that they have re-published the series splendidly for use as a standard textbook. Written by Peter Sydenham, M.E., Ph.D., M.Inst.M.C., F.I.I.C.A., this publication covers practically every type of transducer and deals with equipment and techniques not covered in any other book. Enquiries from educational authorities, universities and colleges for bulk supply of this publication are welcomed. These should be addressed to H. W. Moorshead, Editor.

£3.00 + 25p P&P

TOP PROJECTS No. 5

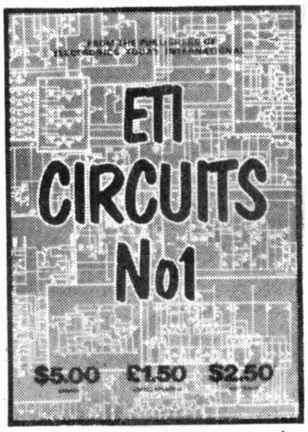
Twenty-two complete projects including, 5W Stereo Amp, Stage Mixer, Disco Mixer, Touch Organ, Audio Limiter, Infra-Red Intruder Alarm, Model Train Controller, Reaction Tester, Headphone Radio, STD Timer, Double Dice, G P Power Supply, Logic Tester, Power Meter, Digital Voltmeter, Universal Timer, Breakdown Beacon, 1-2 Hour Timer, Heart Rate Monitor, IB Metal Locator and Temperature Meter.

£1.00 + 25p P&P

ELECTRONICS TOMORROW

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?

75p + 25p P&P



ETI CIRCUITS No. 1

Contains nearly 250 circuits largely taken from the best of our Tech-Tips. Great care has been taken to index each circuit for rapid selection. An additional section at the back gives plenty of reference data including transistor specs and equivalents.

Sales of this publication have been excellent -- hardly surprising when the circuits cost less than 1p each!

£1.50 + 25p P&P

ETI 4600 SYNTHESISER

A complete reprint of our superb synthesiser design, published with Maplin Electronics (who also supply the parts). This reprint will also be of interest to those not specifically wanting to build the unit as the circuitry is highly original and is in fact patented by ETI!

£1.50 + 25p P&P

HOW TO ORDER

Postage and packing also refers to overseas. Send remittance in sterling only.
ETI Specials
ETI Magazine
25-27 Oxford Street
London W1R 1RF
Please mark the back of your cheque or PO with your name and address.

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 questionaires. Yes, we really do care about what you, the reader, thinks!

Thanks for your help,

May the EMF be with you.

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.

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

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

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)
I saw a circuit I wished to build.
g) How many other people read your copy? 0

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?
~~MPUs~~/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	✗			
Smoke Detector	✗	✗	✓	✗
M.P.U. Doorbell	✗	✓	✗	✗
Chess Challenger	✗			

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 arbitary 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 N. Crook
Address 19 Greenlands St.
Staines Middx
TW18 4ER

If you win a T shirt, what size do you want?
~~Small~~/Medium/~~Large~~

THANK YOU FOR YOUR TIME,
PLEASE MAIL TO:
ETI SURVEY,
25/27 OXFORD STREET,
LONDON W1R 1RF

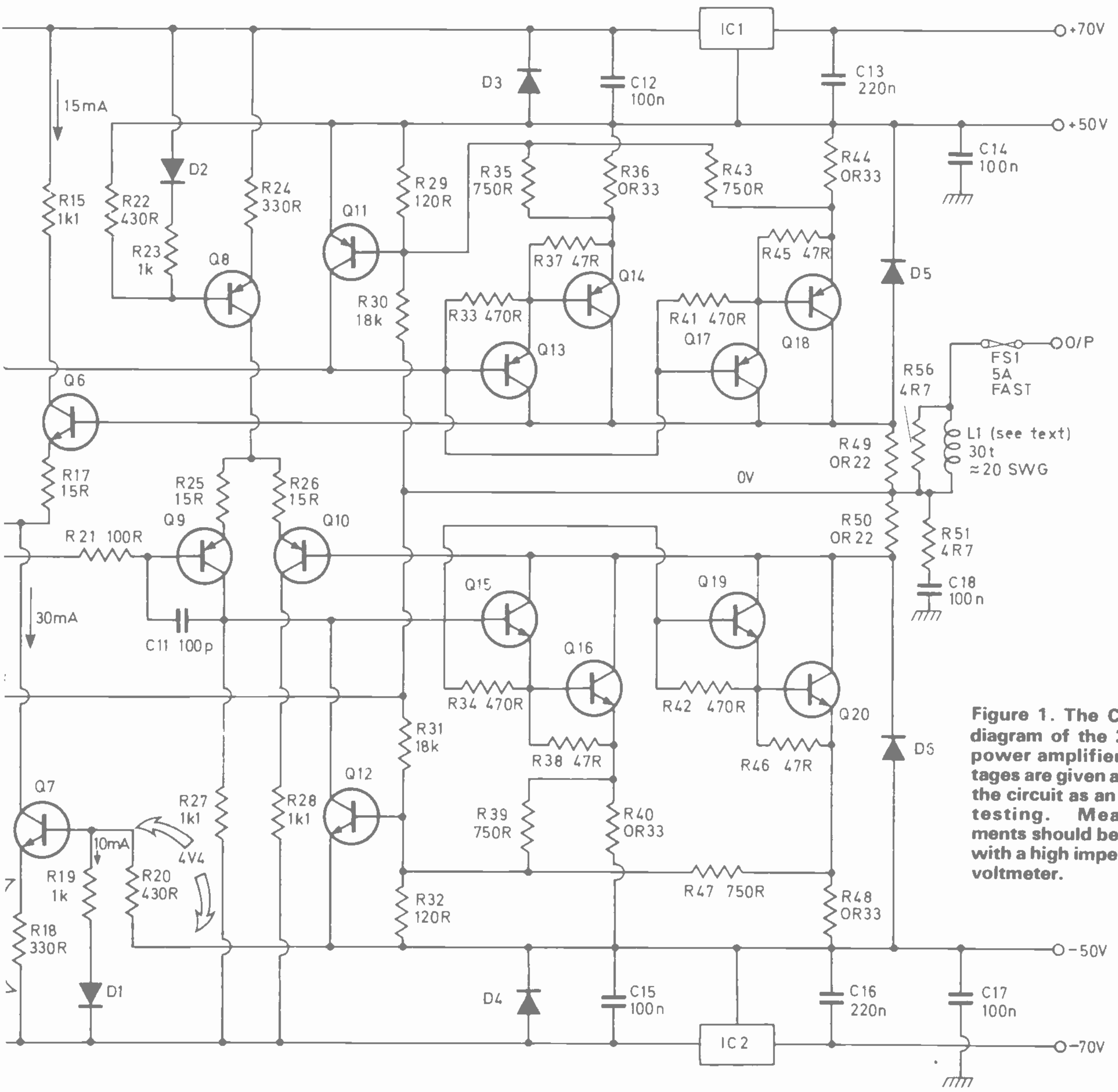


Figure 1. The Circuit diagram of the 200W power amplifier. Voltages are given around the circuit as an aid to testing. Measurements should be made with a high impedance voltmeter.

RKS~Main Amp

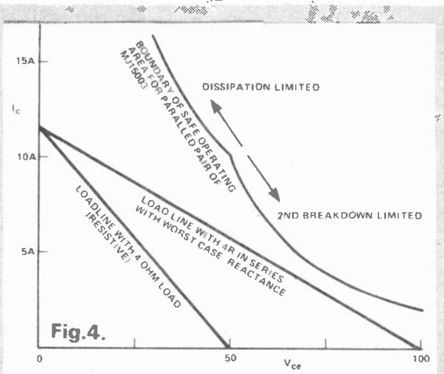


Fig.4.

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 Iq 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-

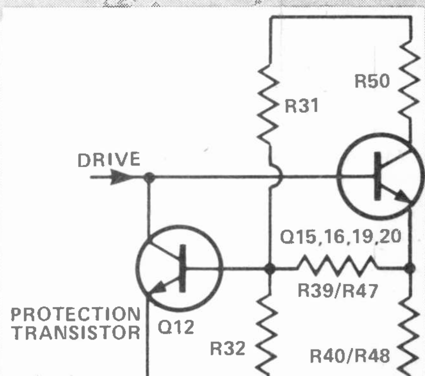


Fig.5.

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.

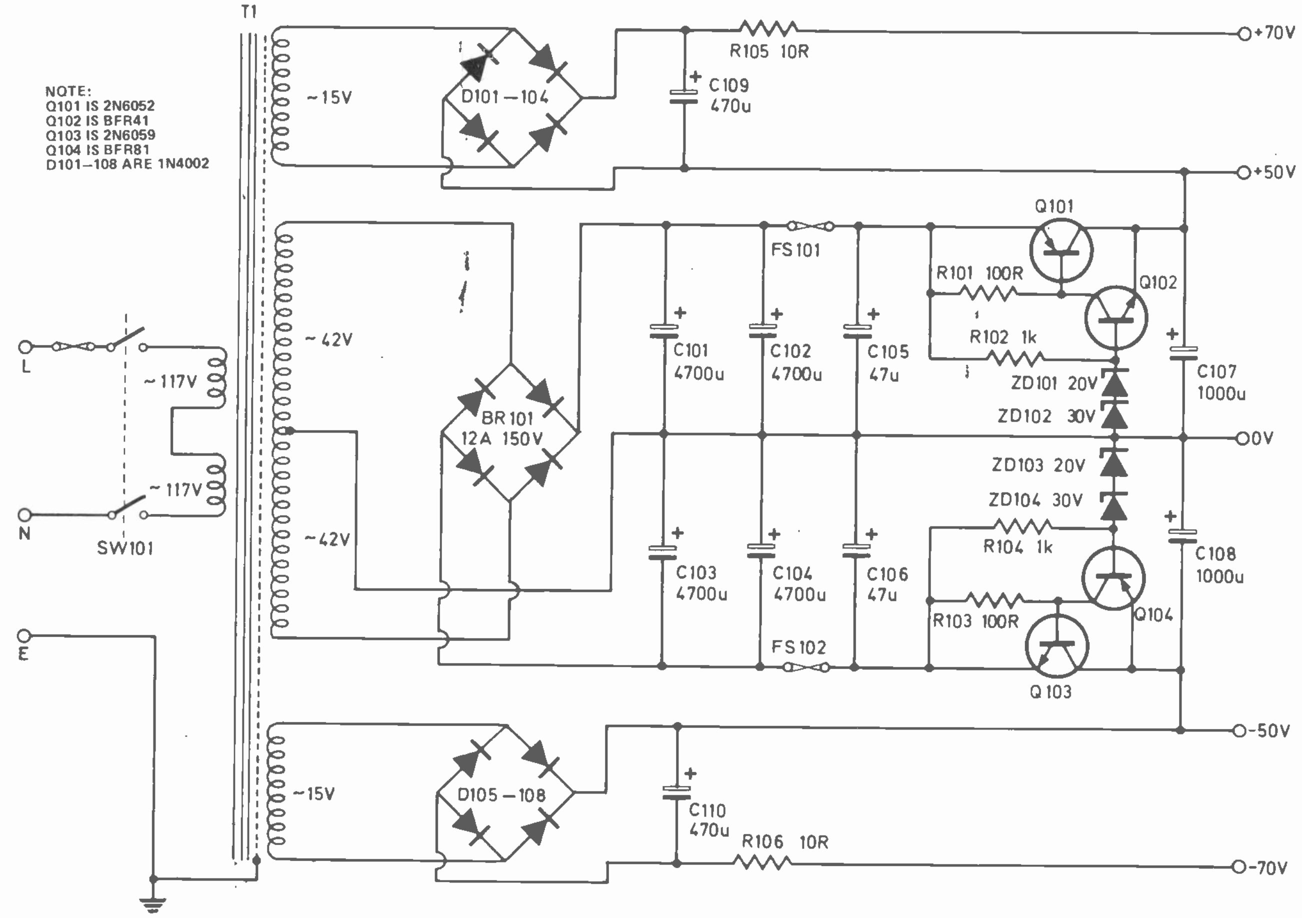
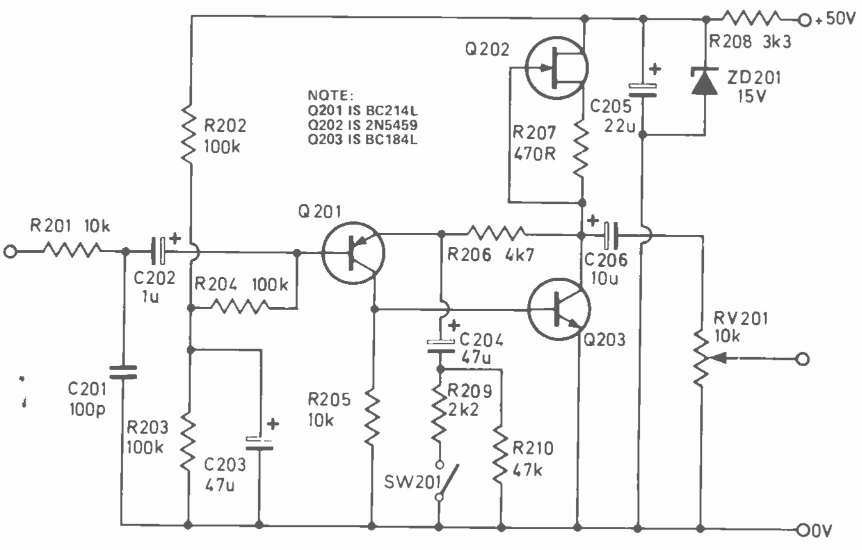


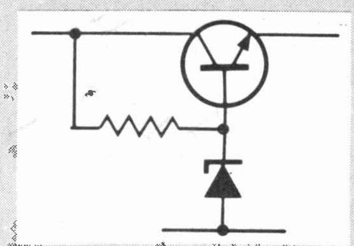
Figure 6. (Above) Circuit diagram for the PSU. Note that the transformer is a special unit wound for the 200W amplifier by Powertran Electronics. Figure 7. (Below) The circuit diagram for the buffer to increase the input impedance of the unit, and provide variable input sensitivity if required.



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.

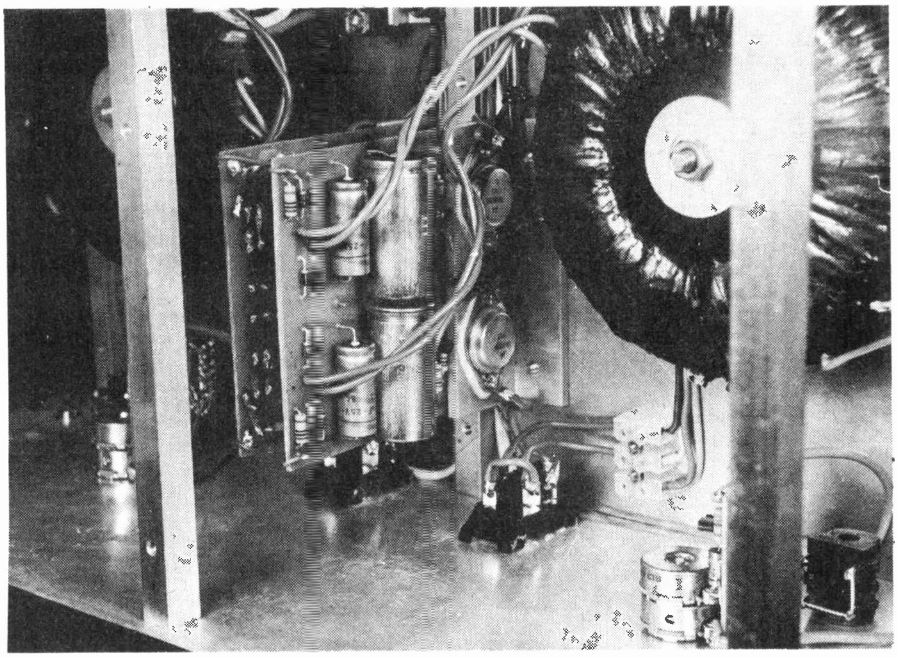
The ±70V rails are dreived from a simple bridge rectifier circuits.



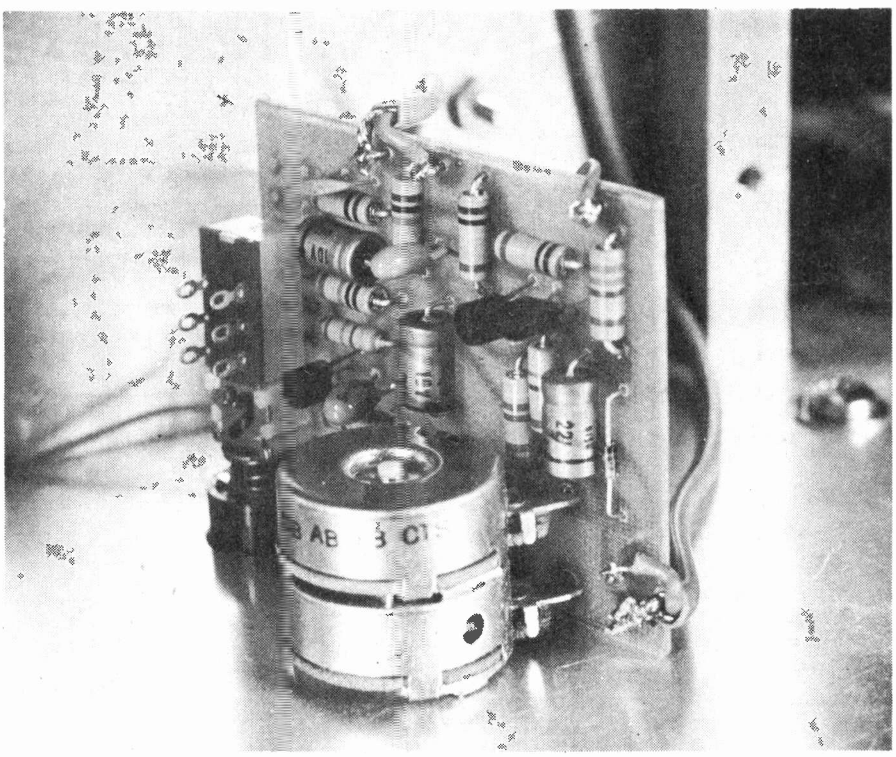
THE BUFFER

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 te 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.

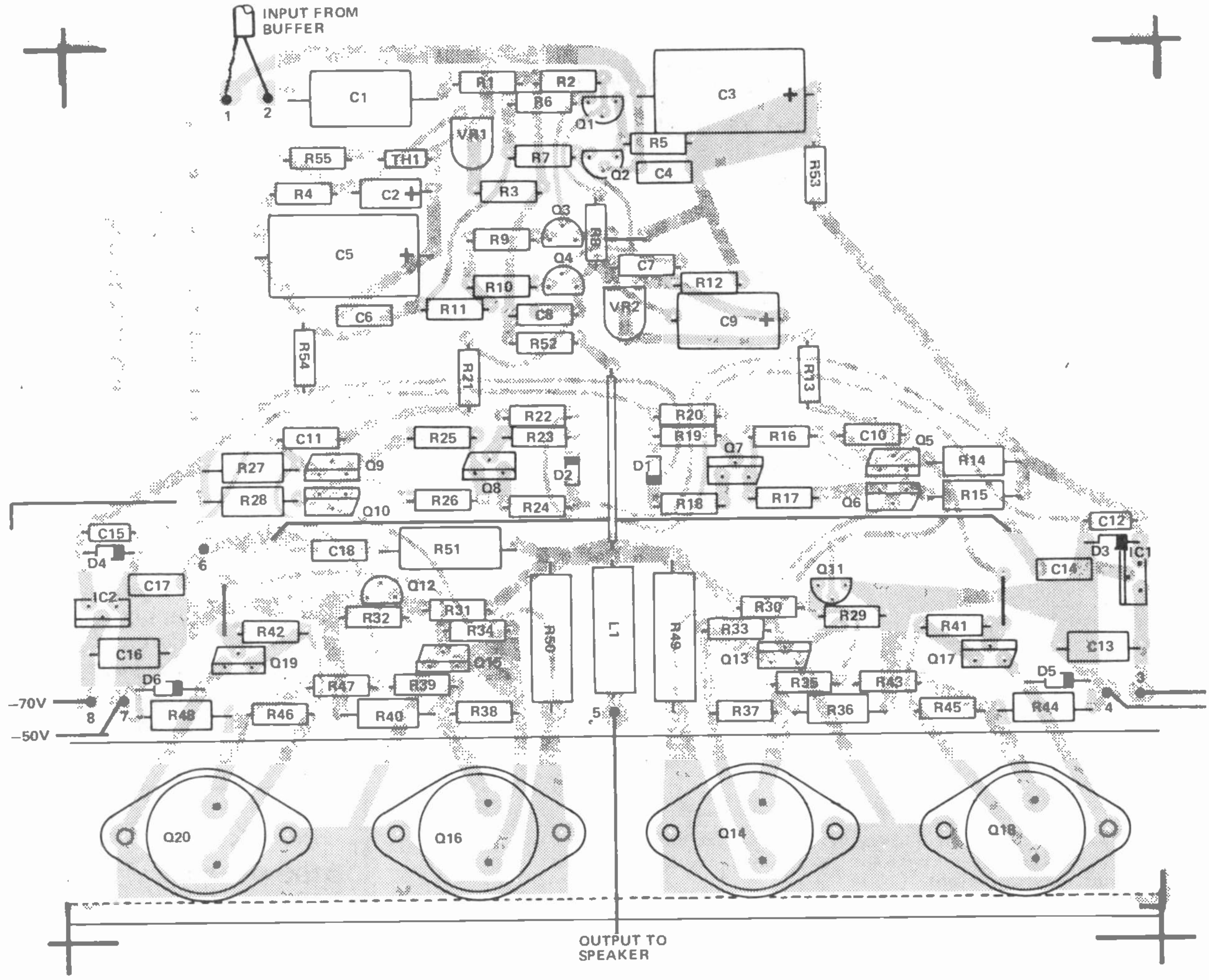
Next connect a 1k5 1W resistor between Q101c and 0V and a similar resistor between Q103c and 0V. Switch on and hopefully the voltages will be shown in Table 2.

TABLE 2

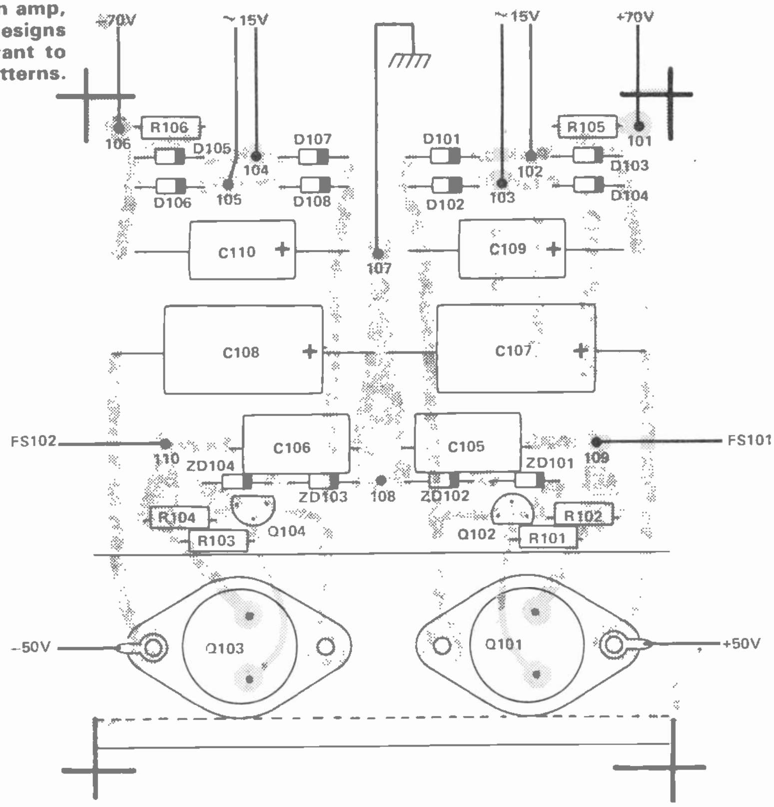
Q101c to 0 V	+50 V
Q103c to 0 V	—50 V
PSU pin 101 to 0 V	+72 V
PSU pin 106 to 0 V	—72 V

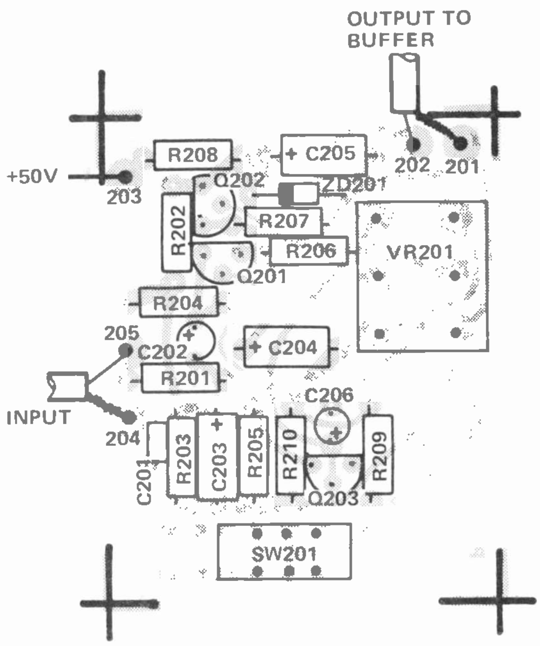
Again if OK, switch off and discharge those Cs.

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

RESISTORS (allows 2% metal oxide unless stated).

