

electronics today

NOVEMBER 1978

INTERNATIONAL

45p

Presenting the

ETI TRITON Home Computer

• Single PCB • Resident BASIC

**Inside:
computing
today no1**

THE FIRST ISSUE OF OUR NEW
MAGAZINE FOR SMALL SYSTEMS!

Autochord

Venus Probe

Crimson Pre-amp

LCD DFM/Oscillator

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

TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

The TRANSCENDENT 2000 is a 3 octave instrument transposable 2 octaves up or down giving an effective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch modulation, a VCF with both low and high pass outputs and a separate dynamic sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or ½% metal film!) and it really is complete — right down to the last nut and bolt and last piece of wire! There is even a 13A plug in the kit — you need buy absolutely no more parts before plugging in and making great music! Virtually all the components are on the one professional quality fibre glass PCB printed with component locations. All the controls mount directly on the main board, all connections to the board are made with connector plugs and construction is so simple it can be built easily in a few evenings by almost anyone capable of neat soldering! When finished you will possess a synthesizer comparable in performance and quality with ready built units selling for between £500 and £700!



**STILL ONLY
£172.00
+ VAT
FOR COMPLETE KITS!**

Comprehensive handbook supplied with all complete kits! This fully describes instruction and tells you how to set up your synthesizer with nothing more elaborate than a multi-meter and a pair of ears.

Due to the fantastic success in the launching of this superb new kit, instead of £186.50 we are able to continue the special introductory offer of £172.00 + VAT!

200 + 200 watt AMPLIFIER

As featured in Electronics Today International

400W rms continuous — 800W peak!

0.03% THD at FULL power!

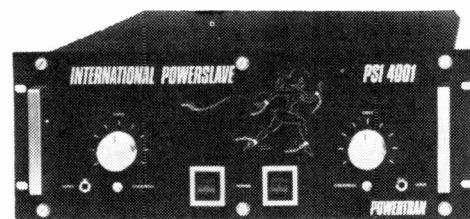
PLUS all the following features too!

- ★ Each channel totally independent with its own stabilised power supply driven by custom designed TOROIDAL transformers!
- ★ Inherent reliability — monster heat sinks for cool running at the hottest venues — electronic open and short circuit protection!
- ★ Ultra low feedback (an incredible low 14dB overall!), super high slewing rate (20V/μs), 200W rms continuous to 4 ohm from EACH channel, input sensitivity 0.775V (0dB)
- ★ Professional quality components, sturdy 19" rack mounting chassis 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 instruction suitable for both experience constructors and newcomers to electronics
- ★ Value for money — quality and performance comparable with ready-built amplifiers costing over £600!

**SUPER NEW
LOW PRICES!**

**PSI 4001
COMPLETE KIT ONLY £187.50
+ VAT
PSI 4002
COMPLETE KIT ONLY £196.90
+ VAT**

PSI 4001 SLAVE MODEL



PSI 4002 STUDIO MODEL



The kits shown on this page are available as separate packs. Prices are given in our FREE CATALOGUE

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

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.

U.K. ORDERS: Subject to 12% surcharge for VAT* (i.e. add 1/6 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

NOVEMBER 1978 VOL 7 NO 11

INTERNATIONAL



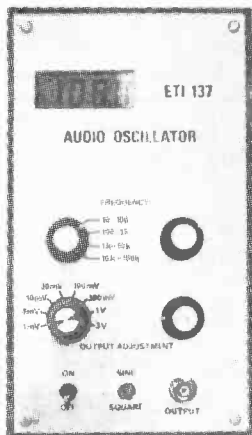
what a display p.16

FEATURES

- NEWS DIGEST **7** Find out here before you hear it elsewhere!
 VENUS PROBE **37** Details of the Multiprobe mission.
 SWITCH IN LINE SAVES NONE **51** Down with DPDTs at inputs.
 GAIN CONTROL PART 2 **65** Concluding Tim Orrs survey.
 ULTRASONICS IN MEDICINE **79** Inside information obtained.
 AUDIOPHILE **85** DIY Preamp and Sony's new 60 !
 TECH TIPS **91** Your circuits to you.

PROJECTS

- ONE BOARD COMPUTER **16** Wow!
 TV CHESS PART 2 **44** Full constructional details.
 AUTOCHORD **57** Play along with the PROMs?
 AUDIO OSCILLATOR **71** LCD DFM option too.




sign of the times p. 71

INFORMATION

- SUBSCRIPTIONS **10** Make it easy on yourself.
 HOBBY ELECTRONICS **12** Here it comes!
 COME AND JOIN US **13** Your ETI needs YOU!
 ETI PRINTS **15** The only way to board.
 ETI BOOK SERVICE **35** Fine print and proud of it.
 ETI SPECIALS **54** All our wares on show.
 MARKET PLACE **55** Price reductions here.
 DECEMBER PREVIEW **63** What goes in next month.