R101, 103	100R
R102, 104	Ik
R105, 106	10R

CAPACITORS

C101, 102, 103 104	4700u 63 V electrolytic
C105, 106	47u 63 V electrolytic
C107, 108	1000u 63 V electrolytic
C109, 110	470u 25 V electrolytic

SEMICONDUCTORS

Q101	2N6052
Q102	BFR 41
Q103	2N 6059
Q104	BFR 81
D101-108	1N4002
BR1	12A 150 V bridge
ZD 101, 103	20 V 400 mW
ZD 102, 104	30 V 400 mW

TRANSFORMER

T1	see text

MISCELLANEOUS
PCB as pattern, fuses.

BUFFER

RESISTORS (All 2% OW5 metal oxide unless stated).

R201, 205	10k
R202, 203, 204	100k
R206	4k7
R207	470 R
R208	3k3
R209	2k2
R210	47k

POTENTIOMETERS

RV20 1	10k

CAPACITORS

C201	100p polystrene
C202	1u 16 V tantalum
C203, 204	47u 10 V electrolytic
C205	22u 25 V electrolytic
C206	10u 16 V tantalum

SEMICONDUCTORS

Q201	BC214L
Q202	2N5459
Q203	BC184L
ZD1	15 V 400 mW

MISCELLANEOUS
PCB as pattern.

PARTS LIST~Main Amp.

200 W AMP PARTS LIST

RESISTORS (all 2% OW5 Metal Oxide unless stated)

R1	9k1
R2	10k
R3, 52	470k
R4	56k
R5	62k
R6, 7	22k
R8	3M9
R9, 10, 13, 21, 53, 54	100R
R11, 19, 23	1k
R12	13k
R14, 15, 27, 28	1k1 1W Carbon Film
R16, 17	15R
R18, 24	330R
R20, 22	430R
R25, 26	15R
R29, 32	120R
R30, 31	18k
R33, 34, 41, 42	470R
R35, 39, 43, 47	750R
R36, 40, 44, 48	OR33 2W5 Wire Wound
R37, 38, 45, 46	47R
R49, 50	OR22 5W Wire Wound
R51,	4R7
R55	6k8
R56	4R7 2WG Wire Wound

POTENTIOMETERS

RV1	5k Cermet
RV2	200R Cermet

THERMISTOR

TH1	VA1056

CAPACITORS

C1	1u polyester
C2	47u 10 V electrolytic
C3, 5	220 63 V electrolytic
C4, 6, 12, 14, 15, 17, 18	100n polyester
C7	22p 160 V polystrene
C8	5p6 63 V polystrene
C9	470u 6V3 electrolytic
C10, 11	100p 160 V polystrene
C13, 16	220n poltester

SEMICONDUCTORS

Q1, 2	2N5401
Q3, 4	2N5382
Q5, 6, 7	BF460
Q8, 9, 10	BF463
Q11	BC212L
Q12	BC182L
Q13, 17	BD420
Q14, 18	MJ15004
Q15, 19	BD419
Q16, 20	MJ15003
IC1	7815
IC2	7915
D1-4	1N4148
D5, 6	1N4002

INDUCTOR

L1	see text

MISCELLANEOUS
PCB as pattern, thermal fuse, mica washers, connecting wire, etc.

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 or 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.

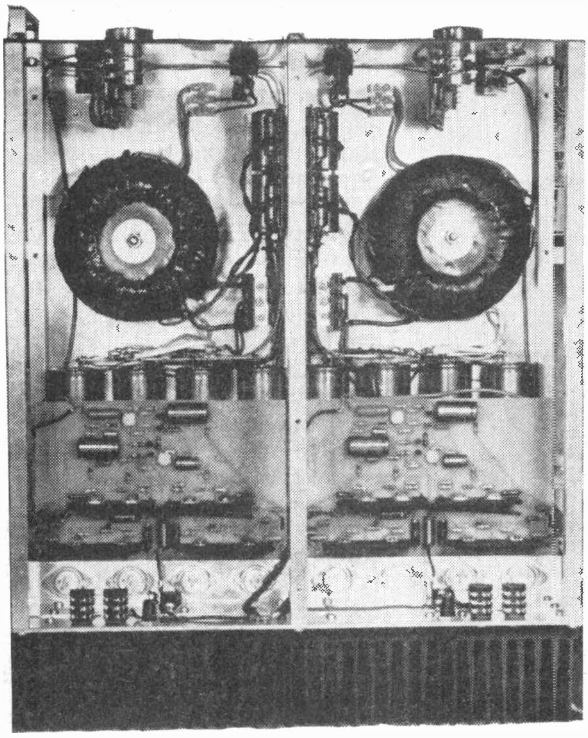
Note that solder tags are required to connect to the cases of the two PSV transistors but not on the main amp's devices where connection is made via the PCB.

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



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

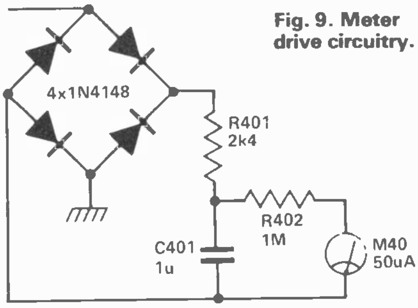
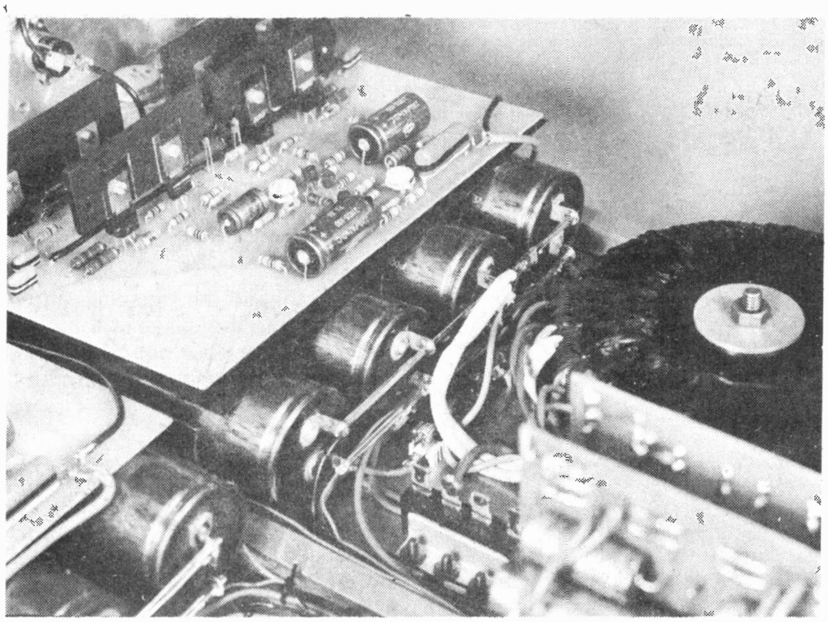


Fig. 9. Meter drive circuitry.

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.



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

SEMICONDUCTOR OFFERS ALL FULL SPEC.

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.Ts. similar to 2N3819 18p. Mofset 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 Recs. (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. Regs 95p Min. Nixies ITT 5870Si 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 (TO5) Thyristors 30p.

MICROPHONES. Grundig Electret Inserts with built-in F.E.T. Preamp £1.50. Crystal Mike Inserts 37mm 50p Electret Condenser Mikes 1KΩ Imp. with std. Jack Plug £2 85. Cassette Condenser Mikes with 2.5 and 3.5 Jack Plugs £2.85 Standard Cassette Mikes 200 ohm Imped. with 2 5 and 3 5 Jack Plugs £1.20 P.A Mikes Mobile Type 50KΩ, Thumb Switch, £4.20

MORSE KEYS—Plastic Type 95p Hi-speed Type, all metal, £2 25. Hi Imp Phones 2KΩ £1.95. SWR/Power Meter type SWR50, SWR; 1. 3-1 1, Power 0-1kW., 3.5-150MHz., 52 ohms imped , £12 75. SWR ANOF.S. Meter, 3-150MHz, 50 ohms imped., £9.50. Marker Gen , 300KHz steps to 60MHz, supplied with Xtal for this coverage, £7.90.

CRYSTALS. 300KHz HC6U 40p. 4.43MHz C.T V. Xtals 45p. 0·1" Edge Connectors, 64 way 65p. 32 way 40p

RELAYS. Min. sealed Relays, all 4 pole changeover, 36Ω (6v DC) 45p. 700Ω (24v DC) 55p Min. 220v AC Sealed Relay 2 pole C/O 45p. 240v AC Sealed Relay 3 pole C/O 5 amp Contacts 11-pin base 80p 12 volt 4 pole N.O Reed Relay 20p. 30 turn dial mechanism with locking arm, aluminium finish dial scaled 0-100, window 0-29, 32mm diam, 6.3mm spindle new £1.75.

MOTORS. 1.5 to 6v DC Model 20p. 12v DC 5 pole 35p. 115v AC min. 3 R.P.M. with Gearbox 30p. 240v AC Synch Motor 1/5th R.P.M. 65p. 240v AC Synch. Motor 1/24th R.P M. 65p.

BOXES. Black A B.S Plastic with brass inserts and lid, 75 x 56 x 35mm 40p. 95 x 71 x 35mm 49p 115 x 95 x 16mm 57p Grey Potting Boxes with lugs, 23 x 48 x 23mm 11p 38 x 52 x 25mm 13p. 60 x 80 x 42mm 28p.

TRANSFORMERS. -6-0-6v 100mA, 9-0-9v 75mA, 12-0-12v 50mA 75p each. 12-0-12v 100mA 95p 1 1 Triac Xenon Pulse Transformer 30p.

CONDENSER MIKES. EM506 Condenser Mikes, Uni-directional, F.E T Amp, Dual imped , 50K/600 ohms, 30-18KHz., on/off switch, £11.00. Miniature Tie Pin Condenser Mike, 1K imp , omni-directional, uses hearing aid battery (supplied) £4.95.

STEREO HEADPHONES. 8 ohms, padded earpieces and headband, with curly lead, 30-18KHz only £3.00.

SWITCHES—Min. Toggle, SPST 8 x 5 x 7mm 30p DPDT 8 x 7 x 7mm 60p. DPDT Centre Off 12 x 11 x 9mm 75p. 4P 2W Sliders 20p DPDT C/O Sliders 20p SPST 10 amp Rockers 12p. R.S Single Pole C/O Push Buttons 45p Roller Micro Switches 15p Min Micro Switches 13 x 10 x 4mm 20p G.P O Keyswitch Assy. 3 Switches 2-3 way, 1-2 way Multipole 35p Min. Push to make or push to break Switches 16 x 6mm 15p Plessey Winkler Stud Switches, 2 bank, 1 pole 30 way adj. stop, 75p. Solder Sucker, Plunger type, eye protection, replaceable nozzle, high suction £4.95. Reed switches 28mm norm. open, 6p each

TAPE HEADS—Jap Cassette Mono 99p. Cassette Stereo £3.00 BSR MN1330 ½ Track Dual Impedance Rec./Playback 50p. BSR SRP9D ¼ Track Stereo Rec /Playback £1.95 TD10 Assemblies, two heads, ¼ Track Rec /Playback Staggered Stereo with built-in erase per head £1.20 Tape Head Demag 240v AC £1.95.

BUZZERS—GPO Type 6-12v 20p Min Solid State Buzzers 6-9-12 or 24v 15mA 75p U.H.F. TV Transistorised Push Button Tuners (not Varicap), new and boxed, £2.50

POT CORES—Adj. Vinkor 250-370 Micro H 20p 260 or 500 Milli Henry Cores 10p each

METERS—Stereo Tuning Meters 100μa per movement £2 75. Grundig Batt. Level Meter 1mA 40 x 40mm £1.10 Min. Level Meter 200μa 25 x 15mm 75p. Ferranti 600v AC Meter £3.95

BOARDS. 465KHz I.F Panels, 6 I F.T.s 30p Board with 14 12v N/O Reed Relays £2 40 Board with 6v C/O Reed Relay £1.20. Contact cooled set reel, 12v/50mA — 15p. Cannon 50 way gold inlay plugs and sockets, free plug — new £1.50 pair

AEROSOLS—Servisol Switch Cleaner + Lubricant 8ozs 55p Freezer 6ozs 50p Gear Cleaner & Tar Remover 14ozs. 85p

SOLENOIDS—240v AC 45p. 12v DC H Duty 75p

POSTAGE 30p UNLESS OTHERWISE SHOWN (EXCESS POSTAGE REFUNDED WITH ORDER) OVERSEAS POST AT COST VAT INCLUDED IN ALL PRICES

S A E FOR LISTS

ORDER ADDRESS

PROGRESSIVE RADIO

31 CHEAPSIDE, LIVERPOOL 2

051-236 0982

SENSATIONAL NEWS!

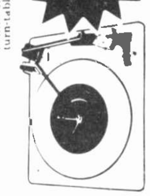
Hi-Fi Stereo at prices everyone can afford

HiFi Stereo Speakers

specially matched 8" x 5", high performance speakers, complete with all necessary leads for DIN connection.

our price £4·95*

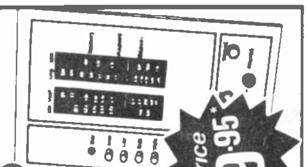
HiFi Stereo BSR Autochanger



3 speed auto selection (6 records) or single play, cue & pause control, size 13¼" x 11¼". All leads supplied (to DIN specification) for connecting this turn-table chassis.

our price £12·95*

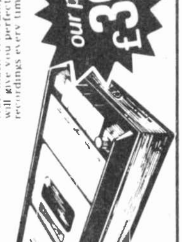
HiFi Stereo Tuner/Amplifier chassis



30 watts total power output LW MW FM (VHF) stereo decoder, tape input output sockets Headphone socket for private listening, chassis size 7½" wide, 5" deep, 12½" high, supplied complete with all necessary plugs and leads.

our price £29·95*

HiFi Stereo Cassette deck



adds new dimensions to your existing audio system. Make your own Hi Fi Stereo tapes just plug in. Records direct from radio, record player etc. Automatic recording adjustment will give you perfect recordings every time.

our price £39·95*

** All prices include VAT,POSTAGE & PACKING. Send cheque/PO Today for immediate delivery Goods fully guaranteed for 12 months. Easy payment terms available on request.*

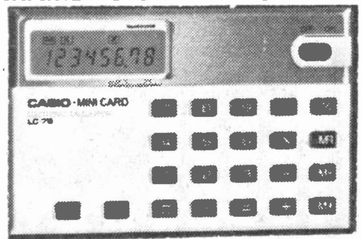
CALLERS WELCOME — ACCESS & BARCLAY CARD ORDERS ACCEPTED

LEWIS radio 100 Chase Side, Southgate, London N14 5PL — Tel: 01-882 1644

NOW! THE WORLD'S SLIMMEST CALCULATOR

The new DINKY calculator with the super slender style from KRAMER & Co. ONLY £16.90.

As thin as 3.9mm



Weighs only 39g (including batteries), nearer in size to a business card than to the common calculator.
Its features are: 8 digit LCD, also shows function command signs to help you operate it easily.
Perfect percentage — regular, ratio, add-on, discount mark-up, profit, increase/decrease.
Battery lasts for a long 1,000 continuous hours.
Comes in special leatherette card case.

Enquiries to: Price **£16.90**

KRAMER & CO.
9 OCTOBER PLACE
HOLDERS HILL ROAD, LONDON
NW4 1EJ
Telex 888941. Attn. KRAMER K7
Telephone: 01-203 2473
EXPORT ORDERS WELCOME
MAIL ORDER ONLY

APRIL FOOL

APRIL ONLY

DM958 **10p.** DM936 **10p.** 2N2192, 25 **£1.** 74H00 **15p.** TBA810S + Data **50p.** TiP 31 **35p.** 2N3055 **40p.** 3.5 MM JACK SKT Chassis MNT 5 for **30p.** FPE 100 GaAs Intra Red Emitter + Data **35p.** Westinghouse Hybrid Rectifier/Voltage Regulators 12-18.5v 2A + Data **£3.50.** BF1956P, T1L209 (Red) **9p.** .2 Led (Red) **10p.** Ocp70 **10p.** WO4 (400v 1 amp Bridge) **18p.** 75450 **30p.** 741 (8Dil) **17p.** All above P/P **10p.**

POCKET PAGER

Miniature crystal controlled FM RX Single Superhet around 30MHZ 450KHZ IF contains various tone detectors. Ideal for modification to 27MHZ Radio Control OR 28MHZ Amateur Band. Many complete with built in 2.5v DEAC + circuit of similar type **£3.95.** P/P 25p.

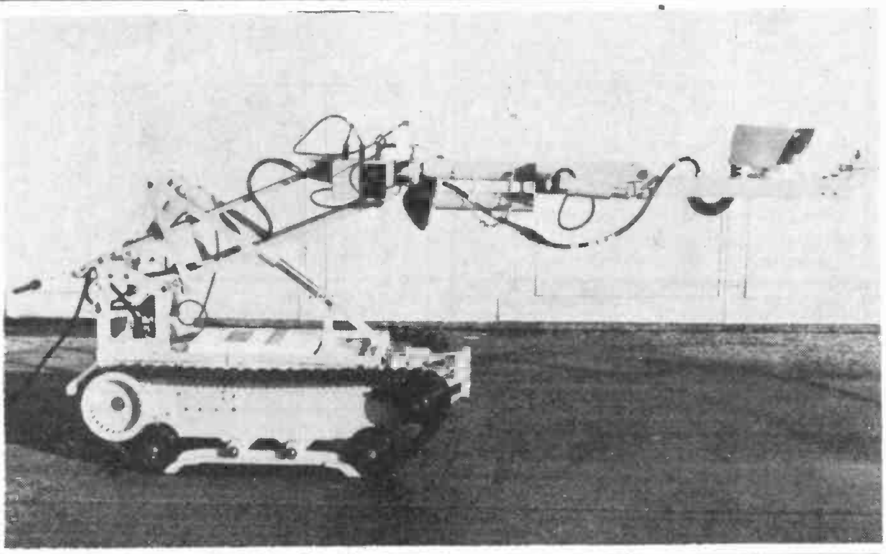
A1, A2, A3 Boards still available.

L.B. Electronics
43 Westacott, Hayes
Middlesex UB4 8AH

electronics today 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

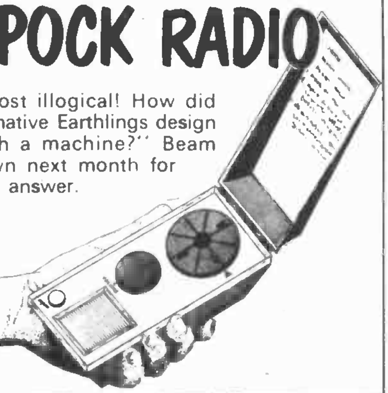
In the beginning there was tape phasing, and it was good — but cumbersome. Then ETI said, 'Let us use new technology,' and it was good — and compact. Next month we publish a state-of-the-art phaser/flanger using the Mullard TDA1022 delay line, which is a charge coupled device. So if you want really good 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 marilibone jelly!

SPOCK RADIO

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



TI59 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 TI59 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.

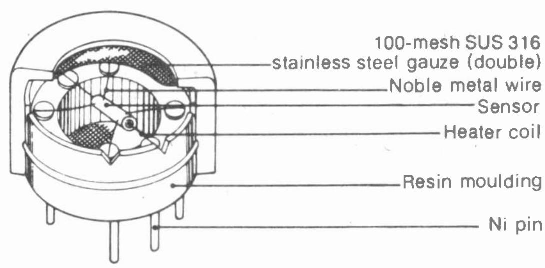
The sensor consists of a ceramic tube onto which is deposited a layer of the semiconductor (mainly tin dioxide) and the electrodes.

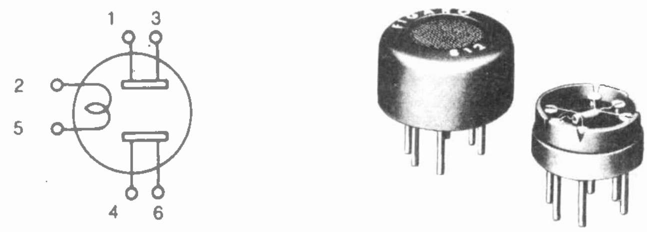
In fresh air the resistance of the semiconductor is constant, but as the concentration of the detectable gases increases and comes into contact with the sensor's surface, the resistance of the semiconductor changes.

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.





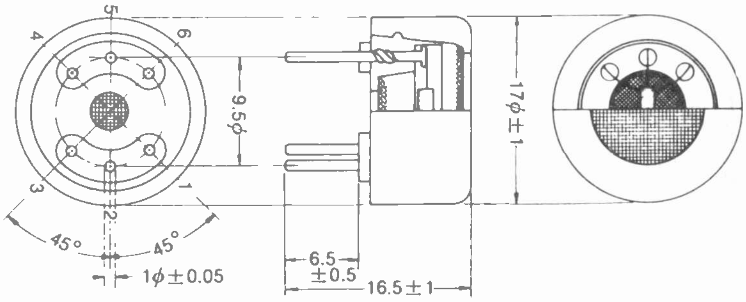


Fig 1. Mechanical structure of types 812 & 813 sensors, in mm.

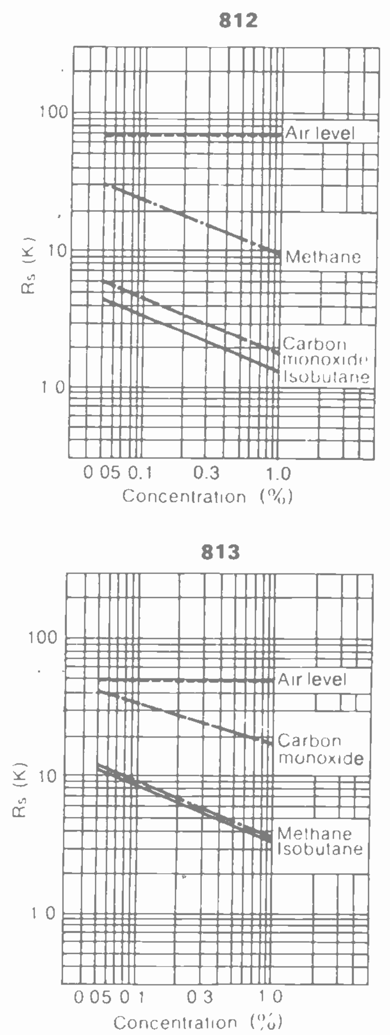


Fig 2. Sensor resistance (Rs) changes with different concentrations of gas.

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

Fig 3. Sensor characteristics.

Sensor type	Electrical ratings	Applications and Features
812	V_C: (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_C: (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.

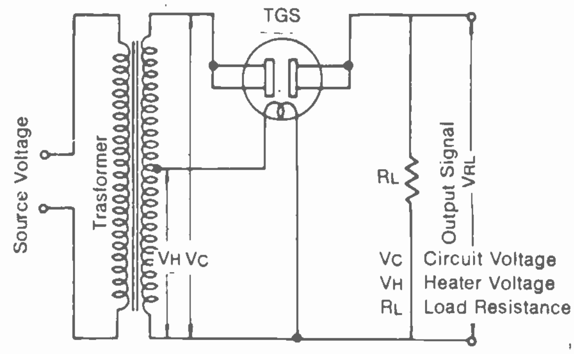


Fig 5. Basic test and measuring circuit.

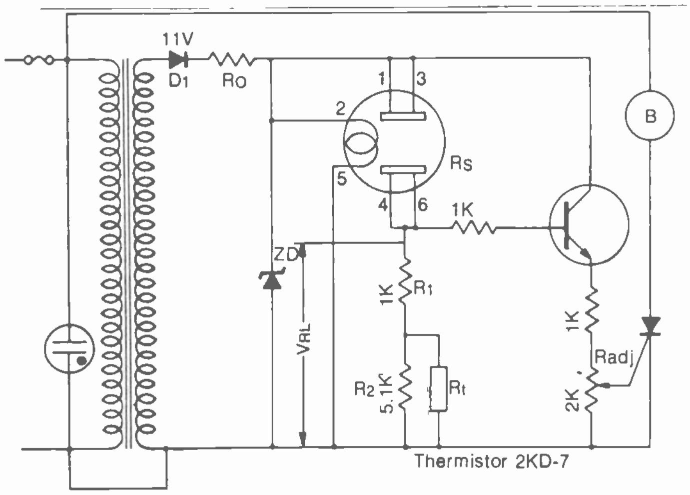


Fig 6. Circuit for use as a gas leak detector.

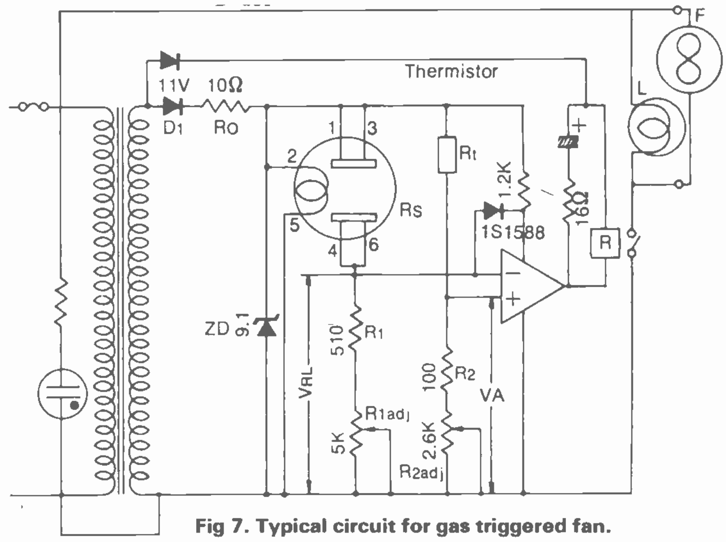


Fig 7. Typical circuit for gas triggered fan.

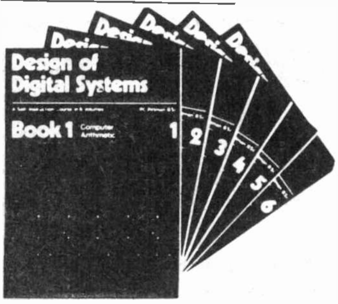
Join the Digital Revolution

Understand the latest developments in calculators,

computers, watches, telephones, television, automotive instrumentation . . .

Each of the 6 volumes of this self-instruction course measures 11¾" x 8¼" and contains 60 pages packed with information, diagrams and questions designed to lead you step-by-step through number systems and Boolean algebra, to memories, counters and simple arithmetic circuits, and on to a complete understanding of the design and operation of calculators and computers.

Design of Digital Systems.



£7.10

plus 90p packing and surface post anywhere in the world

Overseas customers should send for Proforma invoice.

VAT zero rated

Also available — a more elementary course assuming no prior knowledge except simple arithmetic.
Digital Computer Logic and Electronics.
In 4 volumes:

1. Basic Computer Logic
2. Logical Circuit Elements
3. Designing Circuits to Carry Out Logical Functions
4. Flipflops and Registers

£4.60

plus 90p P&P

Offer Order both courses for the bargain price £11.10 plus 90p P&P
A saving of £1.50

Designer
Manager
Enthusiast
Scientist
Engineer
Student

These courses were written so that you could teach yourself the theory and application of digital logic. Learning by self instruction has the advantages of being quicker and more thorough than classroom learning. You work at your own speed and must respond by answering questions on each new piece of information before proceeding to the next.

NEW from Cambridge Learning Enterprises:
THE ALGORITHM WRITER'S GUIDE
use, design and layout; vital for computing, training, wall charts, etc.

£2.95

plus 45p P&P

Guarantee. If you are not entirely satisfied your money will be refunded.
Cambridge Learning Enterprises, Rivermill Lodge, St. Ives, Huntingdon, Cambs.
Proprietors: Drayridge Ltd. Regd. Office as above. Reg. No. 1328762.

To: Cambridge Learning Enterprises, Unit 15 Freepost
Rivermill Lodge, St. Ives, Huntingdon, Cambs. PE14 4BR.
Please send me . . . . set(s) of Design of Digital Systems at £8.00 each, P&P included.
or . . . . . . set(s) of Digital Computer Logic and Electronics at £5.50 each, p & p included
or . . . . . . combined set(s) at £12.00 each, p & p included
or . . . . . . The Algorithm Writer's Guide at £3.40 each, p & p included*

Name . . . .

Address . . . .

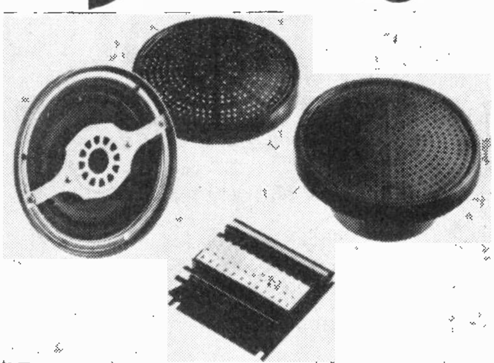
. . . .

*Delete as applicable

No need to use a stamp — just print FREEPOST on the envelope.

ETI 11

THE DYNAMIC DUO



The C15/15 is a unique Power Amplifier providing Stereo 15 watts per channel or 30 watts Mono and can be used with any car radio/tape unit. It is simply wired in series with the existing speaking leads and in conjunction with our speakers S15 produces a system of incredible performance.

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

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

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

C15/15
15 watts per channel into 4Ω
Distortion 0.2% at 1kHz at 15 watts
Frequency Response 50Hz-30kHz
Input Impedance 8Ω nominal
Input Sensitivity 2 volts R.M.S. for 15 watts output
Power Line 10-18 volts
Open and Short Circuit Protection
Thermal Protection
Size 4 x 4 x 1 inches

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

Data on S15
6" Diameter
5¼" Air Suspension
2" Active Tweeter
20oz Ceramic Magnet
15 watts R.M.S. Handling
50Hz-15kHz Frequency Response
4Ω Impedance

S15 Price per pair £17.74 + £2.21 VAT P&P free

TWO YEARS GUARANTEE ON ALL OF OUR PRODUCTS

Please supply . . . .
Total Purchase Price . . . .
I enclose cheque ☐ *Postal Order* ☐ *Money Order* ☐
Please debit my Access Account ☐ *Barclaycard Account* ☐
Account Number . . . .
Name & Address . . . .
. . . .
Signature . . . .

ILP ELECTRONICS LTD

Crossland House, Nackington, Cantebury, Kent
Tel (0227) 63218

Avoid the horrors of heavenly H_2O 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).

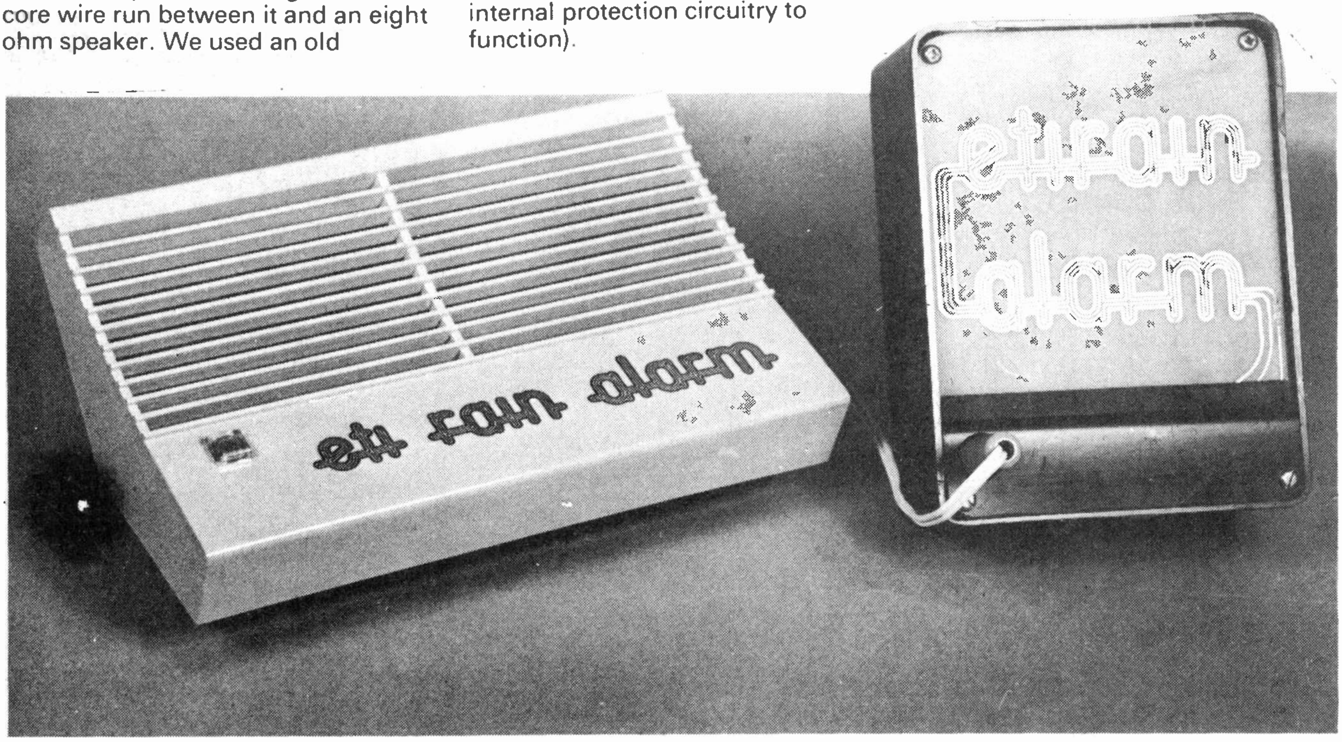
In our prototype we used a value of 4M7 for R1 which acts as a sensitivity adjustment. This value leads to a 'hair trigger' alarm and the value could well be reduced according to the level of sensitivity required.

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



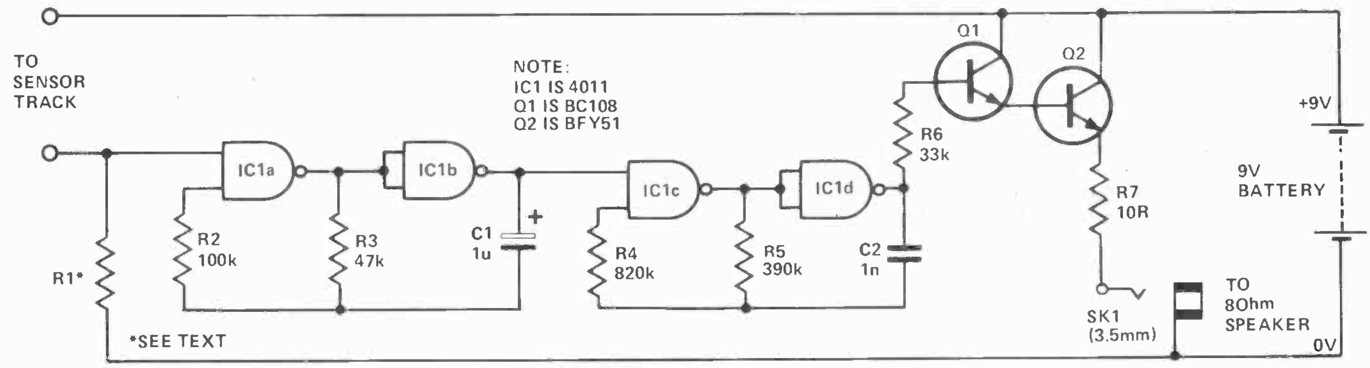
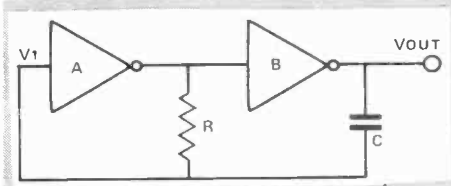


Fig. 1. Circuit diagram of Rain Alarm.

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.

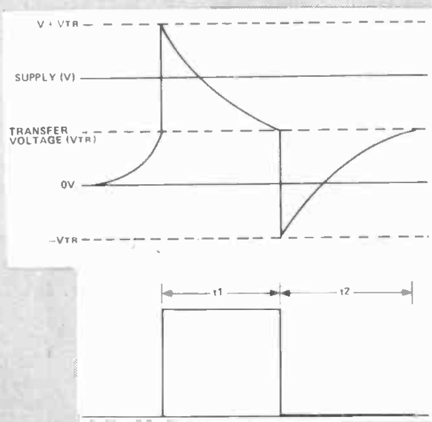


We can consider a CMOS gate to be a comparator that will change output state when the level of voltage at its input reaches a specified value, the transfer voltage (Vtr), usually about half supply. Thus as the voltage on C increases due to the charge current being supplied by R there will come a point 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 usquare 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 loudspeaker via R6, the Darlington pair formed by Q1 and Q2 and resistor R7.

PARTS LIST

RESISTORS (all ¼W 5%)

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

CAPACITORS

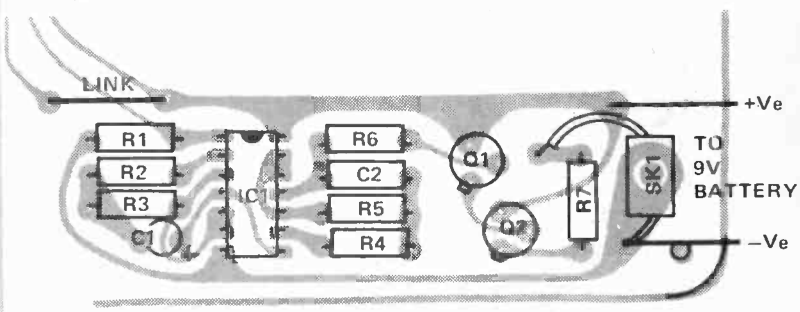
C1	1u0 16 V tantalum
C2	1n0 polyester

SEMICONDUCTORS

IC1	4011
Q1	BC 108
Q2	BFY 51

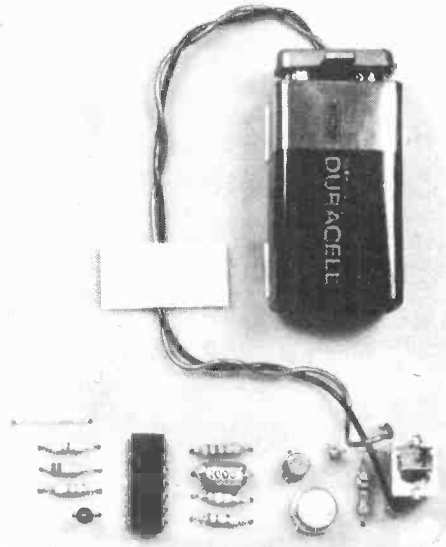
MISCELLANEOUS
PCB as pattern, 3.5mm jack socket, 8R speaker, battery.

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



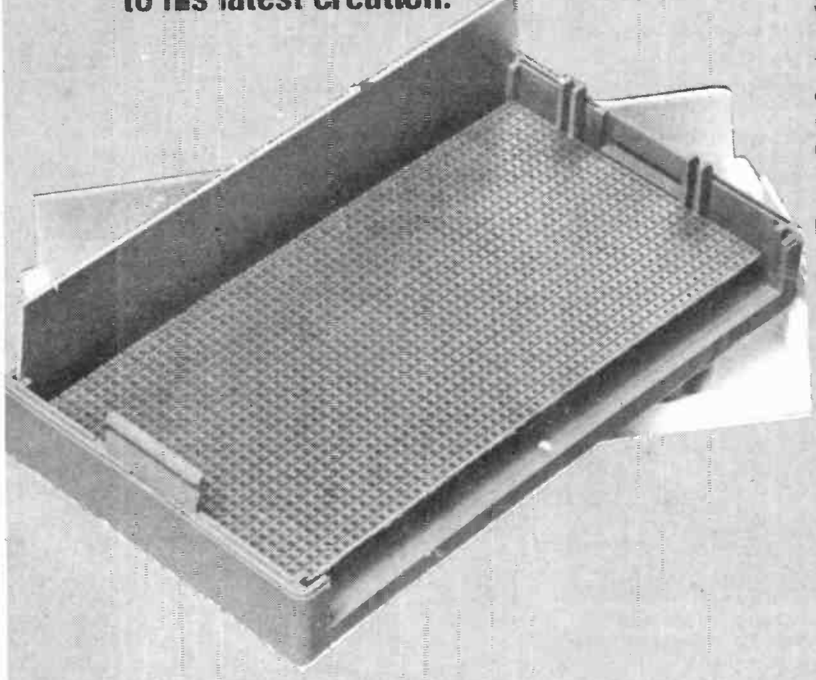
BUYLINES

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.



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?

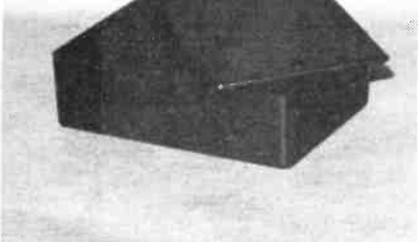
Once a box has been chosen the work begins . . . . The first essential is a layout of all the controls, sockets cable exits and any other holes which need to be made. Careful attention should be made to details such as not mounting audio switches near mains switches to avoid hum pick up.

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.

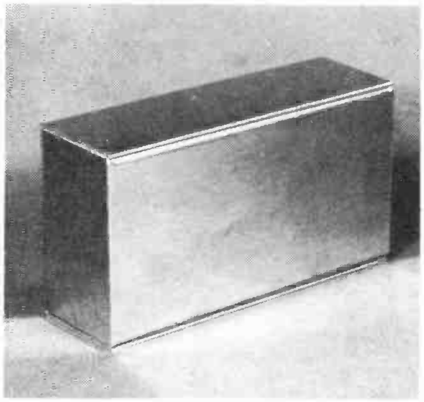
This can be done in a variety of ways (typed labels glued on, dymo type labelling strips . . .) but the method which gives the most professional appearance is rub down lettering transfers (a set of transfers suitable for panel marking, including potentiometer scales (rotary and slider) is available from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

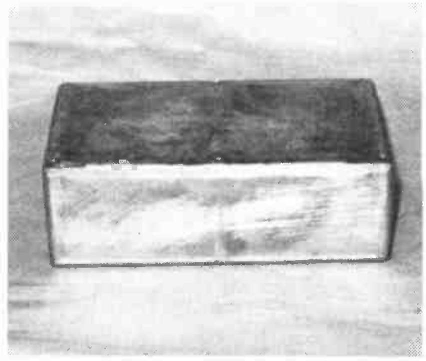
All that remains then is to secure the project in its case, stand back and admire . . . .



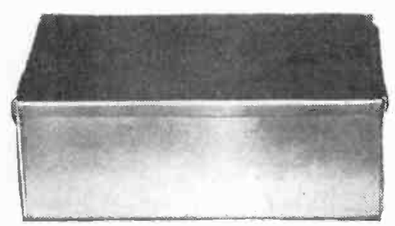
All-plastic 'Gemini' box and lid in black, grey or white. 110x70x30 at 71p. Supplier B.



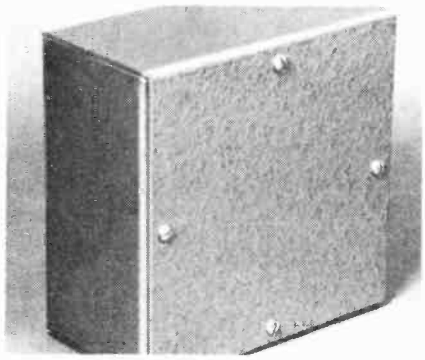
Aluminium plate box in two parts. 6 sizes available. Supplier B.



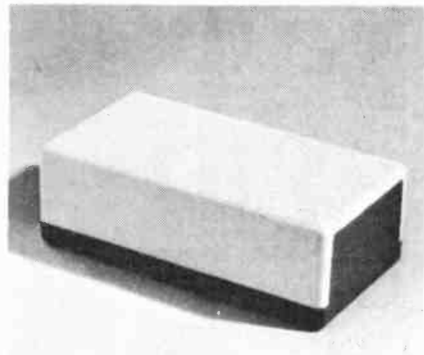
"Eddystone" die-cast aluminium boxes in 1.5mm thick walls. 8 sizes available from 89x38x32 to 222x146x108. Prices from £1.13. Suppliers B & C.



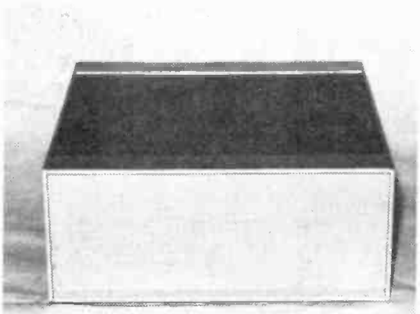
Folded aluminium boxes with lid and screws. 20 sizes from 76x51x25 to 304x203x76. Prices from 49p to £2.27. Supplier B



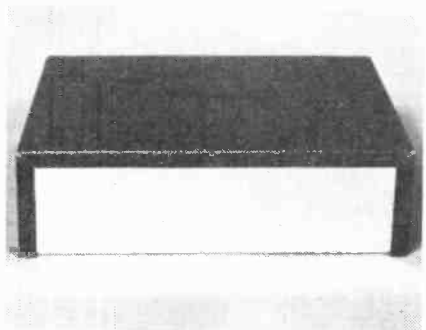
16 SWG aluminium, silver hammer finish cubical boxes. Type N in 3 sizes from 102x102x51 to 203x152x51. Prices from £1.90. Supplier A.



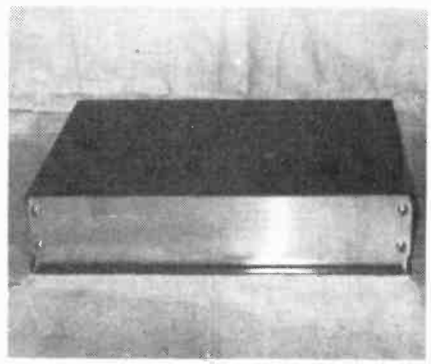
65 series plastic two-piece rectangular cases in white/grey. Sizes from 100x50x25 at £1.80. Supplier G.



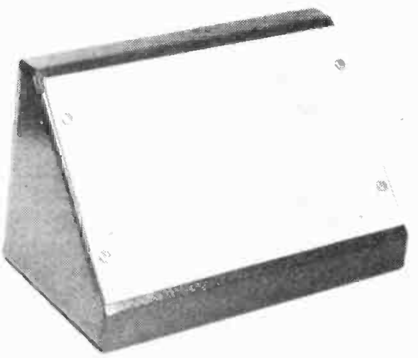
"Classic" instrument case. Satin-finished anodised aluminium with textured vinyl-coated steel top & bottom plates. 6 sizes from 216x127x63. Price from £7.94. Supplier B.



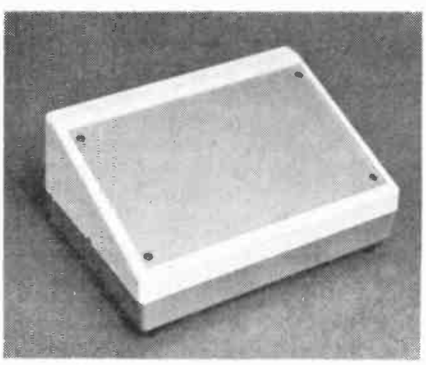
Aluminium two part construction case (type PJ) with front and rear vinyl covered. 7 sizes available from 127x63x57 to 305x158x133. Prices from 65p. Supplier B.



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

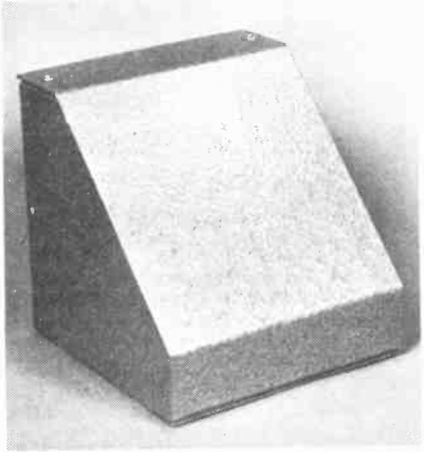


Steel cases with 45° sloping aluminium panels available in 3 sizes, from 150x95x95 with 150x100 front panel. Price from £2.10. Supplier E.



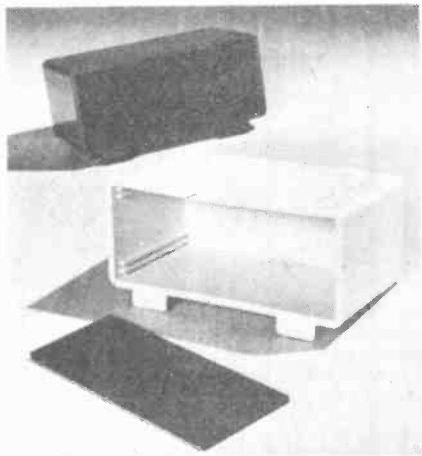
Two colour plastic case with sloping aluminium panel with mounting points for EUROCARD board. Size 171x121x75. Type 75-1798K at £4.53. Supplier G.

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.

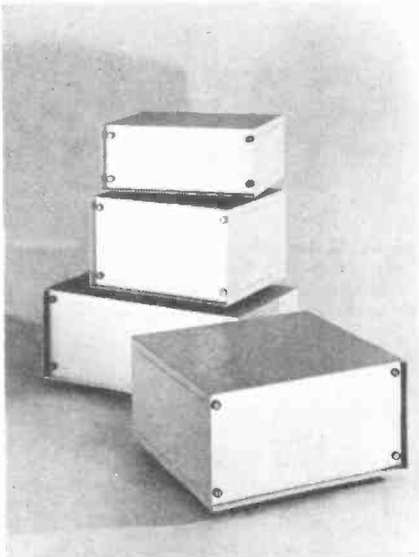


16 SWG aluminium, silver hammer finish. 3-piece construction. Type U case in 8 sizes from 76x76x76 to 381x229x229 from £1.50. Supplier A.

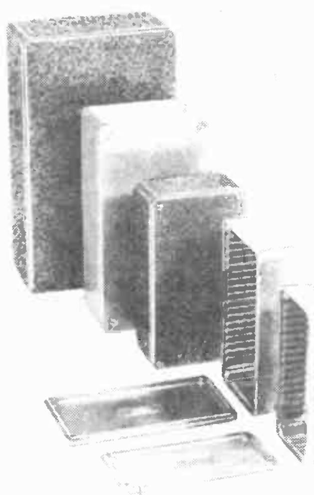
Flip-top polypropylene boxes with aluminium alloy panell in black or yellow. Two sizes 130x75x34 and 196x127x51 at approx £2.05 and £2.70. Supplier G.



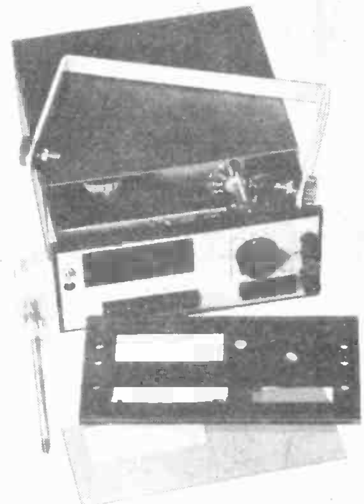
"Time box" for digital clocks in antistatic ABS. Slots for two PCBs available in white, red, orange or blue. Price £2.22. Supplier C.