**COMPUTING TODAY: NEW MAGAZINE FOR SMALL SYSTEMS.
 FIRST ISSUE INSIDE.**

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	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 Jim Perry Specials Editor Phil Cohen B.Sc, William King Editorial Asslstants John Koblanski Project Design Steve Ramsahadeo Project Development Paul Edwards Technical Illustrator Margaret Hewitt Administration Andrew Scott Office Manager Kim Hamlin, Bren Goodwin Reader Services Tim Salmon, Val Tregidgo Advertising Mark Strathern (Manager), Tom Moloney
	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

COPYRIGHT: All material is subject to world wide Copyright protection. All reasonable care is taken in the preparation of the magazine to ensure accuracy but ETI cannot be held responsible for it legally. Where errors do occur a correction will be published as soon as possible afterwards.

High quality audio modules for Stereo and mono

S450

STEREO FM TUNER
Fitted with phase lock-loop

£22.30
+ 40p p&p
+ 12½% VAT

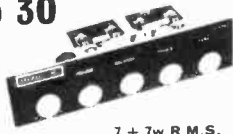


The 450 Tuner provides instant programme selection at the touch of a button ensuring accurate tuning of 4 pre-selected stations, any of which may be altered as often as you choose, simply by changing the settings of the pre-set controls. Features include FET input stage. Vari-Cap diode tuning. Switched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

FREQUENCY RANGE	88-108 Mhz
SENSITIVITY	3 0 µV
BANDWIDTH	250 kHz
SPURIOUS REJECTION	50 dB
SELECTIVITY ± 400 kHz	55 dB
AUDIO OUTPUT (22.5 kHz deviation)	100 mV
STEREO SEPARATION	30 dB
SUPPLY REQUIREMENTS	20 to 30V (90mA max)
AERIAL IMPEDANCE	75 ohms
DIMENSIONS	240mm x 110mm x 32mm

Stereo 30

COMPLETE AUDIO CHASSIS
£18.95
+ 40 p&p
+ 12½% VAT



7 + 7w R.M.S.

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

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

MPA30

MAGNETIC CARTRIDGE PRE-AMPLIFIER

Enjoy the quality of a magnetic cartridge with your existing ceramic equipment using the MPA30 which is a high quality pre-amplifier enabling magnetic cartridges to be used where facilities exist for the use of ceramic cartridges only.

£2.95
+ 35p p&p
+ 12½% VAT



SENSITIVITY	3.5 mV for 100 mV output
EQUALISATION	Within ± 1 dB from 20 Hz to 20 kHz
INPUT IMPEDANCE	50 K ohms
SUPPLY	18 to 30 V—re earth
DIMENSIONS	110 x 50 x 25mm (inc DIN socket)

PA12

STEREO PRE-AMPLIFIER

The PA12 Stereo Pre-Amplifier chassis is designed and recommended for use with the AL20/30 Audio Amplifier Modules, the PS12 power supply and the T538 Transformer. Features include on/off volume, Balance, Bass and Treble controls. Complete with tape output.

£7.10
+ 30p p&p
+ 12½% VAT

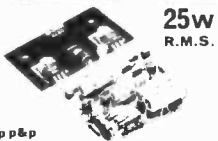


FREQUENCY RESPONSE	20 Hz-20 kHz (-3dB)
BASS CONTROL	± 12 dB at 60 Hz
TREBLE CONTROL	± 14 dB at 10 kHz
INPUT IMPEDANCE	1 Meg. ohm
INPUT SENSITIVITY	300 mV
CROSSTALK	-60 dB
SIGNAL/NOISE RATIO	-65 dB
OVERLOAD FACTOR	± 20 dB
TAPE OUTPUT IMPEDANCE	25 K ohms
DIMENSIONS	152mm x 84mm x 25mm

AL60

AUDIO AMPLIFIER MODULE
25 Watts RMS

£4.55
+ 35p p&p
+ 12½% VAT



25w R.M.S.

This high quality audio amplifier module is for use in audio equipment and stereo amplifiers and provides output powers up to 25 RMS with distortion levels below 0.1%.

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

PS12 POWER SUPPLY

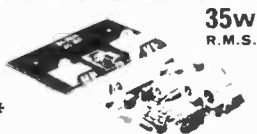
Designed for use with the AL30A S.450 and MPA30 in conjunction with transformer T538.

INPUT VOLTAGE	17-20v AC	£1.30 + 35p p&p + 12½% VAT
OUTPUT VOLTAGE	27-30v DC	
OUTPUT CURRENT	800mA	
SIZE	60mm x 43mm x 26mm	

AL80

AUDIO AMPLIFIER MODULE

£7.15*
+ 35p p&p
+ 8% VAT



35w R.M.S.