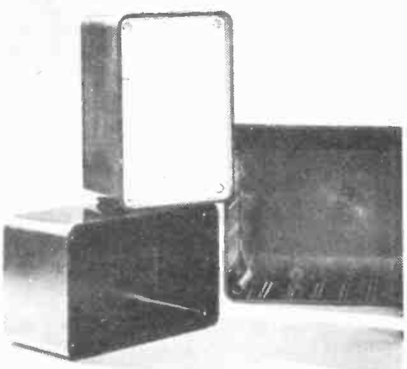
Veropak 49 series cases made of heavy guage PVC clad steel in 5 sizes from 277 x 113 x 219 with prices from £9.70. Supplier G.



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.

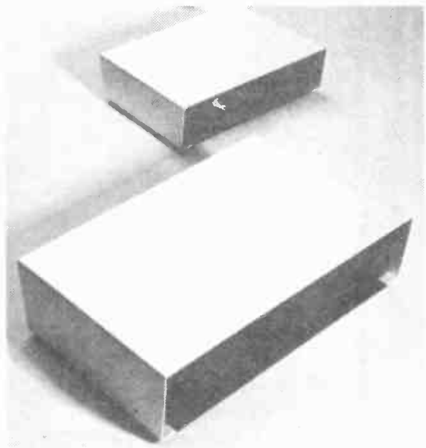


Amatek PDS instrument case system in PVC-coated aluminium with ready drilled front panel. Accepts push button switches, digital displays, meters. Size 178x80x152. Price £9.18. Supplier D.

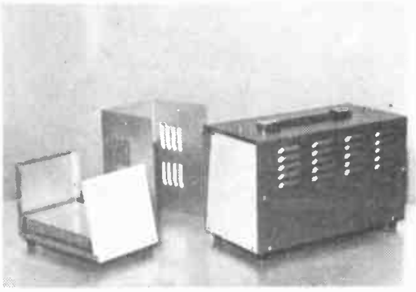


Miniature "Minos" cases in black or white ABS with aluminum panel. Guides for PCBs. 4 sizes from 65 x 100 x 50 to 130 x 200 x 54 at prices from 52p.Supplier C.

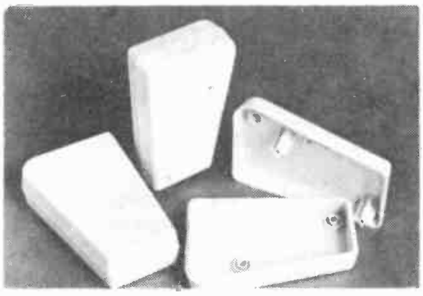
Two vacuum formed cases in black ABS with aluminium panel supplied, for mounting keyboards. Sizes 220 x 276 (about £8) and 550 x 340 (price TBA). Supplier G.



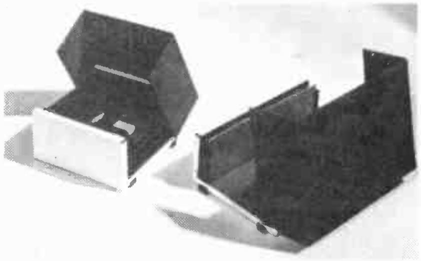
"G range" cases with sloping visor, in 3 sizes with slide on cover. 3 sizes from 44x134x123 from £4.86. Supplier G.



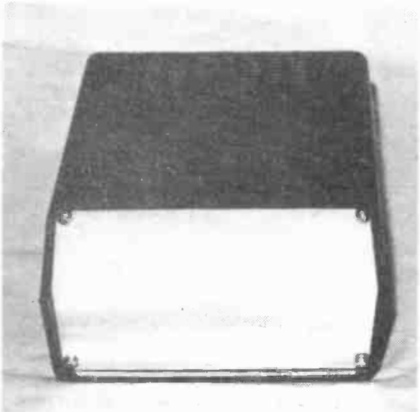
Hammered finished 20 SWG zinc-coated mild steel cases in two colours and 4 sizes, from 101x101x155 to 177x152x307. Supplier E.



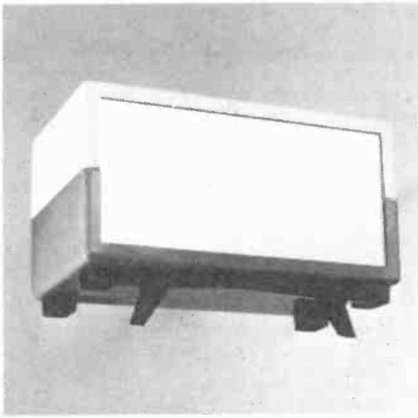
Hand held plastic control boxes approx. 61x94x27 type 75-1799E, in white high impact ABS. Price approx 70p. Supplier G.



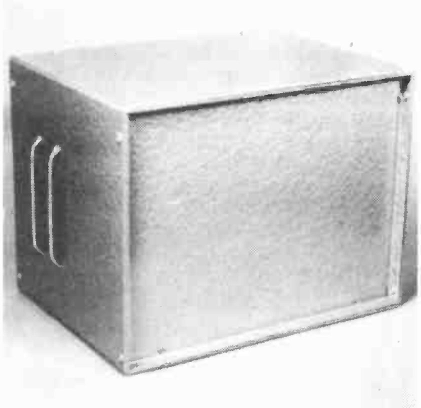
Samos miniature cases in 7 sizes. Two part construction, holds up to 4 PCBs with special PCB feet. Sizes from 50x50x100 to 75x200x125. Prices from £1.47. Supplier C.



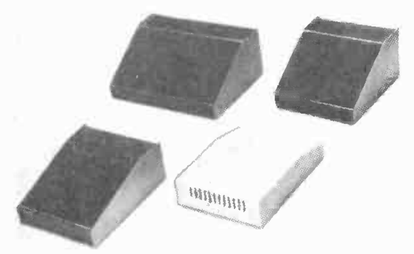
Alfa range plastic cases in 3 sizes. Aluminium panel front & rear. Sizes from 173x130x35 to 173x130x70 with prices from £3.46. Supplier B.



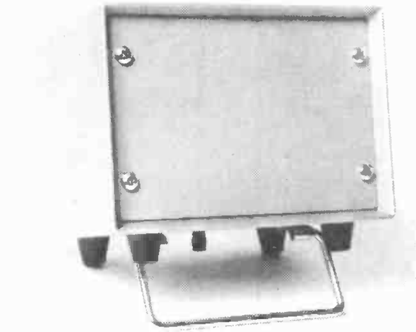
A range ot cases in two colours. Plastic with aluminium front & rear panels with provision for tilt leg. Sizes from 85x40x154 at £2.76. Supplier G.



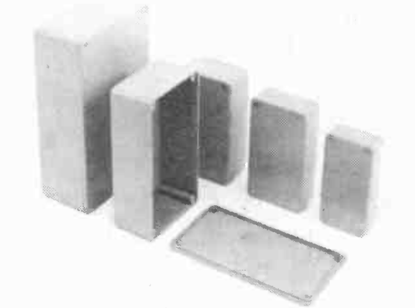
16 SWG aluminium case, silver hammer finish (type W). 4 sizes from 203x152x152 to 381x228x203 with prices from £4.55. Supplier A.



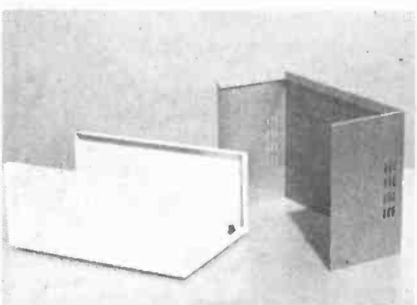
7000 series consoles of all-metal or ABS/metal construction with sizes from 102x28x140 to 356x33x287. Prices from £10.18. Supplier F.



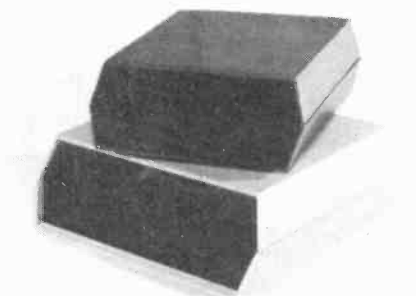
Minicases in mild zinc coated steel sheets with hammertone finish. Sizes from 165x114x114. Supplier E.



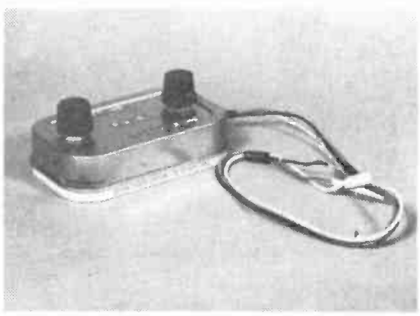
2000 range of boxes in ABS moulded in four colours with slotted guides for 1.5mm PCBs. 5 sizes from 100x50x25 from £1.03. Supplier F.



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

B

Watford Electronics
33 Cardiff Road
Watford, Herts.

C

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

D

Amatek
22 Bardsley Lane
Greenwich, London SE10

E

Olson Electronics Ltd
5-7 Long Street,
London E2 8HJ

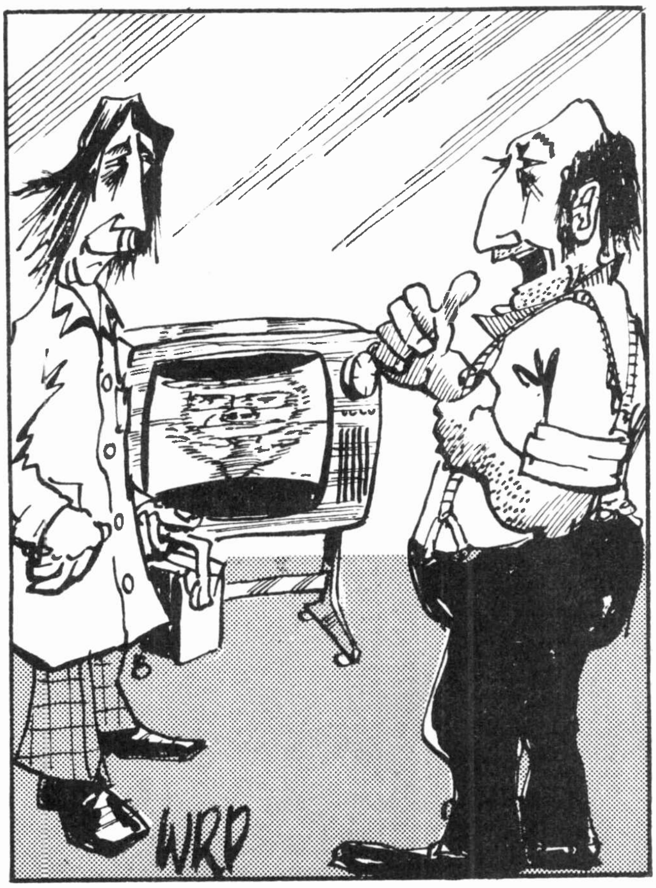
F

Boss Industrial Mouldings
2 Herne Hill Road
London SE24 0AU

G

Vero Electronics Ltd
Industrial Estate
Chandlers Ford
Hampshire SO5 3ZR

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?!!

"STOP PRESS" NEW LOW PRICES

CHROMASONIC electronics

56 Fortis Green Road
Muswell Hill London N10 3HN
Telephone 01-883 3705

TRANSFORMERS

6–0–6V	100mA	1·00*
9–0–9V	75mA	1·00*
12–0–12V	100mA	1·15*
0–9–17V	1A	2·15*
0–9–17V	2A	3·25*
0–9–17V	4A	4·35*
20–0–20V+	1A	3·25*
24–0–24V	500mA	2·15*
0–19–25–33–40–50V+	½A	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 +

HEATSINKS

TO 92	7p*	TO 5 (5F)	9p*
TV 2	25p*	TO 18 (18F)	11p*
TV 3	26p*	U1 (TBA800)	10p*
TV 4	26p*	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 (For 1xTDA2020)	1.49*	3·15 E-19 (For 2xTDA2020)	1.68*

Transistor Covers
TO66 and TO3 12p*

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	1·65	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

BRIDGES

1A 50V	25p	1A 400V	30p	2A 50V	40p
1A 100V	25p	1A 600V	35p	2A 100V	45p
1A 200V	25p	1A 100V	40p	2A 200V	50p

ZENERS

BZY88	400mw 2·7v–33v	10p
1ZS	1w 3·6v–100v	20p

LIGHT EMITTING DIODES

0·125" (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*
0·2" (inc. Clip)			
TIL220 Red	15p*	13p*	11p*
TIL224 Yellow(H.B.)	30p*	28p*	20p*
TIL228 Red (H.B.)	30p*	28p*	20p*
TIL234 Green (H.B.)	30p*	28p*	20p*

(H.B.)—High Brightness.

I.C. SOCKETS

8 pin	10p*	16 pin	14p*	28 pin	30p*
14 pin	12p*	24 pin	20p*	40 pin	44p*
I.C. pins		100	54p*	1,000	£3·78*

POLYESTER CAPACITORS

Mullard C280 Series 250vw

0·01µf	5p	0·068µf	6p	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	9p	2·2µf	40p

Mullard C281 Series 400vw

0·01µf	10p	0·068µf	15p	0·47µf	33p
0·015µf	10p	0·10µf	18p		
0·022µf	10p	0·15µf	18p		
0·033µf	12p	0·22µf	25p		
0·047µf	15p	0·33µf	30p		

CERAMIC CAPACITORS

Mullard 632 Series			Mullard 630 Series	
1·8pf	10pf	56pf	390pf	1500pf
2·2pf	12pf	68pf	470pf	1800pf
2·7pf	15pf	82pf	560pf	2200pf
3·3pf	18pf	100pf	680pf	2700pf
3·9pf	22pf	120pf	820pf	3300pf
4·7pf	27pf	150pf	1000pf	3900pf
5·6pf	33pf	180pf	1200pf	4700pf
6·8pf	39pf	220pf		
8·2pf	47pf	270pf		
		330pf		

6p each

Mullard 629 Series
0·01uf 0·022uf

T.T.L.

Just a selection. Send for full list

7400	18p*	7430	18p*	7474	27p*	74121	27p*
7401	18p*	7441	58p*	7475	40p*	74123	49p*
7402	18p*	7442	52p*	7476	30p*	74141	65p*
7403	18p*	7445	70p*	7485	78p*	74145	85p*
7404	17p*	7447	59p*	7486	27p*	74151	49p*
7408	19p*	7448	65p*	7489	2·32*	74154	85p*
7410	18p*	7451	18p*	7490	38p*	74174	72p*
7413	27p*	7470	27p*	7492	41p*	74192	86p*
7420	18p*	7472	22p*	7493	41p*	74193	86p*
7427	28p*	7473	27p*	74107	27p*	74196	79p*

PLUGS AND SOCKETS

DIN Connectors

Pins	Plugs	Sockets	Line Couplers
2	14p	10p	18p
3	14p	10p	18p
4	14p	10p	18p
5 (180)	16p	10p	18p
5 (240)	14p	10p	18p
6	14p	10p	18p
7	14p	10p	18p

C.Mos

4000	18p*	4014	1·00*	4024	78p*	4051	86p*
4001	18p*	4015	97p*	4025	19p*	4052	88p*
4002	18p*	4016	53p*	4026	1·78*	4060	1·16*
4006	1·09*	4017	97p*	4027	58p*	4068	22p*
4007	19p*	4018	97p*	4028	87p*	4070	22p*
4009	62p*	4019	58p*	4029	1·18*	4071	22p*
4010	62p*	4020	1·08*	4040	1·68*	4081	22p*
4011	18p*	4021	97p*	4042	83p*	4082	22p*
4012	21p*	4022	86p*	4049	58p*	4510	1·24*
4013	58p*	4023	19p*	4050	58p*	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	6p each
56pf	560pf	5600pf	
68pf	680pf	6800pf	
82pf	820pf	8200pf	

JACK CONNECTORS

Type	Plugs Plastic	Plugs Chrome	Sockets
2·5mm	15p	25p	12p
3·5mm	15p	25p	12p
Mono	—	30p	20p
Stereo	—	37p	25p

PHONO Connectors

Plugs		Sockets			
Plastic Moulded	10p	1 way	8p	3 way	12p
Chrome Screened	15p	2 way	12p	4 way	14p

CO-AXIAL Connectors

Plug	Surface Socket	Coupler
16p	16p	43p

LINEAR INTEGRATED CIRCUITS

uA703 (TO99)	£1·00	LM370N	£2·75	SL415A	£2·47
uA709 (8 pin DIL)	41p	LM371	£1·75	SL440A	£2·38*
uA709 (14 pin DIL)	41p	LM372N	£1·75	SN75491N	85p*
uA709 (TO99)	50p	LM373N	£2·99	SN75492N	£1·15*
uA710 (8 pin DIL)	50p	LM337N	£1·95	SN76001N	£1·40
uA710 (14 pin DIL)	55p	LM380N-8	£1·00	SN76003N	£2·45
uA710 (TO99)	60p	LM380N	99p	SN76013N	£1·60
uA711 (14 pin DIL)	90p	LM381N	£1·75	SN76023N	£1·60
uA711 (TO99)	98p	LM382N	£1·35	SN76033N	£2·45
uA741 (8 pin DIL)	25p	LM3900N	65p	SN76544N	£1·55
uA741 (14 pin DIL)	42p	LM3905N	£1·50*	SN76532N	£1·55
uA741 (TO99)	45p	LM3909N	70p*	SN76552N	65p
uA747 (14 pin DIL)	90p	MC1303/LM1303N	£1·10	SN76666N	£1·00
uA748 (8 pin DIL)	42p	MC1310P	£1·80	SN76660N	65p
uA748 (14 pin DIL)	60p	MC1312P	£2·15	TAA263	£2·50
uA748 (TO99)	65p	MC1314P	£3·50	TAA320A	75p
uA753 (8 pin DIL)	£1·95	MC1315P	£6·10	TAA350A	£2·70
AY-1-0212	£6·50	MC1327P/TDA1327	£1·50	TAA570	£2·50
AY-1-5051	£1·65			TBA120S	£1·00
AY-5-1224A	£3·39*	MC1330P	£1·15	TBA231	£1·00
AY-5-3507	£5·99*	MC1350P	£1·00	TBA520Q	£2·00
AY-5-4007	£7·99*	MC1351P	£1·00	TBA530Q	£2·00
CA3045	£1·50	MC1352P/		TBA540Q	£2·00
CA3046	80p	TDA1352	£1·20	TBA550Q	£2·00
CA3053	85p	MC1357P/		TBA651	£2·25
CA3075	£2·00	LM2111N	£1·70	TBA750Q	£2·00
CA3080	80p	MC1375P	£1·50	TBA800	£1·00
CA3081	£1·50	MC1456CG	£2·50	TBA810S/AS	£1.10
CA3082	£1·50	MC1495L	£4·90	TBA820	£1.00
CA3089/TDA1200	£2·30	MC3302P	£1·65	TBA990Q	£2·00
CA3090Q	£4·25	MFC6030A	£1·00	TCA730	£4·69
CA3123E/LM1820	£1·50	NE540L	£2·25	TCA740	£4·69
CA3097E	£1·75	NE546	£2·15	TCA940	£1·75
CA3130S	99p*	NE555	35p*	TDA2020	£3·50
CA3140S	99p	NE556	90p*	ZN414	£1·10
CA3160S	£1·60	NE560	£4·40*	ZN417E	£1·65
CA3600E	£1·75	NE561	£4·40*	ZN423T	£1·08*
LM301AN (8 pin)	40p	NE562	£4·40*	ZN424E	£1·35
LM301AT (TO99)	50p	NE565	£1·40*	ZN425E	£3·78*
LM308N (8 pin)	90p	NE566	£1·65*	ZN1034E	£2·03*
LM308T (TO99)	£1·40	NE567	£1·85*	ZN1040E	£8·43*
LM339N	£1·00	SL414A	£1·90	ZNA116E	£8·75*

SILVER MICA CAPACITORS

2·2pf	10p	68pf	10p	500pf	15p
3·3pf	10p	75pf	10p	560pf	15p
5pf	10p	82pf	10p	680pf	15p
10pf	10p	100pf	10p	820pf	15p
18pf	10p	120pf	10p	1000pf	20p
20pf	10p	150pf	10p	1500pf	20p
22pf	10p	180pf	10p	1800pf	20p
25pf	10p	200pf	10p	2200pf	20p
27pf	10p	220pf	10p	2700pf	30p
30pf	10p	250pf	10p	3600pf	30p
33pf	10p	270pf	10p	4700pf	30p
39pf	10p	300pf	15p	5000pf	30p
47pf	10p	330pf	15p	6800pf	40p
50pf	10p	390pf	15p	8200pf	40p
56pf	10p	470pf	15p	0·01µf	40p

SWITCHES

D.P.D.T. toggle	·50p*
S.P.S.T. toggle	·30p*
D.P.D.T. Slide	·18p*
D.P.D.T. Slide Miniature	·15p*
Push to Make Miniature	·18p*

MYLAR CAPACITORS

1000pf	5p	0·04µf	8p
2000pf	5p	0·047µf	8p
2200pf	5p	0·05µf	8p
4700pf	5p	0·068µf	9p
5000pf	5p	0·1µf	10p
0·01µf	8p	0.2µf	12p
0·02µf	7p	0.22µf	12p
0.022µf	7p		
0.03µf	8p		

RESISTORS

Type	Range	
¼ watt 5% Carbon film	E12 Series 10R-1M	2p each
½ watt 5% Carbon film	E24 Series 3·3R-10M	2p ea.
1 watt 5% Carbon film	E12 Series 10R-1M	5p each

TANTALUM BEAD CAPACITORS

0·1µf	35v	15p	10µf	25v	20p
0·22µf	35v	15p	10µf	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	100µf	6·3v	25p
10µf	16v	17p	100µf	10v	34p

POTENTIOMETERS

5K 250K, 10K 500K, 25K 1M, 50K 2M, 100K:
- Lin and Log less Switch (inc. IK Lin) ·27p
- Lin and Log Dual less Switch ·75p
- Lin and Log with Switch ·60p
- 10K, 100K, 500K, 1M Dual log with Switch ·75p

10K Log + 10K Antilde less Switch ·75p

CAR ALARM

Car Alarm and Immobiliser Unit. Easy to fit. Excellent Anti-Theft Device.
Send for Free Leaflet. Price £17·27.

PRESETS

100R	5K	250K	·1 watt
250R	10K	500K	Horizontal
500R	25K	1M	and
1K	50K	2·5M	Vertical
2·5K	100K	5M	7p each

SUPERSAVER

TIMER 5 5 5
4 for £1.00
28p each

OUR NEW A4 I.C. BOOKLET
Supplied FREE with orders of any I.C.'s worth £4 00 or more. Contains Circuits, pin connections & Data. (35p inc. P&P if sold alone).