The AL80 is similar in design to the AL60 above and is of the same high quality but provides output powers up to 35W with distortion levels below 0.1%.

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

GE 100 NINE CHANNEL MONO-GRAPHIC EQUALIZER

The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut limits are ± 12dB. Max. Voltage handling 2 V RMS, T.H.D., 0.05%, input impedance 100K. Output impedance less than 10K. Frequency response 20 Hz-20 KHz (3dB). The nine gain controls are centred at 50, 100, 200, 400, 800, 1,600, 3,200, 6,400 and 12,800 Hz. The suggested gain controls are 10 K LIN sliders (not supplied with the module) See Paks S31 and 16192. + 35p p&p + 12½% VAT

£22.00

SG30 POWER SUPPLY BOARD for GE100 15.0-15 VOLT **£5.50** + 12½% VAT + 35p p&p

AL250

POWER AMPLIFIER

£17.25*
+ 40p p&p + 8% VAT



125w R.M.S.

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

OUTPUT POWER	125 Watts RMS continuous
OPERATING VOLTAGE	50-80 V
LOADS	4-16 ohms
FREQUENCY RESPONSE	25 Hz to 20 kHz measured at 100 Watts
SENSITIVITY FOR 100 WATTS O/P AT 1 kHz	450 mV
INPUT IMPEDANCE	33 K ohms
TOTAL HARMONIC DISTORTION	
50 WATTS into 4 ohms	0.1%
50 WATTS into 8 ohms	0.06%

SIREN ALARM MODULE

American Police screamer powered from any 12 volt supply into 4 or 8 ohm speaker. Ideal for car burglar alarm, freezer breakdown and other security purposes. Order No. S15. No. BP124. Only **£3.50** + 8% VAT + 25p p&p

AL30A

AUDIO AMPLIFIER MODULES

£3.75
+ 35p p&p
+ 12½% VAT



10w R.M.S.

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

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

MA60 HI-FI AMPLIFIER KIT

Build your own top quality amplifier, save yourself pounds. The MA60 kit comprises the following BI-PAKs modules, 2 x AL60 amps, 1 x PA100 pre-amp, 1 x SPM80 stab. power supply, 1 x BMT80 transf. giving 17 watts RMS per channel STEREO. All modules covered by the BI-PAK satisfaction or money back guarantee. Details of the above modules are in this ad. Price **£32.00** + 12½% VAT + 62p p&p.

SPM80

STABILISED POWER SUPPLY

£4.25
+ 35p p&p
+ 12½% VAT



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

INPUT A.C. VOLTAGE	33-40V
OUTPUT D.C. VOLTAGE	33 V nominal
OUTPUT CURRENT	10 mA-1.5 amps.
OVERLOAD CURRENT	1.7 amps approx.
DIMENSIONS	105mm x 63mm x 30mm

TC60 KIT

A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional touches to your home built amplifier. Full set of parts incl. Front & Back Panels, Knobs, Chassis, Fuses, Sockets, Nuts, etc. Ideal for the MA60. Size: 425mm x 290mm x 95mm. Price **£19.95** + 12½% VAT + 86p p&p

PA100

STEREO PRE-AMPLIFIER

£15.80
+ 40p p&p
+ 12½% VAT



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

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

TRANSFORMERS

T538 For use with S.450 AL30A MPA30 Order No. 2036 Price: **£3.20** + 55p p&p + 12½% VAT
T2050 For use with Stereo 30 Order No. 2050 Price: **£3.25** + 55p p&p + 12½% VAT
BMT80 For use with AL60 SPM80 Order No. 2034 Price: **£5.40** + 86p p&p + 12½% VAT
BMT250 For use with AL250 Order No. 2035 Price: **£6.35** + **£1.10** p&p + 12½% VAT

BI-PAK

DEPT. E.T.I. 11, P.O. Box 6, Ware, Herts.

SEMICONDUCTORS - COMPONENTS

CERAMIC PAK

Containing a range of first quality miniature ceramic capacitors.

16160	- 24 - 3 of each value	22pf, 27pf, 33pf, 39pf, 47pf, 68pf, 82pf	60p
16161	- 24 - 3 of each value	100pf, 120pf, 150pf, 180pf, 220pf, 270pf, 330pf, 390pf	60p
16162	- 24 - 3 of each value	470pf, 560pf, 680pf, 820pf, 1000pf, 15000pf, 2200pf, 2200pf, 3300pf	60p
16163	- 21 - 3 of each value	4700pf, 6800pf, -0.1uf, -0.15uf, -0.22uf, -0.33uf, -0.47uf	60p

ELECTROLYTIC PAKS

A range of paks each containing 18 first quality, mixed value miniature electrolytics.

16201	- values from	-47mFD - 10mFD	60p
16202	- values from	10mFD - 100mFD	60p
16203	values from	100mFD - 680mFD	60p

CARBON RESISTOR PAKS

These paks contain a range of Carbon Resistors assorted into the following groups.