REGULATORS

723 Variable		45p*
78L05AWC	5V	65p*
78L12AWC	12V	65p*
78L15AWC	15V	65p*
7805KC	5V	2·17*
7812KC	12V	2·17*
7815KC	15V	2·17*
7805UC	5V	1·25*
7812UC	12V	1·25*
7815UC	15V	1·25*
7818UC	18V	1·25*
7824UC	24V	1·25*
L005T1	5V	1·50*
L036T1	12V	1·50*
L037T1	15V	1·50*
L129	5V	85p*
L130	12V	85p*
L131	15V	85p*
TBA625A	5V	1·25*
TBA625B	12V	1·25*
TBA625C	15V	1·25*
LM309K	5V	1·50*
Negative		
7905UC	5V	1·25*
7912UC	10V	1·25*
7915UC	15V	1·25*
7918UC	18V	1·58*
7924UC	24V	1·25*

TRANSISTORS

AC126	20p*	BC558	15p	MPF104	40p	2N1302	45p*
AC127	20p*	BC559	15p	MPF105	40p	2N1304	45p*
AC128	20p*	BC547	15p	MPSA05	25p	2N1305	30p*
AC176	20p*	BC548	15p	MPSA06	25p	2N1306	45p*
AC187K	35p*	BC549	15p	MPSA55	30p	2N1308	30p*
AC188K	35p*	BCY70	18p*	MPSA56	30p	2N1309	45p*
AD161	45p*	BCY71	18p*	MPSU05	50p	2N1711	25p
AD162	45p*	BCY72	18p*	MPSU06	55p	2N1893	35p
BC107	10p*	BD131	50p*	MPSU55	55p	2N2646	50p*
BC108	10p*	BD132	50p*	MPSU56	60p	2N2925	10p
BC109	10p*	BD135	40p	TIP31A	55p*	2N2926G	10p
BC147	9p	BD136	40p	TIP32A	60p*	2N3053	22p*
BC148	9p	BD139	40p	TIP41A	65p*	2N3054	55p*
BC149	10p	BD140	40p	TIP42A	75p*	2N3055	60p*
BC157	11p	BD239C	35p*	TIS43	40p*	2N3442	1·50
BC158	11p	BF180	35p*	TIS91	25p	2N3702	11p
BC159	11p	BF181	35p*	ZTX107	12p	2N3703	11p
BC169C	12p	BF184	25p*	ZTX108	12p	2N3704	11p
BC177	18p*	BF185	25p*	ZTX109	12p	2N3705	11p
BC178	18p*	BF194	12p	ZTX300	15p	2N3706	11p
BC179	18p*	BF195	12p	ZTX301	15p	2N3708	12p
BC182L	11p	BF196	12p	ZTX302	17p	2N3709	12p
BC183L	11p	BF197	12p	ZTX303	20p	2N3710	12p
BC184L	11p	BF200	35p	ZTX311	15p	2N3711	12p
BC212L	11p	BF244B	35p	ZTX312	17p	2N3772	1·50*
BC213L	11p	BFY50	20p*	ZTX341	20p	2N3819	25p
BC214L	11p	BFY51	20p*	ZTX500	15p	2N3904	20p
BC441	35p	BRY39	50p*	ZTX501	17p	2N3906	20p
BC461	35p	MJ2955	1·20*	ZTX502	17p	2N5447	18p
BC477	25p	MJ3055	1·20*	ZTX503	20p	2N5449	19p
BC478	25p	MJE340	50p	ZTX504	25p	2N5777	50p*
BC479	25p	MPF102	40p	ZTX531	25p	3N141	1·00
BC557	15p	MPF103	40p	ZTX550	17p	40673	75p*

ELECTROLYTIC CAPACITORS

uf	V6·3	10	16	25	40	63
1	—	—	—	—	—	7p
1·5	—	—	—	—	—	7p
2·2	—	—	—	—	—	7p
3·3	—	—	—	—	—	7p
4·7	—	7p	—	7p	—	7p
6·8	—	—	—	—	7p	7p
10	—	—	—	7p	—	7p
15	—	—	—	—	7p	8p
22	7p	7p	7p	7p	7p	8p
33	—	—	7p	—	7p	—
47	7p	7p	—	7p	7p	12p
68	7p	—	7p	8p	—	—
100	—	—	7p	8p	12p	25p
150	—	—	7p	8p	12p	25p
220	—	8p	8p	12p	15p	25p
330	—	8p	8p	—	—	30p
470	—	15p	—	25p	30p	35p
680	—	15p	20p	25p	30p	—
1000	15p	15p	30p	25p	40p	65p
1500	—	—	25p	—	—	—
2200	—	30p	35p	45p	70p	90p
4700	—	35p	—	55p	80p	95p

VAT INCLUSIVE PRICES

Postage and Packing 25p
Items followed by a * include VAT @ 8%, all others include 12½%. Always pleased to see personal callers.
Trade and Export Customers most welcome. Overseas Customers deduct 2/27 from items marked with a*, 1/9 from others

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

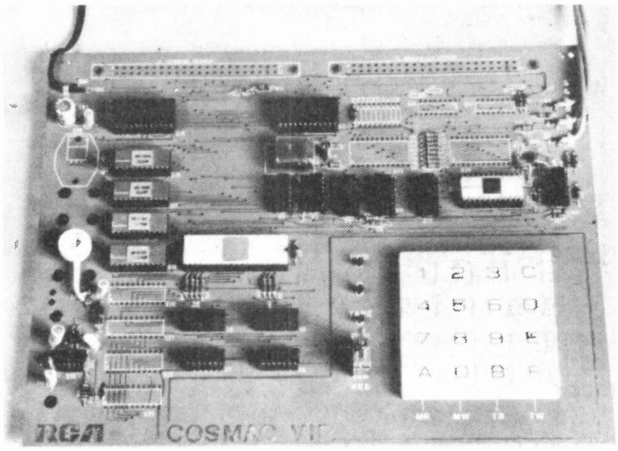
The COSMAC VIP (Video Interface Processor) pictured is a new computer kit from RCA.

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.

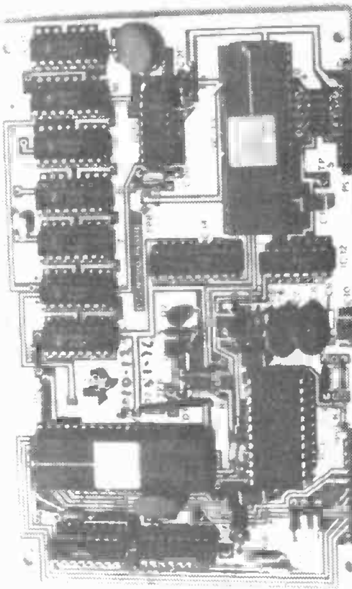
The response to my offer to provide a BASIC listing of a game program last month has been overwhelming.

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.

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. Facilites include seven colours, upper and lower case alphanumerics, 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.

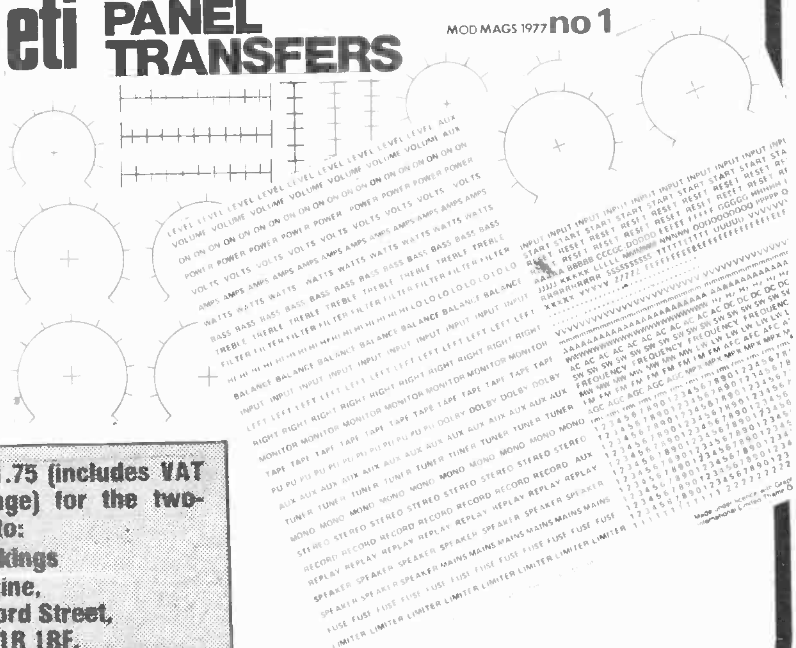
videocraft

29-31 Goswell Road
London EC1.
01-251 0391/2/3
Telex: 896953

WE'RE OUT TO FINISH YOU OFF!

Rapitype

eti PANEL TRANSFERS



GOOD AND PROPER!

. . . . or at least your projects. If there is one thing which is impossible to do at home is lettering front panels to professional standards. At least until now. If you cast your eyes right a while you'll see our new panel transfers sheet, which has been carefully designed to allow you to do exactly that.

The transfers are easily rubbed down, and the two sheet set contains a mass of lettering and —uniquely—control scales for both rotary and slider puts.

Each sheet measures 180mm X 240mm and comes packed flat in a stiff cardboard envelope for protection. There should be enough for dozens of projects here - and the longer you wait the worse they'll look!

Send £1.75 (includes VAT and postage) for the two-sheet set to:
Panel Markings
ETI Magazine,
25-27 Oxford Street,
London W1R 1RF.

AIRAMCO LTD.
OPENING SALE

741 op Amp MDIP	20
380 2W Audio Amp DIP	80*
381N Low Noise Dual pre amp DIP	1.45*
555 Timer mDIP	29
556A Dual 555 Timer DIP	85
8038 Volt Controlled Sig Gen DIP 14	3.50

AY51013A UART	5.25
2102 1024 x 1 RAM	1.55
1702A 256 x 8 EPROM	6.25
2708A 1024 x 8 EPROM	10.90
8080A CPU	9.90
8008A CPU	9.90

MM5312 12 Clock 4 digit, MPX, BCD, 7 seg 12/24 hr. 50/60 Hz. 24 pin	5.05
MM5314 Clock 6 digit MPX. 12/24 hr. 50/60 Hz. 24 pin	3.99
MM5316 Clock 5 digit + Alarm. 12/24 hr. 50/60 Hz. 40 pin	6.99
16 pin Skt	16
24 pin Skt	35

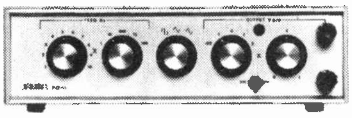
Discounts for quantities over 100 .. **P.O.A.**

Trade enquiries and orders welcome. Add 12½% VAT to items marked* Add 8% VAT to all oters P&P Add 40p Mail order only Facilities for Access and Barclaycard

24 Ansaphone ordering service with access or Barclaycard NO.

AIRAMCO LTD.
30 Witches Linn
Ardrossan, Ayrshire
0294 65530

JAYEN
FG-1



BUILD THIS ADVANCED DESIGN FUNCTION GENERATOR

★ **Designed around 8038 Waveform Generator I.C.**

★ **DC Coupled Amplifier**

★ **1 Hz to 100 kHz**

★ **Sine, Triangle and Square Wave output**

JAYEN Developments, 25 Westgate, Louth, Lincs LN11 9YQ.

Please send a JAYEN FG-1 PC board complete with instructions, photo anodised Front Panel and Component Shopping List at £3.85 incl VAT and P&P

Name ____________________

Address ____________________

____

Save on Calculators

TEXAS

T15040 (print, display, 10 digits, mem, printing calc)	£85.95
PC100A (Print Cradle for T1 prog. calculators)	£174.12
SR51-11 (3 memories/stats. engineering notation)	£32.35
T145 Scientific Green Display 15 sets of ()'s	£24.00
T133 (15 bracket levels **£15.00.** RK3 (Rech Kit)	£8.44
T157 (Key Prog. 150 Prog. steps 8 Mems)	£39.42
T158 (480 Prog. steps/60 mem.)	£79.92
T159 (960 Prog. steps/100 mem.)	POA
Software for T159 & 58 (each) (four available)	£25.00
TI Programmer	£50.40

CASIO

*PROFXI (Mag. card prog. 11 memories. 127 steps)	POA
*FX201P (Key programmable, 127 steps, 11 memories)	£49.95
FX2200 (6 + 2, scientific/fraction, LCD, 1000 hours)	£19.95
FX120 (10 dig full sci + 6 brkts + Polar/rect cordinates Permutations + combinations	£19.95
J3 (12 Digit with Delta%)	£24.95
FX31 (29 sci./fractions inc. degree, rad and grad)	£13.95
FX3000 (L.C.D. full sci + 2 brkts + rect./polr + %)	£25.95
ST-1 (4-way Stopwatch function & %)	£24.95
MQ1 (L.C.D. Clock, Calendar, Stopwatch & Calc.)	£34.95
MQ2 (L.C.D. Clock, two Alarms, Calendar, Calc.)	£34.95
CQ1 (Clock + Calculator + Stopwatch)	£29.89
CQ2 (Larger Clock, Calculator, Stopwatch)	SAE
AQ810 (L.C.D. Calc., Timer Clock, Alarm)	£19.95
Casio 31CS 10B L.C.D. watch	£59.95
●*Free mains adaptor* CQ1 or CQ2 ADAPTOR	£3.00

HEWLETT PACKARD

HP 19C (cont. mem., prog., sci. printer)	£203.32
H.P. 21 (8 + 2 Scientific, R.P.N.)	£52.95
H.P.22 Business/Management Calculator	£80.64
H.P.25 (49 prog. steps, 8 mems, engineering notation)	£80.64
H.P. 25C (Continuous memory programmable scientific)	£106.95
H.P. 29C (new combo H.P. 27 + H.P. 25C)	£123.83
H.P. 67 (Mag card programmable, 224 steps)	£287.04
H.P. 97 (Mag card prog. with LED display & Printer)	£437.06

CBM

4190R (90 functions 10 + 2)	£28.40
PRO100 (8 + key prog. 72 steps, 10 memories)	£37.80
M55 (Maths) S61 (Stats) N.60 (Navigator)	£68.50
LC5KI (L.C.D., 5,000hr bat life)	£11.38
LC43SR Scientific 1,000hrs	£21.95
SINCLAIR MICROVISION TV in stock	POA
SHARP EL8 130, LCD musical calc. — great, no keys	£19.94
EL8029 L.C.D. Folding Pen type Calculator with clip	£21.95
CT550 L.C.D. Clock Calc. 24 time zones (Alarm)	SAE

Basic Chess Challenger at £99.95 (20,000 moves).
Master Chess Challenger POA (60,000 moves).
Gamma Master II (Computer backgammon) **£175.**

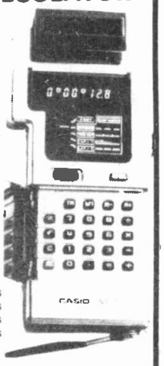
NEW FROM SINCLAIR
A 36 Step Programmable Scientific

ONLY **£13.92** inc. VAT

Full algebraic functions plus 1 x ½x, x/-, sin, cos, tan, arc, rads/degrees in and ex.
PLUS 36 STEPS OF PROGRAMMING WITH CONDITIONAL BRANCHING
AC Adaptor **£2.95**
Full set Program Library only **£4.92** + 54p P&P if bought separately

ELECTRONIC STOPWATCH CALCULATOR

£24.90



SPECIFICATIONS
STOPWATCH
Measuring capacity:
9 hours 59 minutes 59.9 seconds (after 10 hours, it reverts to 0 again)
Timing unit
1/10th of a second
Types of measurement:
Normal time
Net time
Two kinds of Lap times
Read-out
Digital display of hours, minutes, seconds, fraction of a second.
CALCULATOR
Operation:
Four basic functions, chain and mixed operations, constant calculation for four functions, automatic accumulation in four functions, direct access to the memory, percentage calculations including add-ons/discounts and mark-ups, square roots, powers, reciprocals, time calculations, and various kinds of practical calculations.
Capacity:

Four basic functions	8 digits
Accumulation into the memory	8 digits
Square root	7 digits
Time calculation	Max. 2 digits (hour); 2 digits (minute and second); 1 digit (fraction of a second)

12 FUNCTION CHRONOGRAPH
LCD

Hours, mins, secs, day, month, chrono stopwatch. Backlight, mineral glass, water resist, chrono timing to 1/100th. Lap time to max of 59.59.99 (but function still continued). Stainless steel bracelet and case.
ONE OF THE MOST ACCURATE LCD WATCHES ON SALE IN THE UK

NE6290/18

£38.00 inc. VAT, P&P

The New MQ2, the tiny alarm clock, timer, calculator with day, date, year, valid 'till past 2000 A.D. a.m./p.m. hour, minute, 2 alarm clock settings. Time zone memory **and** full function calculator with % all in a tiny ⅜" + 4⅝" × 1⅜" case with 18 month (approx) battery life for only **£34.90.**

WE SUPPLY ALL SIEKO WATCHES
We accept govt./company purchase orders on all goods

KRAMER & CO

9 October Place, Holders Hill Road, London NW14 1EJ.
Telex: 888941. ATTN. KRAMER, K7. Tel. 01-203 2473
MAIL ORDER ONLY. S.A.E. for data sheets
Export enquiries welcome

ETCH RESIST TRANSFER KIT SIZE 1:1

Complete kit 13 sheets 6in x 4½in **£2.50** with all symbols for direct application to P.C. board. Individual sheets 25p each. (1) Mixed Symbols (2) Lines 0.05 (3) Pads (4) Fish Plates and Connectors (5) 4 Lead and 3 Lead and Pads (6) DILS (7) BENDS 90° and 130° (8) 8—10—12 T.O.5. Cans (9) Edge Connectors 0.15 (10) Edge Connectors 0.1 (11) Lines 0.02 (12) Bends 0.02 (13) Quad in Line.

FRONT AND REAR PANEL TRANSFER SIGNS

All standard symbols and wording. Over 250 symbols, signs and words. Also available in reverse for perspex, etc. Choice of colours, red, blue, black, or white. Size of sheet 12in x 9in. Price **£1.**

GRAPHIC TRANSFERS WITH SPACER ACCESSORIES

Available also in reverse lettering, colours red, blue, black or white. Each sheet 12in. x 9in contains capitals, lower case and numerals ⅛in kit or ¼in kit. **£1** complete. State size.

All orders dispatched promptly. All post and VAT paid

Ex U.K. add 50p for air mail
Shop and Trade enquiries welcome
Special Transfers made to order

E. R. NICHOLLS
P.C.B. TRANSFERS
DEPT. PE/10
46 LOWFIELD ROAD
STOCKPORT, CHES.061-480 2179

1N4148 Diodes by ITT/TEXAS
100 for £1.50

TEXAS TIS 88A VHF FET 10 for £2.30
100 for £20.00

7410	10 for £1.00	Special
7412	10 for £1.50	offer
7420	10 for £1.00	
7430	10 for £1.00	LEDs 0.125"
7432	10 for £2.00	or
7442	10 for £3.50	
7474	10 for £2.00	0.2" red
7476	10 for £2.50	
7483	10 for £7.00	100 for
7493	10 for £2.50	
7496	10 for £4.50	£9.00
74107	10 for £2.00	
74121	10 for £2.50	1000 for
74153	10 for £4.00	
74161	10 for £8.00	£60.00

Ring for devices not listed

555 10 for £2.80 | 741 10 for £2.00

MULLARD 0.01 uf C280 100 for £2.50

1200μF	63v 2 for £1.00	BTY87	
2200	63v 2 for £1.50	100R	£1.00
3300	63v 2 for £1.60	100V 8.5A	each

BD607/608 Comp Power £1.50 pair

RCA, SCR TO3 case 100v 12.5A
£2.00 each

2102/4L RAM @ **£1.60** each	4 for **£6.00** 8 for **£11.60**

BF257 10 for £1.50

Prices include Post and VAT

XEROZA RADIO

306 ST PAUL'S ROAD
HIGHBURY CORNER, LONDON N1
TEL: 01-226 1489

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.

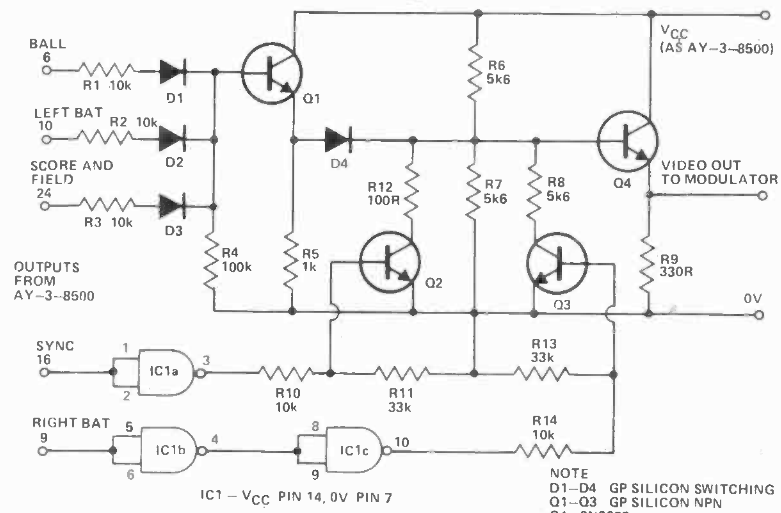
The modifications are shown below. The output on Q2 emitter spends the majority of the time at a "grey" level, and this "grey" voltage is defined at the junction of R6 and R7.

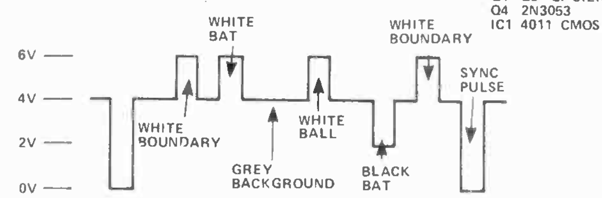
The three signals from the 8500 requiring a white output are Ball (pin 6), left player (pin 10) and the score and field (pin 24). These are "Or'ed" together by Q1 to produce a white level defined by the ratio of R1-R3 and R4. The white level on Q1 takes the output on Q1 to white via diode D4.

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, OV.

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.



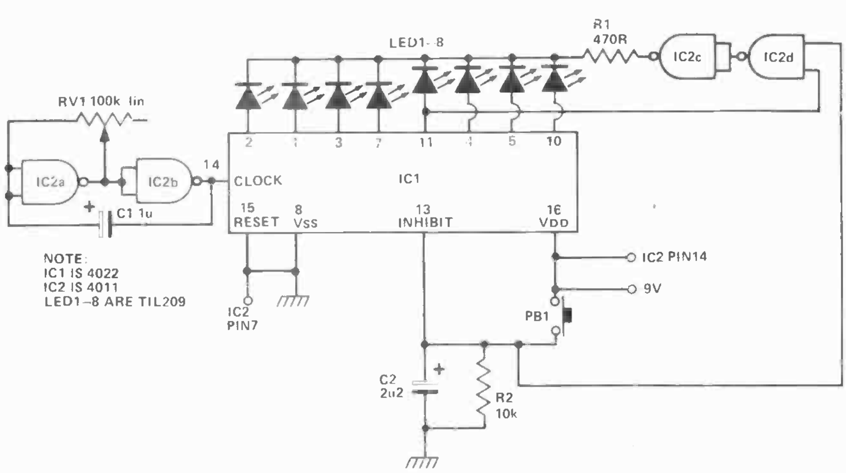


WAVEFORMS (LINE SCAN)

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 PBI 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.

GREENWELD

443 Millbrook Road Southampton
SO1 OHX Tel:(0703) 772501

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

Our retail shops at **21 Deptford Broadway, London, SE8 (01-692 2009) and 38 Lower Addiscombe Road, Croydon (01-688 2950)** stock some of the advertised goods for personal callers only. Ring them for details.

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

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

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

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

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

K001 50V ceramic plate capacitors. 5%. 10 of each value 22pF to 1000pF. Total 210. **£3.35.**

K002. Extended range, 22pF to 0.1μF. 330 values. **£4.90.**

K003. Polyester capacitors. 10 each of these values: 0.01, 0.015, 0.022, 0.033, 0.047, 0.068, 0.1, 0.15, 0.22, 0.33, 0.47μF. 110 altogether for **£4.75**

K004 Mylar capacitors, min 100V type. 10 each all values from 1000pF to 10,000pF. Total 130 for **£3.75**

K005. Polystyrene capacitors, 10 each value from 10pF to 10,000pF. E12 series 5% 160V. Total 370 for **£12.30**

K006 Tantalum bead capacitors. 10 each of the following: 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1, 2.2, 3.3, 4.7, 6.8, all 35V; 10/25 15/16 22/16 33/10 47/6 100/3. Total 170 tants for **£14.20**

K007 Electrolytic capacitors 25V working, small physical size. 10 each of these popular values: 1, 2.2, 4.7, 10, 22, 47, 100μF. Total 70 for **£3.50**

K008 Extended range, as above, also including 220, 470 and 1000μF. Total 100 for **£5.90**

K009. Extended mylar pack. Contains all values from 1000pF to 0.47μF total 290 capacitors to **£11.25.**

K021 Miniature carbon film 5% resistors, CR25 or similar. 10 of each value from 10R to 1M. E12 series. Total 610 resistors, **£6.00**

K022 Extended range, total 850 resistors from 1R to 10M **£8.30**

K041 Zener diodes, 400mW 5% BZY88 etc. 10 of each value from 27V to 36V, E24 series. Total 280 for **£15.30**

K042 As above but 5 of each value **£8.70**

VEROBOARD

Our packs of vero offcuts are one of our biggest sellers — and no wonder, they are amazing value!! Each pack contains 7 or 8 pieces to make up a total area of 100 sq. ins. All packs are the same price, **£1.30 each** and are available as follows:
Pack A, all 0.1" pitch
Pack B, all 0.15" pitch
Pack C, mixed 0.1 & 0.15"
Pack D, all 0.1" plain
Also available by weight: 1lb **£3.95** 10lbs **£32.50**
Regular size vero:
17x3¾x0.1" **£2.00**, 10 strips **£15**
17x3¾x0.15 **£1.76**; 0.1" plain **£1.63**

DIP Breadboard, size 6.15x4.5", can accomodate 20 x 14 pin IC's **£2.35**

VQ Board, size 148 x 75mm 0.1" pitch. Copper strips in rows of 4 to facilitate construction with IC's. Layout sheet provided **85p**

VERO PINS AND TOOL

Spot face cutter for 0.1 or 0.15 pitch **75p**
0.1" pins single sided **30p**/100
0.1" pins double sided **35p**/100
0.15" pins single sided **30p**/100
0.15" pins double sided **35p**/100

VEROCASES

Plastic top and bottom, ally panels front and back.

1237	154x85x40	**£2.53**
1238	154x85x60	**£2.79**
1239	154x85x80	**£3.32**
3007	180×120×40	**£3.30**
3008	180×120×65	**£3.50**
3009	180×120×90	**£3.74**
1410	205x140x40	**£3.51**
1411	205x140x75	**£4.05**
1412	205x140x110	**£5.12**

VERO PLASTIC BOXES

Professional quality two tone grey polystyrene with threaded inserts for mounting PC boards

2518	120x65x40	**£2.17**
2520	150x80x50	**£2.45**
2522	188x110x60	**£3.23**

SLOPING FRONT BOXES

1798	171x121x75/37.5	**£4.19**
2523	220x174x100/53	**£6.90**

Potting box, 71x49x24mm black or white **40p**
Hand controller box 94x61x23mm White **64p**

SEMICONDUCTORS

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

400mW Zeners 2V 7 to 36V, **10p** each. 1.3W Zeners 3V3-200V, **20p.** 10 watt zeners from 4V3 to 200V **93p.** OA81, **5p;** OA91, **8p;** 1N4148, **4p.**

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

SCR's

0.8A	60V	TO92	**35p**
1A	400V	TO5	**60p**
4A	200V	TO220	**52p**
4A	400V	TO220	**70p**
6A	200V	TO220	**56p**
6A	400V	TO220	**75p**
6A	400V	TO66	**80p**
10A	100V	TO220	**82p**
10A	200V	TO220	**87p**
10A	400V	TO220	**120p**
10A	600V	TO220	**148p**
Triacs			
6A	400V	TO220	**98p**
8A	600V	TO220	**135p**
15A	200V	Stud	**135p**
15A	400V	Stud	**220p**

TRANSISTORS

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

74 Series TTL

7400	**12p**	7447	**84p**	74107	**37p**
7401	**14p**	7450	**15p**	74121	**36p**
7402	**14p**	7451	**14p**	74122	**51p**
7404	**17p**	7453	**14p**	74123	**64p**
7405	**23p**	7454	**14p**	74132	**56p**
7406	**28p**	7460	**14p**	74141	**63p**
7408	**14p**	7472	**29p**	74150	**173p**
7410	**14p**	7473	**29p**	74151	**79p**
7413	**28p**	7474	**29p**	74154	**144p**
7414	**62p**	7475	**51p**	74155	**73p**
7420	**14p**	7476	**29p**	74157	**66p**
7427	**36p**	7483	**91p**	74159	**200p**
7430	**14p**	7485	**132p**	74164	**126p**
7432	**28p**	7486	**40p**	74174	**110p**
7437	**36p**	7490	**46p**	74179	**120p**
7438	**36p**	7491	**75p**	74180	**120p**
7440	**15p**	7492	**52p**	74190	**188p**
7442	**65p**	7493	**52p**	74191	**158p**
7445	**88p**	7495	**73p**	74192	**120p**
7446	**88p**	7496	**85p**	74193	**120p**
				74367	**120p**

C-MOS

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

LINEAR & MISC IC's

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

DARLINGTON COMP PAIR

What an offer!! BD695A + BD696A PNP-NPN complimentary pair. Just look at the spec! — 45V 8A 70W Gain of 750 at 4A! All packed into a TO220 case. The pair for **£1.50**

EDGE CONNECTORS

High quality 0.1" pitch double sided, gold plated. Selling at less than 1/3 their original price.

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

SOLAR CELLS

These silicon chips size 19x6.5mm will give 50μA @ ½V in sunlight, and can be banked for greater power. Prices: 3 for £1; 10 for £3; 25 for £7; 100 for £25. Ideal for powering small CMOS projects, etc.

S-DECS & T-DECS

S-DEC Breadboard **225p**
T-DEC Breadboard **325p**

POWER PACK

Wood-grained metal case, 90x80x75mm containing mains transformer giving 6V @ 200mA, 2 co-ax sockets, PC board with 1¼" fuseholder R's C's, etc. **Only 75p.**

SOLDERING IRONS

Antex model C — 15W gen. purpose iron. Our best seller at **£3.50**
Antex model CCN — 15W element with ceramic shaft. Very low leakage. **£3.90**
Antex MLX12. This is a 12V iron, ideal for car and boat use. 25W rating. Comes complete with large crocodile clips fitted + booklet "How to solder" and strong PVC carrying case **£4.29**

1977/8 CATALOGUE

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

SIRENS

Use in cars, houses, anywhere that a powerful noise will frighten off would-be intruders. Uses 4 HP7 batts. Overall size 100 x 72 x 60mm. Only **£1.70.**

COMPONENT PACKS

200 miniature resistors, ⅛, ¼, ½W **£1.00**
400 assorted resistors, ¼, ½, 1W **£1.30**
200 poly, mica, ceramic capacitors **£1.20**
100 Mullard C280 polyesters, 0.01-1uF **£1.00**
150 wirewound resistors, 2-10W **£1.60.**
200 PC resistors, ¼ and ½W **60p.**
20 asstd pots, inc. sliders **£1.70.**
200 transistors, mostly unmarked, inc. power devices. About 75% useable **£1.35.**

COMPUTER PANELS

A dozen boards with top grade components — transistors, inc power types, zeners, trimpots, IC's, resistors and capacitors. Hundreds of parts for just **2.75.**

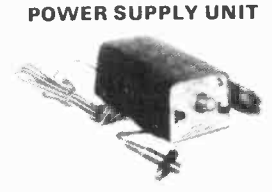
PC ETCHING KIT MkIII

This latest version of our popular kit now contains 200 sq ins copper clad board, 2 miniature drill bits, 1lb Ferric Chloride, DALO etch resist pen, abrasive cleaner, etching dish and full instructions, **£3.90.**

VOLTAGE REGULATORS

78L12	TO92	12V	150mA	75p
723	14dil	2-37V	150mA	50p
MC1469R	TO66	2½-37	500mA	150p
78M05	TO5	5V	500mA	85p
78M12	**TO5**	**12V**	**500mA**	**85p**
1405	**TO126**	**5V**	**600mA**	**85p**
1412	**TO126**	**12V**	**500mA**	**95p**
7715	**TO220**	**15V**	**750mA**	**120p**
7805	**TO220**	**5V**	**1A**	**150p**
7812	**TO220**	**12V**	**1A**	**150p**
LM309K	**TO3**	**5V**	**1.2A**	**150p**
LM323	**TO3**	**5V**	**3A**	**650p**

POWER SUPPLY UNIT



A102 standard mains input. Outputs 3, 6, 7½, or 9V DC @ 400mA max. 3 switches, on/off, polarity reversing and voltage change. Regulated to supply exact marked voltage from no load up to full current. Size 127x76x57mm. Price: **£5.95**

★ ★ ★ BULK BUYERS CORNERS ★ ★ ★

All prices per 100; all goods full spec. Send sae for current list containing hundreds of bulk offers.

1N4001	£3.20	BC157/8/9	£6.00
1N4002	£3.80	BC183	£5.00
1N4003	£4.40	BC213	£6.00
1N4004	£5.00	BFY51	£12.00
1N4005	£5.60	2N3053	£16.00
1N4006	£6.20	2N3055	£34.00
1N4007	£6.80	741 8DIL	£18.00
1N4148	£2.30	555	£28.00
AC127	£12.00	LM301	£16.00
AC128	£12.00		
AC176	£13.00		
AC187	£14.00		
AC188	£14.00		
BC107	£7.00		
BC108	£7.00		
BC109	£7.00		
BC147/8/9	£6.00		

74 series TTL less 25% for 100+ of any one type (+VAT). Tant bead caps — less 30% for 100+ of one value.

Miniature 5% Carbon Film Resistors, 1R-10M (1M2-10M are 10%) **90p**/100, **£6.20**/1,000. No mixing. Special 100 each value 1R-10M (8500) **£65;** 1,000 each value **£550.** 50V min ceramic plate caps. 22pF to 1000pF 5% **£2** per 100, **£1.75**/1,000. No mixing.

Add VAT to bulk prices

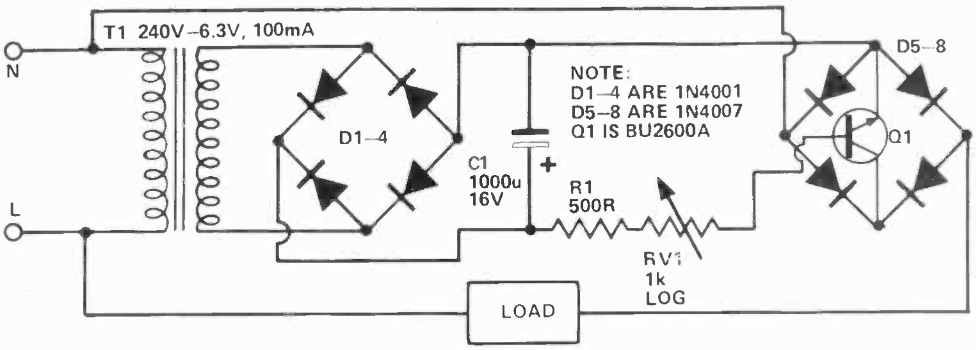
★ SPECIALS ★

1,000 off 8 pin DIL 741C op-amp by Texas — **£160.**
2N5401 60V 0.8A plastic SCR **£25**/100.
MPSA66 Darlington transistor — hfe 75,000 @ 10mA. Vce 30V. **£27**/100.

1500uF 18V PC mntg elecs. 18 x 32mm **£4**/100; **£35**/1000.
12.5uF 25V 12 x 7mm **£1**/100, **£7**/1000.
50uF 350V 27 x 38mm **£18**/100.

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.

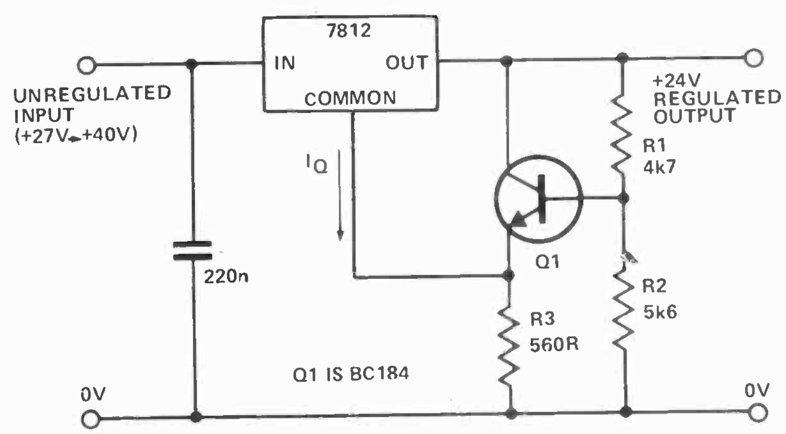
Bias to the transistor is supplied by the mains transformer and controlled by RV1. Q1 must be able to withstand peak mains voltage (—350V).

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.

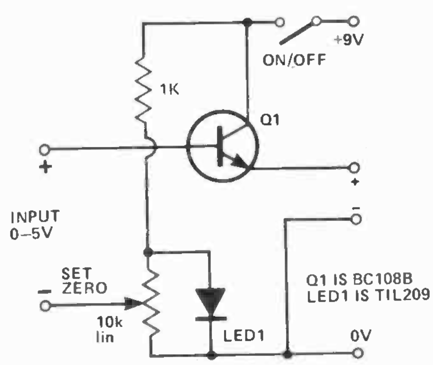


The circuit above avoids the problem by using transistor Q1 to generate a low impedence at the regulator common terminal by emitter-follower action, while transferring the voltage derived from a relatively high-resistance divider network. The value of R3 is not critical, but must be low enough to accept the highest likely quiescent current without causing Q1 to turn off.

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

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.

SEND FOR SINTEL FREE CATALOGUE

SINTEL

RESEARCH MACHINES COMPUTER SYSTEMS

AVAILABLE THROUGH SINTEL

RESEARCH MACHINES 280Z with 2k ROM Monitor 4k bytes RAM £398.00
RESEARCH MACHINES 380Z Part-Assembled, 2k ROM Monitor, 4k RAM £539.00
RESEARCH MACHINES 380Z Ready-Built, 2k ROM Monitor, with Keyboard, with 16k RAM **£1081;** with 32k RAM **£1448;** with 48k RAM **£1895**
Supporting Software available, including **8k Extended BASIC** £24.50

PRICES exclusive of VAT CARRIAGE at Cost.
PLEASE CONTACT SINTEL FOR FULL INFORMATION ON THESE AND OTHER SYSTEMS.

SINTEL CLOCK KITS

RED DIGIT DESK CLOCK

	CODE	PRICE
6 Red Digit **ALARM CLOCK** w.205mm h 40mm d.140mm	ACK	£28.80
4 Red Digit **DESK CLOCK** w.154mm h.40mm d 85mm	111-222	£15.50
4 Green Digit **DESK CLOCK** w.154mm h.40mm d.85mm	GCK	£12.95
6 Red Digit **CAR CLOCK WITH TIMER** w.205mm h.40mm d.140mm	CCK	£41.90
4 Red Digit **CAR CLOCK** w.154mm h.40mm d 85mm	AUT-CK	£18.85
50Hz **CRYSTAL TIMEBASE KIT**	XTK	£5.46

CMOS

Mainly RCA

		CD4020	1.28	CD4040	1.11	CD4066	0.63	CD4096	1.08
		CD4021	1.04	CD4041	0.86	CD4067	3.85	CD4097	3.85
		CD4022	0.94	CD4042	0.86	CD4068	0.23	CD4098	1.13
CD4000	0.17	CD4023	0.23	CD4043	1.01	CD4069	0.23	CD4099	1.90
CD4001	0.18	CD4024	0.80	CD4044	0.96	CD4070	0.51	CD4502	1.24
CD4002	0.17	CD4025	0.23	CD4045	1.45	CD4071	0.23	CD4510	1.41
CD4006	1.20	CD4026	1.78	CD4046	1.37	CD4072	0.23	CD4511	1.72
CD4007	0.18	CD4027	0.58	CD4047	1.04	CD4073	0.23	CD4514	2.84
CD4008	1.00	CD4028	0.92	CD4048	0.58	CD4075	0.23	CD4515	3.24
CD4009	0.58	CD4029	1.18	CD4049	0.58	CD4076	1.34	CD4516	1.40
CD4010	0.58	CD4030	0.58	CD4050	0.58	CD4077	0.45	CD4518	1.25
CD4011	0.20	CD4031	2.30	CD4051	0.94	CD4078	0.23	CD4520	1.19
CD4012	0.23	CD4032	1.02	CD4052	0.94	CD4081	0.23	CD4527	1.64
CD4013	0.58	CD4033	1.44	CD4053	0.94	CD4082	0.23	CD4532	1.39
CD4014	1.04	CD4034	1.97	CD4054	1.20	CD4085	0.74	CD4555	0.90
CD4015	1.04	CD4035	1.22	CD4055	1.36	CD4086	0.74	CD4556	0.90
CD4016	0.58	CD4036	3.29	CD4056	1.36	CD4089	1.60	MC14528	1.22
CD4017	1.04	CD4037	0.98	CD4059	4.93	CD4093	0.92	MC14553	4.68
CD4018	1.03	CD4038	1.10	CD4060	1.15	CD4094	1.94	IM6508	8.05
CD4019	0.58	CD4039	3.20	CD4063	1.13	CD4095	1.08		

A RANGE OF SINTEL INDUSTRIAL MODULE KITS

Latched Counter modules are now available from SINTEL, using both CMOS and TTL ICs. These kits will give you a very compact unit at less than the cost of the components bought separately and will save you considerable design, purchasing, building and de-bugging time.
Each kit has a set of red LED displays, two PCBs and the appropriate number of TTL or CMOS ICs, plus brackets, etc., resistors, capacitors, single in-line plug and sockets and instructions.

KITS FOR LATCHED COUNTER MODULES

	TTL		CMOS	
	Part No	Price	Part No	Price
2 digit	526-412	£10.52	548-470	£10.42
4 digit	657-412	£17.98	191-470	£18.11
6 digit	721-412	£25.66	869-470	£25.85

For our full range of Counter PCB sets and Display PCBs — send for FREE CATALOGUE.

COMPONENTS

MICROPROCESSORS

MEK6800D2	190.00
MC6800	15.97
MC6820	8.02
Z80-CPU 2.5MHz	28.44
Z80-CPU 4MHz	36.98
Z80-CTC	12.80
Z80-P10	12.80

SOLDERCON PINS

100	0.50
1000	4.00
3000	10.50

CLOCK CHIPS

AY51202	3.10
AY51224	3.50
MK50253	5.60

DISPLAYS

TYPE	
FND500 C.C.	1.30
TYPE	
TIL321 C.A.	1.49
SLT01	4.90

CRYSTALS

32 768KHz	3.50
5.12MHz	3.60

MEMORIES

2102A-6	2.05
2112A-4	2.90

VEROCASES

75141DJ	3.36
751411D	4.10
751237J	2.50
751238D	3.00
751239K	3.58

DATABOOKS

Intel Memory Design Handbook	£5.20
Intel 8080 Microcomputer Systems User's Manual	£5.25
Intel 8085 Microcomputer System User's Manual	£5.15
Motorola Booklet From the Computer to the Microprocessor	£1.80
Motorola McMOS Databook (Vol. 5 Series B)	£3.50
Motorola M6800 Microprocessor Applications Manual	£12.95
Motorola M6800 Programming Manual	£5.35
National SC/MP Introkit User's Manual	£0.75
National SC/MP Technical Description	£1.80
National Semiconductor TTL Databook	£2.10
RCA CMOS and Linear IC Databook	£5.45
Texas Instruments Pin Configuration Guide. A very useful set of gloss cards showing top and bottom pin-out views of 7400 ICs plus many others (T.I. Memories, Op-Amps, etc.)	£2.95
Z80 Assembly Language Programming Manual	£7.50
Zilog Z80-CPU Technical Manual	£5.60
Zilog Z80-CTC Product Specifications	£0.80
Zilog Z80-PIO Technical Manual	£3.30

DATASHEETS at **75p** each on IM6100, 6800, SC/MP, CDP1802, 2650, TMS5501, TMS8080, 9131, Z80$_\mu$P, Intel 8085. Also free data on some components.

BEST OF BYTE Volume 1. 380 pages £11.95

Our Offices are at 209 Cowley Road, Oxford, but please do not use this as a postal address.

ALL PRICES VALID UNTIL 30th APRIL, 1978

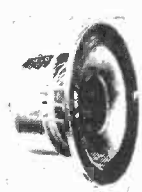
OFFICIAL ORDERS ARE WELCOME from Companies, Govt. Depts., Natn. Inds., Univs., Polys.

ORDERS: C.W.O. add VAT @ 8% + 35p p&p. TELEPHONE and CREDIT (Invoice) ORDERS add VAT @ 8% + 60p p&p minimum charge (the balance will be charged at cost). Please see 'FAST SERVICE'. EXPORT ORDERS welcome, no VAT but add 10% (Europe), 15% (Overseas) for Air Mail p&p. For Export postage rates on heavy items — contact us first.

ORDERS TO: SINTEL, PO BOX 75A, OXFORD
Tel. 0865 49791

FAST SERVICE We guarantee that Telephone Orders for goods in stock, received by 4.15 p.m. (Mon-Fri) will be despatched on the same day by 1st Class Post (some heavy items by parcel post) and our stocking is good. Private customers should telephone and pay by giving their Access or Barclaycard number, with a minimum order value of £5. Official orders, no minimum.

SINTEL



Wilmslow Audio

THE firm for speakers!

Send 15p stamp for the world's best catalogue of Speakers, Drive Units, Kits, Crossovers, etc., and discount price list

ATC ● AUDAX ● BAKER ● BOWERS & WILKINS ● CASTLE ● CELESTION ● CHARTWELL ● COLES ● DALESFORD ● DECCA ● EMI ● EAGLE ● ELAC ● FANE ● GAUSS ● GOODMANS ● HELME ● I.M.F. ● ISOPHON ● JR ● JORDAN WATTS ● KEF ● LEAK ● LOWTHER ● McKENZIE ● MONITOR AUDIO ● PEERLESS ● RADFORD ● RAM ● RICHARD ALLAN ● SEAS ● TANNOY ● VIDEOTONE ● WHARFEDALE

WILMSLOW AUDIO Dept. ETI

SWAN WORKS, BANK SQUARE, WILMSLOW, CHESHIRE, SK9 1HF

Discount HiFi, etc., at 5 Swan Street and 10 Swan Street

TEL: WILMSLOW 29599 FOR SPEAKERS
WILMSLOW 26213 FOR HIFI

TECHNALOGICS PROUDLY PRESENT

THE "LOGISCAN Mk. II"

COLOUR TELETEXT DECODER

WITH "NEW FACILITIES"

YOU CAN NOW BUY A TELETEXT DECODER TO THE LATEST BBC/IBA/BREMA JOINT SPEC. (NB. Many other decoders are not full spec. display).

THE LOGISCAN Mk. II OFFERS THESE EXTRAS:

- ★ Double/Single Height
- ★ Conceal/Reveal Switch
- ★ Discrete Graphics
- ★ Graphics Hold/Release
- ★ Auto Newsflash
- ★ Flash/Steady Display
- ★ 6800 MPU Compatible
- ★ Background Colour Fix
- ★ Unfix (revert to black)
- ★ Contiguous Graphics (Instant Colour Changes)
- ★ Roll Mode
- ★ Sub-title Inserts
- ★ DMA Capability
- ★ Kit is complete with case, psu
- ★ Header Switch
- ★ Freeze switch

FULL TECHNICAL BACK UP SERVICE

— 12 months' guarantee on all parts — subject to correct assembly and use.
— Board fault finding service (boards unpluggable for easy dispatch) Interface included
— Technical advice on installation.

We are also glad to announce that our decoders are available installed in either 26" or 22" colour televisions for just over £500 and are available for view or purchase from Colourvision, Smithdown Road, Liverpool L18.

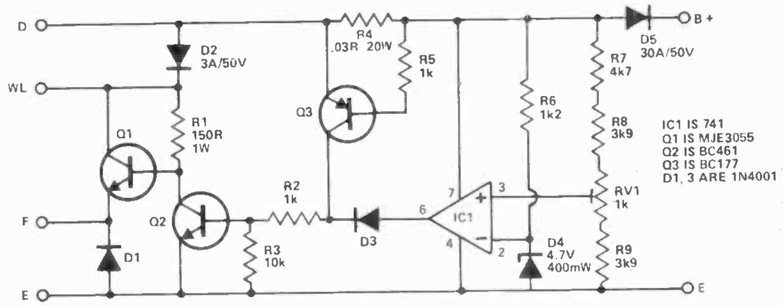
KIT £205 + 12½%. **BUILT £265** + 12½%
Details large S.A.E. Mail Order

TECHNALOGICS
8 EGERTON STREET
LIVERPOOL L8 7LY

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 ICl, 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 constant. The battery voltage is adjusted by RV1 to approximately 13.5 volts.



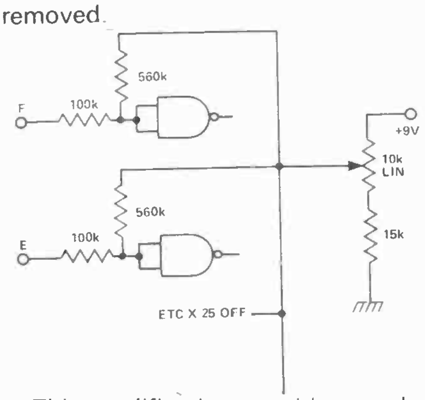
Under cold weather starting the battery voltage drops very low. Once the engine has started the internal resistance of the battery is also very low, which would draw excessive current from the dynamo causing possible damage. To limit the current R4 is inserted in the main power lead from the dynamo,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

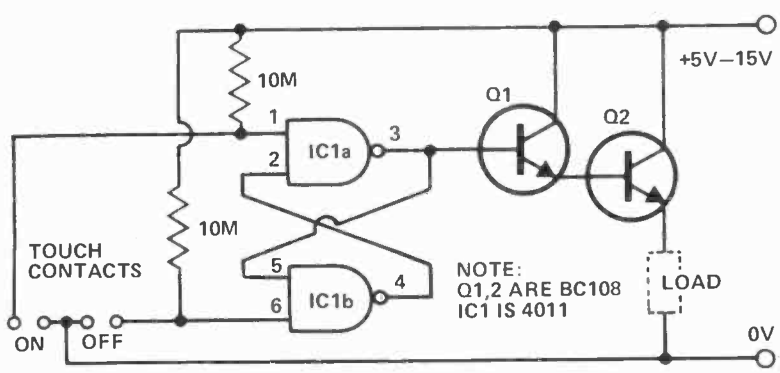


This modification provides a solution in the form of a sensitivity control.

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

New Total Development System M68 TDS from Motorola.

6800 Update

RECENTLY RECEIVED from a Motorola distributor is an M6800 series shortform catalogue entitled 'Microprocessor 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 Motorla 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 45o 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 Purpose Interface Adaptor, Modems, DMA Controller, Bus transceivers and a thing called a 'Triple Bidirectional 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. ETI

BARGAIN PARCELS SAVE POUNDS

Huge quantities of electronic components must be cleared as space required. 1000's of capacitors, resistors, transistors. Ex-equipment panels, etc. covered in valuable components. No time to sort. Must sell by weight 7lbs—£4.95, 14lbs—£7.95, 28lbs—£12.00, 56lbs—£20.00, 112lbs—£30.00

BARGAIN PACKS

Handy Packs

4 aluminium boxes 128 x 44 x 38mm, ideal for signal injectors, etc. £1.00
Self-fluxing enamelled copper wire 18 and 22 swg on 2oz. reels 2 for £1.10
100 miniature reed switches, ideal for burglar alarms, model railways, etc. £3.30
15 2-pole reed relays on board operate at 12 volts £2.45
6 6-pole 12 volt reed relays on board £2.45
High quality computer panels smothered in top-grade components:
5lbs. £4.75
10lbs. £8.95
New U.H.F. transistor TV tuners, 4 push-button type £2.50
Rotary type with slow motion drive £2.50
Set of 4 black and chrome knobs for P/B tuners above 60p
Aluminium TV coax plugs 10 for £1.00
20mm anti-surge fuses. 800mA, 1A, 1.25A, 1.6A, 2A, 2.5A, 3.15A. Your selection 12 for £1.00; 100 for £7.00
Ultrasonic transceiver units, each contains transmit, and receive transducers (7/8" Diam), transistor circuit board, range control, connection chart and tamper-proof switch contained in small aluminium case with grille. Brand new and boxed £5.25 ea.
Miniature mains transformers, fully shrouded, ex new equipment. 240V in 6-0-6v out at 100 mA. Complete with mains lead and plug on input and short leads on output £1.20
Miniature edgewise panel meters 200μA F.S.D. £1.20

Component Bargains

300 mixed resistors ½ & ¼ watt £1.50
300 modern mixed caps most types £3.30
100 mixed polyester caps £2.20
100 mixed modern miniature ceramic plate caps £1.80

Semiconductor Bargains

100 new and marked silicon and germanium transistors including BC148, BF194, BC183, etc. £3.95
200 new and marked transistors including 2N3055, AC128, BFY50, BD131, etc. £6.95
100 mixed diodes IN4148, etc. £1.20
100 mixed diodes including zener, power and bridge types £3.30
200 unmarked mixed transistors, lots of interesting types including power. Send 60p for samples £4.50
25 new and marked integrated circuits including 555, 741, 7400, 7490, TBA 800, CD4001, etc. £4.70
BR 101 full spec. 5 for £1.00
ITT 25kV ctv eht triplers for Decca "Bradford" chassis brand new £2.50 5 for £10

DELUXE FIBRE GLASS PRINTED CIRCUIT ETCHING KITS

Includes 150 sq. ins. copper clad f/g board, 1lb. ferric chloride, 1 dalo etch resist pen, abrasive cleaner, 2 mini drill bits, etch tray and instructions — only £5.30.

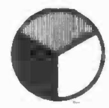
REFILL PACKS FOR ABOVE

150 sq. ins. fibre glass board	£2.00
Dalo pen	90p
1lb. ferric chloride to mil spec.	£1.95
5lbs. ferric chloride to mil spec.	£5.00
Instruction sheet	20p

30p P.&P. ON ALL ABOVE ITEMS. SEND CHEQUE OR POSTAL ORDER WITH ORDER TO SENTINEL SUPPLY DEPT., ETI, 149a BROOKMILL ROAD, DEPTFORD, LONDON, SE8

Callers by appointment only

TV GAMES



Fully assembled, attractively cased TV games: — black and white **£14.95**. Colour **£26.95**. AY-3-8500 **£5.95** (only **£4.80** for 10 off). AY-3-8550 **£9.95**. AY-3-8600 **£11.95**. Black and white TV games kits: Standard model **£9.50**. Economy model **£4.95**. Colour TV games kits: Standard **£17.00**. Economy **£12.45**. Colour Generator kit, adds colour to most black and white games **£7.50**. Rifle kit **£4.95**. Send sae for giant, free data.

NEW COMPONENT SERVICE

Resistors 5% carbon E12 10 to 10M. ¼W **1½p.** 1W **3p. Preset pots** subminiature 0.1W 100 to 4M7 **9p. Potentiometers** ¼W 4K7 to 2M2 log or lin. Single **30p**; dual **95p. Polystyrene capacitors** E12 63V 22pf to 8200pf **3½p. Ceramic capacitors** 50V E6 22pf to 47000pf **3p. Polyester capacitors** 250V E6 .01 to .1mf **5½p**, .15, .22, .33mf **7p**, .47mf **11p. Electrolytics 50V** .47, 1, 2mf **5p. 25V** 5, 10mf **5p. 16V** 22, 33, 47mf **6p.** 100mf **7p.** 220, 330 **9p.** 470 **11p.** 1000mf **18p. Zener diodes** 400mW E24 3V3 to 33V **8½p.**

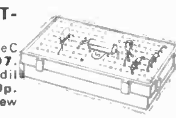
MAINS TRANSFORMERS

6-0-6V 100mA **94p.** 9-0-9V 75mA **94p.** 12-0-12V 50mA **94p.** 13V ½A **£1.10.** 6.3V 1½A **£1.89.** 6-0-6V 1½A **£2.35.** 9-0-9V 1A **£1.99.** 12-0-12V 1A **£2.49.** 15-0-15V 1A **£2.79.** 30-0-30V 1A **£3.59.** 20V 2½A **£1.99.** 9-0-9V 2A **£2.60.**

PRINTED CIRCUIT MATERIALS

PC etching kits: — economy **£1.70.** Standard **£3.82.** 50 sq ins pcb **40p.** 1 lb FeC1 **£1.05. Etch resist pens**: Economy **45p.** Dalo **83p.** Small drill bit **20p.** Laminate cutter **75p.**

S-DECS AND T-DECS★



S-DeC **£2.23.** T-DeC **£3.98.** u-DeCA **£3.97.** u-DeCB **£6.67.** 16 dil adaptors: — plain **99p.** With socket **£1.91.** New S-de-kit **£4.95.**

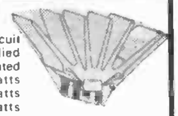
SINCLAIR PRODUCTS★

Cambridge Scientific programmable calculator **£13.95.** Prog. library **£4.95.** Mains adaptor **£3.20.** Cambridge Scientific **£8.45.** Oxford Scientific **£10.60.** PDM35 digital multimeter **£25.95.** Adaptor **£3.24.**

BI-PAK AUDIO MODULES

S450 Tuner **£21.95.** AL60 **£4.86.** PA100 **£14.95.** MK60 audio kit **£36.45.** Stereo 30 **£17.95.** SPM80 **£3.75.** BMT80 **£5.95.** Send for free data.

JC12, JC20, JC40 AMPLIFIERS



A range of integrated circuit audio amplifiers supplied with free data and printed circuits. JC12 6 Watts **£1.95.** JC20 10 Watts **£2.95.** JC40 20 Watts **£4.20.**
Send sae for free data.

FERRANTI ZN414

IC radio chip **£1.44.** Extra parts and pcb for radio **£3.85.** Case **£1.** Send sae for free data.

BATTERY ELIMINATOR BARGAINS

TV games power unit stabilized 7.7V 100ma **£3.25. 3-way models** with switched output and 4-way multi-jack: — 3/4½/6V 100ma **£2.92.** 6/7½/9V 150ma **£3.30. 100ma radio models** with press stud connectors. 9V **£2.85.** 6V **£2.85.** 4½V **£2.85.** 9V+9V **£4.50.** 6V+6V **£4.50.** 4½V+4½V **£4.50. Cassette recorder mains unit** 7½V 100ma with 5 pin din plug **£2.85. Fully stabilised model** switched output of 3/6/7½/9V 400ma stabilised **£6.40. Car convertors** 12V DC input. Output 9V 300ma **£1.80.** Output 7½V 300ma **£1.80.**

BATTERY ELIMINATOR KITS

Send sae for free leaflet on range.
100mA radio types with press stud battery terminals. 4½V **£1.80.** 6V **£1.80.** 9V **£1.80.** 4½V+4½V **£2.50.** 6V+6V **£2.50.** 9V+9V **£2.50.**
Cassette type 7½V 100ma with din plug **£1.80.**
Transistor stabilised 8-way type for low hum. 3/4½/6/7½/9/12/15/18V 100mA **£3.20.** 1 Amp model **£6.40.**
Heavy duty 13-way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V. 1 Amp **£4.85.** 2 Amp **£7.95.**
Car Convertor kit. Input 12V DC, output 6/7½/9V 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 dil **22p.** NE555 8 dil **35p.** Dalo pens **58p.** 2N3055B **31p.** 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

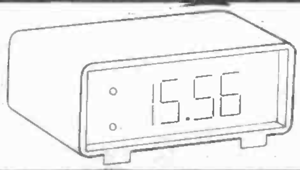
Labgear CM7026 ready to use, attractively cased complete unit which just plugs straight into the aerial socket of the set, giving full colour and requiring no modification to the TV. Remote control page selection **£323.**
Texas Instruments Tifax Module for the experienced 'do-it-yourself' man **£120.**

SWANLEY ELECTRONICS

DEPT. ETI, PO BOX 68, 32 GOLDSEL RD., SWANLEY, KENT BR8 8TQ

Mail order only. Please add 30p to total cost of order for postage. Prices include VAT. Overseas customers deduct 7% on items marked* and 11% on others. Official credit orders welcome.

24 HR. CLOCK/APPLIANCE TIMER KIT



Switches any appliance of up to 1KW on and off at preset times once a day. KIT contains: AY-5-1230 Clock/Appliance Timer IC, 0.5" LED display, mains supply, display drivers, switches, LEDs, triac, complete with PCB and full instructions. **£13.75**

Special white box (56 x 131 x 71mm) with red Acrylic window — undrilled £2.20; ready drilled for kit £2.50

TOUCH CONTROLLED LIGHTING KITS

These KITS replace conventional light switches and control 300W of lighting. No mains rewiring required. Insulated touch plates. Complete with easy to follow instructions.
TSD300K TOUCHSWITCH and DIMMER combined. ONE touchplate to switch light on or off. Brightness controlled by small knob. **£5.20**
TS300K — TOUCHSWITCH. TWO touch plates. One for ON, one for OFF. **£4.00**
TSA300K — AUTOMATIC TOUCHSWITCH. ONE touch plate. Touch for ON and light stays on for preset time (variable from 2 secs to 3½ mins.). Ideal for stairs and hall **£4.00**

LD300K — 300W LIGHT DIMMER KIT. Replaces conventional light switches. **£2.80**

AY-5-1230 Clock Appliance Timer I.C. **£4.85**
LM3911 Thermometer/Temperature Control I.C. (with data) **£1.00**
NE555 Timer I.C. 8 pin dil **36p** (3 for £1.00)
741 Op. Amp I.C. 8 pin dil **24p** (5 for £1.00)

BC147	**8p***	BFY50	**15p**	2N6027 PUT	**34p**
BC148	**8p***	2N3055	**40p**	TIS43 UJT	**24p**
BC158	**10p***	TIP31A	**50p**	1N4148	**4p***
BC182L	**8p***	TIP32	**50p**	1N4004	**4p**

TRIAC BARGAINS

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**

CMOS LOW PRICES

4000	**18p**	4012	**18p**	4023	**18p**	4077	**45p**
4001	**18p**	4013	**51p**	4025	**18p**	4501	**20p**
4002	**18p**	4015	**91p**	4040	**97p**	4510	**150p**
4007	**18p**	4016	**51p**	4049	**50p**	4516	**150p**
4011	**18p**	4017	**91p**	4050	**50p**	4519	**56p**

MINI MAINS TRANSFORMERS

6-0-6V 100mA	**85p***
12-0-12V 100mA	**95p***

OPTO ELECTRONICS

0.2" Red L.E.D.	**10p**
0.2" Green L.E.D.	**21p**
0.2" Yellow L.E.D.	**25p**
DL727 Dual 0.5" Display	**£1.50**

C280 Polyster Capacitors 250V d.c. (values in uF) .01 **4p***; .022, .033, .047, .068 **5p***; 0.1 **6p***; .15 **7p***; .22 **8p***; .33 **11p***; .47 **12p***; .68 **17p***; 1.0 **20p***; 2.2 **36p***
RESISTORS .33W 5% 22ohm to 10Mohm **1½p***
Push Button, push to make **20p***

QUANTITY DISCOUNTS ON REQUEST
Add 8% (*12½%) V.A.T. plus 25p P&P. MAIL ORDER ONLY TO:

T.K. ELECTRONICS (ETI)

106 STUDLEY GRANGE ROAD, LONDON, W7 2LX

TRAMPUS

BARGAIN MONTH! POST FREE £5+

BARCLAYCARD

FREE 1978 CATALOGUE SALE LIST. MANY SURPLUS & CLEARANCE LINES. SEND S.A.E. DO YOURSELF A FAVOUR A SEMICONDUCTOR POWER HOUSE.

TRAMPUS ELECTRONICS LTD. 58-60 GROVE ROAD, WINDSOR, BERKS. SL4 1HS. Telephone Windsor (07535) 54525

Fast service on ex stock product. Normally 24 hour turn around. Quality devices to manufacturers specifications. No minimum order charge except Barclaycard or Access by post or telephone £5 minimum. Send C.W.O. Post Free over £5 except invoiced or Credit Card orders. Otherwise add 20p post & packing. Add 8% VAT to items marked ★. 12½% VAT to unmarked items

LEDS ⅛ & 0.2 Dia
RED No Clip **9p★**
Color LEDS all **12p★**
Color Leds all **16p★**
DISPLAY
0.3 DL704/2 & 707/2 **59p★**
0.6" DL747/2 **£1.50★**
TGS Gas Detectors **£5★**
CAPACITORS
Ceramic 22pf to 0.5 **5p**
Electrolytic 1uF to 200 uF **7p**
1000uF/25V **20p**
Tantalums Only **16p ea**
RESISTORS ¼ ½W **2p ea**
Presets **10p.** Pots **25p**
VERO 0.1 Matrix 2½"x3¾" **42p★.** 3¾"x5" **59p★**
3¾"x17" **£2.50.** 2½"x5" **50p★**
Oil Board 6"x4" **£2.50★**
Dalo PCB Pen **65p★**
Nylon Board Copper 6x4 **60p★**
Tub FEC etch ½kg **£1★**
RS Bleeper 12V **£1.50★**
KNOBS. Cheap **10p★**
RELAY. Multi pole 12V **£1★**
Silicon grease satchet **29p★**
★Digital Clock IC **£2★**

BULK BUY BARGAINS
FULL SPEC. PAKS. ALL £1 ea

PAK A 12xRED LEDS	£1★
PAK B 5x741 8 Pin	£1★
PAK C 4x2N 3055 90w	£1★
PAK D 12xBC109	£1★
PAK E 13xBC182	£1
PAK F 13x2N 3704	£1
PAK G 7xBFY51	£1★
PAK H 7x2N3819E	£1★
PAK J 6x2N 3053	£1★
PAL K 40xIN 4148	£1★
PAK M 4xPair NPN/PNP 2A	£1★
PAK N 50xOA81/91	£1
PAK P 20xPlastic 109	£1
PAK R 14xBC107	£1★
PAK S 14xBC108	£1★
PAK T 10xNPN 2A 60V	£1★
PAK U 4x1A 50V SCR	£1
PAK V 40x5MFD 10V	£1
PAK W 20 Electrolytics	£1
PAK Y 4xLM301/14	£1★
PAK Z 20x2N3702 Type PNP	£1
NEW PAK X 4x555	£1★

TRIAC: 10A 400V **£1★**
SCR: 4A 400V (106) **50p★**
DIAC: BR100 ST2 **25p**
SCR: Tag 1A/600V **60p**
DIL SOCKETS: Lo Profile 8 Pin **12p★.** 14 or 16 Pin **15p★**

REDUCED LINES
ICs & TRANSISTORS

BC107	8p★	ORP12	50p★
BC108	8p★	TIP 2955	65p★
BC109	8p★	TIP 3055	55p★
BC109C	15p★	2N 3055	45p★
BC177/8/9	20p★	2N 3702/4	8p★
BC182/3/4	7p	2N 3819E	18p★
BC212/3/4	7p	2N 3820	38p★
BCY70/1/2	20p★	2N 2646	50p★
BD131/132	39p★	2N 5457	50p★
MJ2955	£1.50★	Matching	+20p
MJE2955	£1★	INS BUSH	
MJE 3055	55p★	Sets A00	10p★

ZENERS 400MW **9p**
DIODES: IN4148 914 **5p**

LINEARS		ICs	
301/14 Pin	29p★	7812	£1★
308 DPA	£1★	7815	75p★
555	29p★	76013	£1.49
741/8	21p★	LM3091C	£1★
747	89p★	LM380	89p
748/14	29p★	LM381	£1.55
748/8	39p★	LM3900	69p
7805	£1★	MC1310	£1
		ZN414 RX	75p

7400 TTL	12p★	7480	45p★
7401	8p★	7490	33p★
7405	8p★	74121	27p★
7413	27p★	74123	50p★
7420	8p★	74157	50p★
7430	8p★	CMOS etc.	
7445	50p★	4001	18p★
7447	79p★	4011	18p★

FREE: 1978 CATALOGUE SALE LIST. SEND S.A.E. BARGAIN OFFERS!

THIS MONTH'S SNIPS. LIMITED STOCKS

Tuner Module Brand New Expensive ex music centre MW/LW FM MPX Push Button **£22.50**
7 Watt Stereo Amplifier Module **£3.69**
Tuning Gang Air spaced 0-360 395pf Half Price **£1 ea**

B. BAMBER ELECTRONICS

DEPT. ETI, 5 STATION ROAD, LITTLEPORT, CAMBS. CB6 1QE
Tel. ELY (0353) 860185 (Tues. to Sat.)

CASH WITH ORDER. (MINIMUM ORDER £2.00)
PLEASE ADD VAT AS SHOWN
POST PAID (UK ONLY), SAE WITH ENQUIRIES
CALLERS WELCOME BY APPOINTMENT ONLY

ALL BELOW — ADD 8% VAT

MAINS TRANSFORMERS, TYPE 15/300 240V input, 15V at 300mA output, £1.50 each.
MAINS TRANSFORMERS, TYPE 45/100, 240, 220, 110, 20, 0V input, 45V at 100mA output, £1.50 each.
MECHANICAL COUNTERS. 4 digit Resettable, 60p each.
REVOLUTION COUNTERS, 000-999, 1 rev of spindle=10, 4mm spindle, 2 hole fixing, alloy body, good quality, 40p each.
4-DIGIT P.O. TYPE PULSE COUNTERS, 24V DC, 500ohm coil. Size approx. 1" x 1" face, 4" deep, 25p each.
SLOW-MOTION MOTORS, 120V 50Hz 1RPM. Size approx. 2" dia., 1½" deep, with ⅛" spindle, 60p each, or 2 for £1.00.
1½V DC MOTORS (Ideal for model makers, quite powerful), 50p each.
6BW6 VALVES (BRAND NEW), 85p each, or 2 for £1.50.
SUB-MINIATURE ROTARY SWITCHES, 4 x 5-way make contacts. Size approx. ¾" dia., 1" deep, 3/16" spindle, 50p each
30pf BEEHIVE TRIMMERS. Brand new, 4 for 50p.
Min. 5pf AIR SPACE TRIMMERS, approx. ⅜" square, 3 for 50p
Min. 5pf COMPRESSION TRIMMERS, ½" x 5/16", 4 for 50p.
SMITHS CLOCK MOTORS. 200-250V 50Hz 2 watts, 1 rev. every 2 mins., 3 hole fixing, ⅛" spindle, £1.00 each.

A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES
Aluminium Boxes with Lids

AB10	5¼x4x1½	60p
AB13	6x4x2	80p
AB14	7x5x2½	£1.00
AB15	8x6x3	£1 30
AB16	10x7x3	£1.50
AB17	10x4¼x3	£1.30
AB25	6x4x3	£1.00

Vinyl Coated Instrument Cases
Blue Tops with White Lower Sections
Very smart finish

WB1	5x2½x2¼	60p
WB2	6x4½x1¾	£1.10
WB3	8x5x2	£1 60
WB4	9x5¼x2½	£1.80
WB5	11x6¼x3	£2.00
WB6	11x7½x3½	£2.25
W87	12x6x5¼	£2.60
WB853	8x5½x3½	£2.00

ALL BELOW — ADD 8% VAT

FULL RANGE OF BERNARDS/BABINI ELECTRONICS BOOK IN STOCK. S.A.E. FOR LIST.

LARGE ELECTROLYTIC PACKS. Contain range of large electrolytic capacitors, low and high voltage types, over 40 pieces, **£3.00** per pack (+ 12½% VAT).
MIXED COMPONENT PACKS. Containing resistors, capacitors, switches, pots, etc. All new, and hundreds of items, £2.00 per pack, while stocks last.
PLUGS AND SOCKETS
BNC PLUGS (ex. equip.), five for £1.50
N-TYPE PLUGS, 50ohm 60p each, 3 for £1.50.
Greenper (GE300015) Chassis Lead Terminations. (These are the units which bolt on to the chassis, the lead is secured by screw cap, and the inner of the coax passes through the chassis.) 30p each. 4 for £1.00.
PL250 Plugs (PTFE), brand new, packed with reducers, 75p each.
SO239 Sockets (PTFE), brand new (4-hole fixing type), 60p each.

VALVES
QQVO3/20A (ex. equipment), £3.00.
QQVO3/10 (ex. equipment), 75p or 2 for £1.20.
6BH6 (ex. equipment), 2 for 50p.
All the above valves are untested, except for heaters, and no guarantee of percentage of emission is given. Sorry, no returns.
MULLARD 85A2 85V STABILISER VALVES (brand new). 70p each of 2 for £1 20.
6BW6 brand new 85p each or 2 for £1.50.

TRANSISTORS
BFY51 Transistors, 4 for 60p.
BYX38/300 Stud Rectifiers, 300V at 2.5A, for 60p.
BCY72 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.
741CG RCA OP Amps 4 for £1.00.
SCRs 400V at 3A, stud type, 2 for £1.00.
TIP2955 Silicon PNP power transistor, 60V at 15A, 90 Watts, Flat pack type, 2 for £1.50.
GERMANIUM DIODES, approx 30 for 30p.
1N4148 (1N914) diodes 10 for 25p.

ALL BELOW — ADD 8% VAT

RED LEDs (Min. type), 5 for 70p.
VIDICON SCAN COILS (Transistor type, but no data), complete with vidicon base, £6.50 each. Brand new.
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.
AEI CS10B/R MICROWAVE DIODES, up to X-Band, max. noise figure 8.5dB at 9.375GHz, 80p each.

PUSH-BUTTON TELEPHONES
A ten digit push-button intercom telephone with handset, finished in smart grey plastic. Ex-equipment, but good condition. Only **£2.50** each.

SPIRALUX Tools for Electronics enthusiast . . . SAE for list.

4MHz XTAL PACKS (10 assorted xtals between 4MHz and 5MHz). Our selection only £1.00 pack
ALU-SOL ALUMINIUM SOLDER (made by Multi-core), solders aluminium to itself or copper, brass, steel, nickel or tinplate, 16SWG with Multicore flux with instructions, approx. 1m coil, 40p pack. Large reel £2.75.
SOLDER SUCKERS (Plunger Type).
Standard Model, £5 50
Skirted Model, £6.00
Spare Nozzles, 60p each.
MULTICORE SOLDER
½Kg (1.1lb.) 60/40 20 SWG on plastic reel, £3.00.
WELLER WP60D Mains operated temperature control, soldering iron, £15.00.
SPARE TIPS (for WP60D). Two types available. TYPE CC7 (W60D) Standard. TYPE AA7 (W60D). Finer tip. £1 15 each.
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.

A RANGE OF DRAPER TOOLS FOR THE ELECTRONICS ENTHUSIAST
(GOOD QUALITY, FULLY GUARANTEED)
MAINS TESTER SCREWDRIVERS, 100 to 500V. Standard size 50p. Large 70p.
RADIO PLIERS, 5¼" £1.60, 6¾" £1.80.
DIAGONAL SIDE CUTTERS, 6¼", £1.90
SMALL SIDE CUTTERS, LJ2 Standard £3.70.
LJ7 (with wire holding device), £4.10.
FLAT NOSE TOP CUTTERS, LJ1 £4.10.
COMBINATION PLIERS, 6¼" £1.75, 7" £1.80.

ALL BELOW — ADD 8% VAT

TIN SNIPS, 7", £2.25.
SLIM OPEN ENDED SPANNER SETS, 0+3, 1+2, 2+4, 3+5, 4+6, 6+8BA SIZES, £1.15.
MIDGET OPEN ENDED SPANNER SETS
0+1, 2+2, 3+5, 4+6, 6+8BA SIZES, £2.85 set of 5
4+4.5, 5+5.5, 4+6, 6+7, 8+9, 10+11 MM SIZES, £3.50 set of 6.
MINIATURE WATCHMAKERS SCREWDRIVER SETS, £1 50 set of 5.
MINIATURE FILE SETS, set of 6 £1.90. Set of 10 £3.25 (Round, flat, etc.).
TAP AND DIE SETS (18-piece) contain 1 each of 0, 2, 4, 6, 8, BA SIZES IN Dies, Plug taps, Taper Taps + American Type tap wrench, T-type tap wrench, Die Holder, £11.60.
TUBULAR HACKSAW FRAMES (with Blade), £2.75.
OSMOR REED RELAY COILS (for reed relays up to ¼" dia., not supplied), 12V, 500ohm coil, 2 for 50p.

PLASTIC PROJECT BOXES, with screws on lids (In black ABS) with brass inserts.
Type NB1 approx. 3" × 2⅛" × 1½" 40p each.
Type NB2 approx 3¼" × 2¼" × 1½" 50p.
Type NB3 approx 4½" x 3¼" × 1½" 60p each.
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 12½% VAT

VARICAP TUNERS, Mullard type, ELC1043/05. Brand new £4 40.

TV Plugs (metal type), 4 for 50p.
TV Sockets (metal type), 4 for 50p.
TV Line connectors (back-to-back skt.), 4 for 50p.
3-pin Din Plugs, 4 for 50p.
Din 3-pin Line sockets, 15p each.
Din Speaker Skts. 2-pin, 4 for 30p

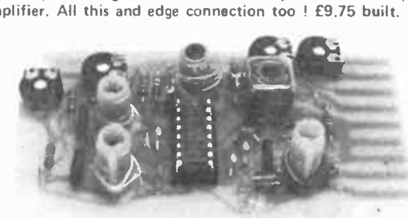
Dubilier Electrolytics, 50µF 450V, 2 for 50p.
Dubilier Electrolytics, 100µF 275V, 2 for 50p.
Plessey Electrolytics, 470µF 63V, 3 for 50p.
TCC Electrolytics, 1000µF 30V, 3 for 60p.
Dubilier Electrolytics 5000µF 35V, 50p each.
Dubilier Electrolytics, 5000µF 50V, 60p each.
ITT Electrolytics, 6800µF 25V, high grade, screw terminals, with mounting clips, 50p each.
Resistor PKS, approx 300 pieces ½ to 2 watt types, mixed values, our selection, £1.00 each

A RANGE OF CAPACITORS AVAILABLE AT BARGAIN PRICES. SAE FOR LIST.

THE WORLD'S FINEST FM TUNER MODULES OK?

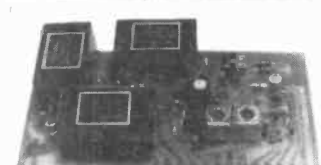
We've said it before, and we'll say it again;
We offer the Largest and the Best range of FM Tuner modules in the UK, Europe and we believe in the World. (Please advise us if you know differently.) We gasp when we read the unsupportable claims of other 'suppliers', describing things like deviation muting, which we have been offering in our 7030 FM IF system for ages. Long before most others gave it a thought. To read some adverts, you might imagine somebody had just discovered the wheel. Furthermore, we believe good signal processing is more important than rows of pretty lights and numbers, don't you?

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.



ALL NEW CATALOGUE

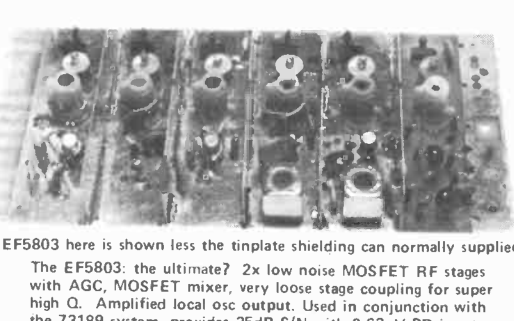
To celebrate our new range of ICs, components, coils, filters, FM and AM modules etc., we are presenting an entirely new catalogue, which is free if you send an A4 SAE (15p stamp on it pse), and the front page from one of our old catalogues. This offer ceases on May 31st 1978, when the normal price of 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.



Always in the leading group, here is Ambit's 73189 IF system, optional 2 or 3 6pole linear phase IF filters, 2xMOSFET IF AGC stage, with the CA3189E. £16.25 built and aligned.

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 ¼ 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 advertized, 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.............



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 0.63uV PD input. And all these modules are British Made. EF5803: £19.75.

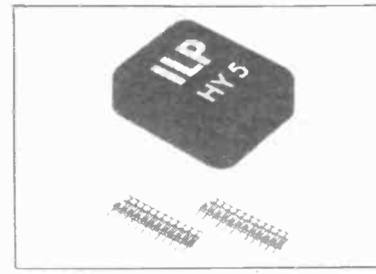
ambit INTERNATIONAL

2 GRESHAM ROAD BRENTWOOD ESSEX

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

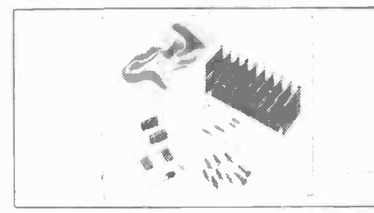
15—240 Watts!

HY5
Preamplifier



The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc.) are catered for internally, the desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.
FEATURES: Complete pre-amplifier in single pack — Multi-function 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 47kΩ at 1kHz
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS: Treble ± 12dB at 10kHz; Bass ± at 100Hz
DISTORTION: 0.1% at 1kHz; Signal/Noise Ratio 68dB
OVERLOAD: 38dB on Magnetic Pick-up; SUPPLY VOLTAGE ± 16-50V
Price £5.22 + 65p VAT P&P free
HY5 mounting board B1 48p + 6p VAT P&P free

HY30
15 Watts into 8Ω

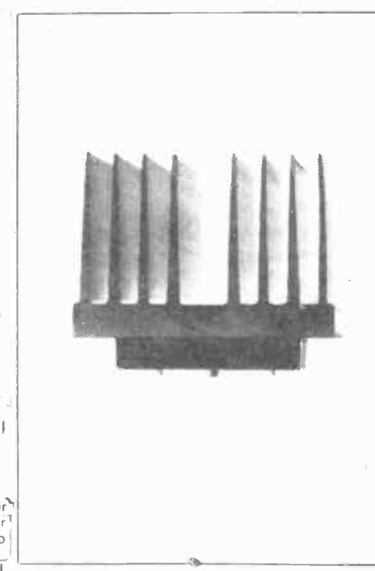


The HY30 is an exciting New kit from I.L.P.; it features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of I.C., heatsink, P.C. board, 4 resistors, 6 capacitors, mounting kit, together with easy to follow construction and operating instructions. This amplifier is ideally suited to the beginner in audio who wishes to use the most up-to-date technology available.
FEATURES: Complete kit — Low Distortion — Short, Open and Thermal Protection — Easy to Build
APPLICATIONS: Updating audio equipment — Guitar practice amplifier — Test amplifier — Audio oscillator
SPECIFICATIONS:
OUTPUT POWER 15W R.M.S. into 8Ω; DISTORTION 0.1% at 15W
INPUT SENSITIVITY 500mV; FREQUENCY RESPONSE 10Hz-16kHz — 3dB
SUPPLY VOLTAGE ±18V
Price £5.22 + 65p VAT P&P free.

HY50
25 Watts into 8Ω

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.
FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors — No external components
APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier
SPECIFICATIONS: INPUT SENSITIVITY 500mV
OUTPUT POWER 25W RMS in 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.04% at 25W at 1kHz
SIGNAL/NOISE RATIO 75dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB
SUPPLY VOLTAGE ± 25V; SIZE 105.50.25mm.
Price £6.82 + 85p VAT P&P free

HY120
60 Watts into 8Ω

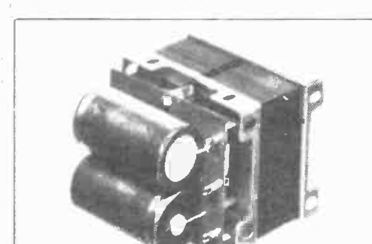


The HY120 is the baby of I.L.P.'s new high power range, designed to meet the most exacting requirements including load line and thermal protection, this amplifier sets a new standard in modular design.
FEATURES: Very low distortion — Integral Heatsink — Load line protection — Thermal protection — Five connections — No external components
APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and organ
SPECIFICATIONS:
INPUT SENSITIVITY 500mV
OUTPUT POWER 60W RMS into 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.04% at 60W at 1kHz
SIGNAL/NOISE RATIO 90dB; FREQUENCY RESPONSE 10Hz-45kHz —3dB; SUPPLY VOLTAGE ±35V
Size 114 x 50 x 85mm
Price £15.84 + £1.27 VAT P&P free.

HY200
120 Watts into 8Ω

The HY200, now improved to give an output of 120 Watts, has been designed to stand the most rugged conditions, such as disco or group while still retaining true Hi-Fi performance.
FEATURES: Thermal shutdown — Very low distortion — Load line protection — Integral Heatsink — No external components
APPLICATIONS: Hi-Fi — Disco — Monitor — Power Slave — Industrial — Public address
SPECIFICATIONS:
INPUT SENSITIVITY 500mV
OUTPUT POWER 120W RMS into 8Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.05% at 100W at 1kHz
SIGNAL/NOISE RATIO 96dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB; SUPPLY VOLTAGE ± 45V
SIZE 114 x 100 x 85mm
Price £23.32 + £1.87 VAT P&P free.

HY400
240 Watts into 4Ω



The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4Ω! It has been designed for high power disco or public address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.
FEATURES: Thermal shutdown — Very low distortion — Load line protection — No external components
APPLICATIONS: Public address — Disco — Power slave — Industrial
SPECIFICATIONS:
OUTPUT POWER 240W RMS into 4Ω; LOAD IMPEDANCE 4-16Ω; DISTORTION 0.1% at 240W at 1 kHz
SIGNAL/NOISE RATIO 94dB; FREQUENCY RESPONSE 10Hz-45kHz — 3dB; SUPPLY VOLTAGE ± 45V
INPUT SENSITIVITY 500mV; SIZE 114 x 100 x 85mm
Price £32.17 + £2.57 VAT P&P free.

POWER SUPPLIES

PSU36 suitable for two HY30's **£5.22** plus 65p VAT P/P free.
PSU50 suitable for two HY50's **£6.82** plus 85p VAT P/P free.
PSU 70 suitable for 2 HY 120's **£13.75** plus £1.10 VAT P/P free.
PSU90 suitable for one HY200 **£12.65** plus £1.01 VAT P/P free.
PSU180 suitable for two HY200's or one HY400 **£23.10** plus £1.85 VAT P/P free.
B1 **48p** plus 6p VAT

TWO YEARS' GUARANTEE ON ALL OF OUR PRODUCTS

I.L.P. Electronics Ltd
Crossland House
Nackington, Canterbury
Kent CT4 7AD
Tel (0227) 63218

Please Supply ____________
Total Purchase Price ____________
I Enclose Cheque ☐ Postal Orders ☐ Money Order ☐
Please debit my Access account ☐ Barclaycard account ☐
Account number ____________
Name & Address ____________
Signature ____________

MINI-ADS & CLASSIFIED

SECURITY PRODUCTS

Designed for the Do-It-Yourself market. Easily installed. Full instructions supplied. As supplied to the trade.

Magnet and Reed switch	Flush	**65p**
	Surface	**70p**
Pressure Mats	Large	**£1.20**
	Stair	**80p**
Bells and Sirens from		**£5.00**
Bell Covers — Metal - Plastic coated		**£5.00**
Window Foil self adhesive		**£2.20**
Foil Blocks		**15p**
Door Loops complete		**70p**
Key Switches top grade		**£2.50**
Control panels from		**£18.75**

Radar, Infra-Red, and many other items available. Send for details.

Please add 12½% VAT + £1 P&P

STRATHAND SECURITY
44 St Andrews Sq
Glasgow G1 5PL
041-552 6731 or 2

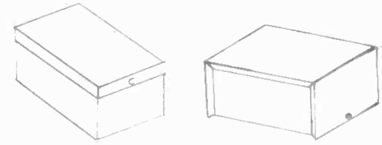
PRINTED CIRCUITS and HARDWARE

Comprehensive range Constructors' Hardware and accessories.
Selected range of popular components.
Full range of ETI printed circuit boards, normally ex-stock, same day despatch at competitive prices.
P.C. Boards to individual designs.
Resist-coated epoxy glass laminate for the d.i.y. man with full processing instructions (no unusual chemicals required).

Send 15p for catalogue.

RAMAR CONSTRUCTOR SERVICES
MASONS ROAD
STRATFORD-ON-AVON
WARWICKS. Tel. 4879

LOW COST BOXES



AND INSTRUMENT CASES

Aluminium box with lid and screws

3x2x1	**42p**
4x3x1½	**49p**
4x3x2	**56p**
6x4x2	**62p**
6x4x3	**72p**
8x6x2	**97p**
8x6x3	**1.08p**

2 Section case. Black pvc coated top and aluminium base

L W H	Price
6x4½x2	**£1.25**
6x4x3½	**£1.37**
8x5½x2½	**£1.50**
10x6½x3	**£1.95**

all prices incl. p&p

Sheet aluminium standard and cut to size, self-tapping screws, nuts bolts and washers. Pamphlet on our full range of cases supplied with every order or send a stamped self addressed envelope to **HARRISON BROS., P.O. Box 55, Westcliff-on-Sea, Essex.** Manufacturing service of sheet metal parts for trade; send drawing and s.s.a.e. for quotation.

E.T.I. P.C.B's

Buy it with Access

BARCLAYCARD

Available for all ETI projects from day one of ETI, 'phone your order

SPECIAL OFFER—Single sided Pax PCB mat, four off, 4¾" x 6½". 99p all up

CROFTON ELECTRONICS LIMITED
35 GROSVENOR ROAD, TWICKENHAM
MIDDLESEX TW1 4AD · Tel: 01-891 1923

P.C.B.s

Standard or 'FR-Glapex' fibreglass P.C.B.'s for ETI projects supplied tinned and drilled.

E.T.I. 541	68p
E.T.I. 549	77p
S68 VDUa (Mod)	255p
S68 VDUb (Mod)	249p
S68 Mainframe PSU	81p
S68 CPU	226p
S68 TTY	193p
3 Channel tone control	63p
Digital Therm	112p
Clock A	97p
Clock B	197p
Companda	152p
Rev Monitor	89p
Freezer alarm	46p

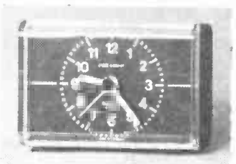
PLUS Special Offers now valid till Mar. '78.
Item 1: Full set S68 pcbs (VDU a & b, PSU, CPU) only £6.75 per set.
Item 2: ETI 804 TV Game, £1.00 each
Item 3: ETI 480 + 480 PSU, £1.90 per pair

All prices shown include VAT. Add 20p post & packing

P.C.B.s also available for this month's ETI projects. Send SAE for full list of available boards

TAMTRONIK LIMITED
217 TOLL END ROAD, TIPTON, WEST MIDLANDS DY4 0HW
Telephone 021-557 9144

BARGAIN FOR ELECTRONIC HANDYMAN



Size 95 x 65mm
1977/78 model 4MHz quartz alarm, made in the Black Forest by Kienzle. Offered as new, unused, but with slightly marked cases.
Ideal for personal use or electronic experimentation.
Recommended retail price £18.95.

Offered at £9.50 inc. VAT with normal movement guarantee while stocks last.

Prescott Clock & Watch Co. Ltd.
Prescott House, Humber Road
London NW2 6ER, England
Telephone: 01-452 9871

NEW GENTS LED GOLD PLATED BRACELET WATCHES

Swiss 10 micron gold plated case.
Hughes 786,432 Hz
5-Function module.
Mineral crystal glass.
Battery access hatches

Exceptional offer only to readers of E.T.I.

Not to be confused with many electronic so-called bargains.

Retail value £69.95 but very slight marks on the bracelets and some cases enables us to offer a limited quantity at **£19.95** inc. VAT.

To be sold boxed, unused, in good working order but without guarantee; suitable for your own wear or electronic experimentation.

Offered subject to being unsold.

PRESCOTT CLOCK & WATCH CO. LTD.
Prescott House, Humber Road
London NW2 6ER, England
Telephone 01-452 9871

HI-FI BARGAINS

Special low prices for repair yourself (RY') Units

	Full Price	RY Price'
20W stereo Hi-fidelity Amp	£52.00	**£26** P&P £1.50
Hi-fi stereo cassette Deck	£51.00	**£36** P&P £1
25W stereo amp, plus turntable in case	£123.00	**£60** P&P £2.50
10W tuner amp plus auto-change in case	£125.00	**£60** P&P £2.50
70W speaker system full hi-fi spec. (carries full guarantee)	£195.00 pr	**£95 pr.** P&P £3

Range of repaired Videotone speakers at keen prices fully guaranteed. Send for list.

ALL PRICES INCLUDE VAT

The repair yourself (RY') items are brand new and complete with only minor faults. Full spares are available at low prices and there is a better than 75% chance of the unit being perfect.

These are incredible bargains to the enthusiast with limited funds.

ELBAR INDUSTRIES
7 Cheriton Avenue, Bromley, Kent
Telephone: 01-690 1916

BARGAIN BUYS. 1702A EROMS, £3.50 each + 15p post and packing. LM309K 5V Regulators, 85p each + 15p post and packing. DID's VDU's, to clear, £110. One VDU with logic fault, £60. Carr. by arrangement. Manual available. Dane Services, 2 Lupin Close, Hinckley, Leics, LE10 2UJ.

VALVES — RADIO, T.V., INDUSTRIAL, AND PROJECTOR LAMPS. 1930 to 1978. 4,000 types in stock. Many obsolete. List 30p. Postal export service. Access & Barclaycard. We wish to purchase new and boxed valves, also projector lamps. Cox Radio (Sussex) Ltd., Dept. ETI, The Parade, East Wittering, Sussex. West Wittering 2023 (STD Code 024366).

0.5" LED DIGITAL CLOCK Module (MA1012) £5.50. Postage 15p. Just add transformer and switches. Panel with buzzer and switches £1 extra. Has repeater alarm/snooze/sleep/radio timer features. SAE free details. Mr Bobker, 29 Chadderton Drive, Unsworth, Bury, Lancs.

ADVERTISEMENT INDEX

LEADER Electronic Kits

Digital Clock Kits

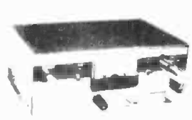
Available in 24 hour version (Kit No. LCK101)
or 12 hour version (Kit No. LCK201)
0.5" High brightness Red LED display. Teak case with Optical grade red perspex front.
Fast & slow reset. 240v 50 Hz. Modular construction.
Full instruction booklet.

Rec. Retail **£13.99** inc. VAT/P&P (Ex. VAT **£12.95**)

Bench Power Supply LPU102

Variable voltage power supply kit with 5 – 30v DC. at 1 Amp. Featuring unique Fairchild regulator chip. (as featured in E.T.I. Magazine).
Fully drilled & painted case/chassis, Meter, all parts,
Full instruction booklet

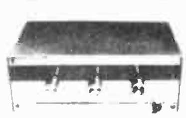
Rec. Retail **£18.75** inc. VAT/P&P (Ex. VAT **£17.36**)



Laboratory Power Supply LPU103

Excellent power supply design featuring exceptional regulation, Zero to 30 volt and Zero to 1 Amp variable output with variable limiting in two ranges 0 – 100mA & 0 – 1A. Output meter reads both current & voltage. System can stand up to 2 hours in full short circuit condition.
Fully punched, plated & painted case/chassis, front panel decal, Building manual/circuits etc.

Rec. Retail **£29.99** inc. VAT/P&P (Ex. VAT **£27.77**)



Test Bench Oscillator LTO104

Sine wave test oscillator featuring. Output variable 0 – 1 volt between 15 Hz to 30 kHz in four ranges 600 Ohm output impedance. Max. 1% distortion at 1 kHz.
Fully portable. (uses 2 x PP3 batteries – extra)

Rec. Retail **£7.99** inc. VAT/P&P (Ex. VAT **£7.40**)

"LEADER" Electronic kits enable even the inexperienced constructor to produce equipment of excellent appearance through our policy of providing
Comprehensive manual of building instructions, Fully finished cases/chassis including all necessary drilling, punching, plating, painting.
Screen printed front panel decals with all lettering etc. Matching instrument knobs.
And most of all – ALL PARTS to the last nut & bolt.

"LEADER" Electronic kits are distributed by Arrow Electronics Limited, Leader House, Coptfold Road, Brentwood, Essex Tel: 0277 219435 Telex 99443

NEW LOW PRICES!

Due to massive purchases, in many cases direct from the manufacturer we are now able to offer TTL and CMOS at considerably reduced prices. We stress that all devices are brand new and full specification from leading manufacturers only (Texas, National, ITT, Fairchild, etc.). Quantity discount regardless of mix 25+ 10%, 100+ 15%, 1000+ 20%.

TTL

7400	12p	7451	13p	74125	45p	74185	120p	4028	70p
7401	12p	7453	13p	74126	46p	74186	720p	4029	90p
7402	12p	7454	13p	74128	62p	74188	540p	4030	50p
7403	12p	7460	13p	74132	70p	74190	110p	4033	130p
7404	13p	7470	28p	74141	58p	74191	100p	4035	110p
7405	13p	7472	22p	74142	202p	74192	100p	4040	90p
7406	29p	7473	26p	74143	202p	74193	110p	4041	80p
7407	29p	7474	26p	74144	202p	74194	92p	4042	75p
7408	14p	7475	30p	74145	65p	74195	85p	4043	85p
7409	14p	7476	26p	74147	135p	74196	92p	4044	85p
7410	13p	7480	45p	74148	120p	74197	92p	4049	45p
7411	18p	7481	90p	74150	100p	74198	150p	4050	45p
7412	21p	7482	80p	74151	60p	74199	150p	4051	88p
7413	25p	7483	75p	74153	60p	CMOS		4052	88p
7414	54p	7484	90p	74154	106p	4000	15p	4053	88p
7416	27p	7485	90p	74165	63p	4001	15p	4055	100p
7417	27p	7486	26p	74156	63p	4002	16p	4060	100p
7420	13p	7489	200p	74157	63p	4006	95p	4066	50p
7421	28p	7490	35p	74159	170p	4007	16p	4068	25p
7422	17p	7491	65p	74160	80p	4008	94p	4069	20p
7423	25p	7492	45p	74161	80p	4009	46p	4070	20p
7425	22p	7493	36p	74162	80p	4010	50p	4071	20p
7426	25p	7494	80p	74163	80p	4011	15p	4072	20p
7427	25p	7495	55p	74164	90p	4012	16p	4073	20p
7428	34p	7496	62p	74165	90p	4013	45p	4075	20p
7430	13p	7497	240p	74166	100p	4014	85p	4076	110p
7432	24p	74100	95p	74167	270p	4015	80p	4078	22p
7433	32p	74104	40p	74170	170p	4016	45p	4081	19p
7437	24p	74105	40p	74172	400p	4017	80p	4082	20p
7438	24p	74107	28p	74173	120p	4018	90p	4502	90p
7440	13p	74109	45p	74174	90p	4019	45p	4507	52p
7441	52p	74110	46p	74175	70p	4020	95p	4508	230p
7442	55p	74111	70p	74176	90p	4021	85p	4510	110p
7443	90p	74116	160p	74177	90p	4022	85p	4511	100p
7444	90p	74118	82p	74178	120p	4023	15p	4512	95p
7445	70p	74119	130p	74179	110p	4024	68p	4516	110p
7446	70p	74120	82p	74180	92p	4025	15p	4518	100p
7447	66p	74121	26p	74181	195p	4026	135p	4520	110p
7448	60p	74122	40p	74182	75p	4027	52p	4528	95p
7450	13p	74123	55p	74184	120p	4028	70p	4585	105p

555 27p 741 20p LM380 76p

Prices VAT inclusive. Please add 20p for carriage. Send large SAE for our more detailed list containing semiconductors, resistors, capacitors, etc. Overseas postage at cost.

C. N. STEVENSON (ET6)

22 Tiverton Drive, London SE9 2BY, England

NASCOM 1 Microcomputer for the Hobbyist

THE ONLY COMPLETE MICROCOMPUTER AVAILABLE TO THE HOME CONSTRUCTOR

FEATURES:

★ Supplied in Kit Form for Self-Assembly
★ Full documentation supplied
★ Includes Printed Circuit Board
★ Full Keyboard included
★ Interfaces to Keyboard, Cassette Recorder & T.V.
★ 2K x 8 RAM
★ 1K x 8 Eprom Monitor Program
★ Powerful Z80 CPU, Mostek
★ 16 line x 48 Character Display Interface to standard, unmodifed T.V. set
★ On board expansion to 2K x 8 Eprom
★ On Board Expansion Facility for Additional 16 Lines I/O
★ Total expansion to 256 Input Ports and 256 Output Ports

SOFTWARE FEATURES:

★ 1K x 8 Nasbug Program in Eprom
★ Provides 8 Basic Operator Commands including single step
★ Expandable Software System via additional user Programs in Ram of Eprom

Manuals Separately **£3.50**

Complete Kits

£197.50
+VAT 8%
POST £2.50

Sole Appointed London Stockists

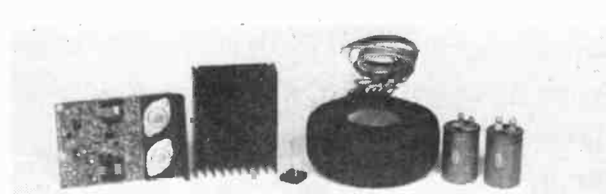
After sales service available

HENRY'S RADIO

All mail to: Henry's Radio 404 Edgware Rd, London W2

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

TWO NEW SUPERMODULES 170W INTO 4 OR 8 OHMS



By popular demand we have designed higher powered versions of our well known modules. The CE 1704 which gives 170W into 4 ohms and the CE 1708 which gives 170W into 8 ohms are physically similar to the original types and have the same combination of compatible performance features which makes CRIMSON amplification audibly superior to the competition and the only choice if you have an ear for music. We have also produced suitable power supplies which again use our superb TOROIDAL TRANSFORMERS, only 50mm high, with a 120-240 primary and single bolt fixing.

Write of phone for more information and biased opinions.

	Home	Europe
POWER AMPLIFIER MODULES		
CE 608 60W/8 ohms 35-0-35V	£16.30	£16.60
CE 1004 100W/4 ohms 35-0-35V	£19.22	£19.30
CE 1008 100W/8 ohms 45-0-45V	£23.22	£23.00
CE 1704 170W/4 ohms 45-0-45V	£29.12	£28.46
CE 1708 170W/8 Ohms 60-0-60V	£31.90	£31.04
TORDIDAL POWER SUPPLIES		
CPS 1 for 2 x CE 608 or 1 x CE 1004	£14.47	£18.40
CPS 2 for 2 x CE 1004 2/4 x CE 608	£16.82	£20.57
CPS 3 for 2 x CE 1008 or 1 x CE 1704	£17.66	£21.35
CPS 4 for 1 x CE 1008	£15.31	£19.18
CPS 5 for 1 x CE 1708	£22.68	£26.50
CPS 6 for 2 x CE 1704 or 2 x CE 1709	£23.98	£27.70
HEATSINKS		
Light Duty 50mm 2°C/W	£0.90	£1.30
Medium Power 100mm 1.4°C/W	£1.60	£2.40
Disco/Group 150mm 1.1°C/W	£2.30	£3.65
THERMAL CUT-OUTS		
Recommended for improved reliability		
70°C for use with free air heatsink	£1.60	£1.90
400 For use with fan cooled heatsink	£1.60	£1.90

T.H.D.	: Typically <.02% any power, 1kHz, 8 ohms
T.I.O.	: Insignificant
Slew Rate Limit	: 20V/μS
S/N Ratio	: 110dB
Freq. Response	: 10Hz–35kHz, –3dB
Stability	: Unconditional
Protection	: Drives any load safely
Sensitivity	: 775mV (250mV or 100mV on Request)
Size	: 120 x 80 x 25mm

CRIMSON ELEKTRIK

Please note our new address and telephone number: Stamford House, Stamford Street, Leicester LE1 6NL. Telephone (0533) 537722.

Home prices include V.A.T. and postage. C.O.D. 90p extra, £100 limit. Export no problem. European prices include carriage, insurance and handling, payment in **Sterling** by bank draft, P.O., International Giro or Money Order. Outside Europe, please write for specific quote by return. Send SAE or two International Reply Coupons for full literature. Favourable trade quantity price list on request. High quality pre-amp circuit 20p.