16213	- 60 mixed	1/4w 100 ohms - 820 ohms	60p
16214	- 60 mixed	1/4w 1K ohms - 8.2K ohms	60p
16215	- 60 mixed	1/4w 10K ohms - 83K ohms	60p
16216	- 60 mixed	1/4w 100K ohms - 820K ohms	60p
16217	- 40 mixed	1/2w 100 ohms - 820 ohms	60p
16218	- 40 mixed	1/2w 1K ohms - 8.2K ohms	60p
16219	- 40 mixed	1/2w 10K ohms - 82K ohms	60p
16220	- 40 mixed	1/2w 100K ohms - 820K ohms	60p
16230	- 60 mixed	1/2w 1 Meg - 10 Meg ohms	60p
16231	- 40 mixed	1/2w 1 Meg - 10 Meg ohms	60p
16231	- 40 mixed	1/2w 1 Meg - 10 Meg ohms	60p

COMPONENT PAKS

16164	- 200 Resistor mixed value approx	(Count by weight)	60p
16165	- 150 Capacitors mixed value approx	(Count by weight)	60p
16166	- 50 Precision resistors	Mixed values	60p
16167	- 1/4w resistors	Mixed values	60p
16168	- 5 pieces assorted	ferrite rods	60p
16169	- 2 Tuning gangs	MW/LW VHF	60p
16170	- 1 Pack wire	50 meters, assorted colours, single strand	60p
16171	- 10 Reed switches		60p
161	- 3 Micro switches		60p
16173	- 15 Assorted pots		60p
16174	- 5 Metal jack sockets	3 x 3.5 mm 2 x standard switch types	60p
16175	- 30 Paper condensers	- mixed values	60p
16176	- 20 Electrolytics	trans. types	60p
16177	- 1 Pack assorted hardware	Nuts, bolts, gromets, etc	60p
16178	- 5 Mains slide switches	assorted	60p
16179	- 20 Assorted tag strips	and panels	60p
16180	- 15 Assorted control knobs		60p
16181	- 3 Rotary wave change switches		60p
16182	- 2 Relays	6-24v operating	60p
16183	- 1 Pak copper laminate	approx 200 sq inches	60p
16184	- 15 Assorted fuses	100mA-5 amp	60p
16185	- 50 metres PVC sleeving	assorted size and colours	60p

METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor - like Mullard C280 series. Mixed values ranging from -0.1uf-2.2uf. Complete with identification sheet O/N 16204

SLIDER PAKS

16190	- 6 Slider potentiometers	mixed values	60p
16191	- 6 Slider potentiometers	all 470 ohm	60p
16192	- 6 Slider potentiometers	all 10k in	60p
16193	- 6 Slider potentiometers	all 22k in	60p
16194	- 6 Slider potentiometers	all 47k in	60p
16195	- 6 Slider potentiometers	all 47k log	60p

TRANSISTORS

BRAND NEW - FULLY GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
AC126	£0.18	BC108C	£0.10	BC479	£0.20	BFX87	£0.22	TIP418	£0.51	2N3646	£0.09		
AC127	£0.18	BC109A	£0.08	BC549	£0.12	BFX88	£0.22	TIP41C	£0.53	2N3702	£0.08		
AC128	£0.18	BC109B	£0.09	BC548	£0.12	BFX90	£0.55	TIP42A	£0.53	2N3703	£0.08		
AC128K	£0.26	BC109C	£0.10	BC549	£0.12	BFY50	£0.16	TIP42B	£0.55	2N3704	£0.07		
AC132	£0.20	BC147	£0.08	BC550	£0.14	BFY51	£0.18	TIP42C	£0.57	2N3705	£0.07		
AC134	£0.20	BC148	£0.08	BC555	£0.14	BFY52	£0.18	TIP2955	£0.65	2N3706	£0.08		
AC137	£0.20	BC149	£0.08	BC557	£0.13	BP19	£0.38	TIP3055	£0.50	2N3707	£0.08		
AC141	£0.22	BC157	£0.10	BC558	£0.12	BP20	£0.38	TIS43	£0.24	2N3708	£0.07		
AC141K	£0.30	BC158	£0.10	BC559	£0.14	BP19/20MP		TIS90	£0.22	2N3708A	£0.07		
AC142	£0.20	BC159	£0.10	BD115	£0.50			UT46	£0.22	2N3709	£0.07		
AC176	£0.18	BC167	£0.12	BD116	£0.50	BRY39	£0.45	ZTX107	£0.10	2N3710	£0.07		
AC176K	£0.26	BC168	£0.12	BD121	£0.65	SU1005	£1.40	ZTX109	£0.10	2N3711	£0.07		
AC178	£0.25	BC169	£0.12	BD124	£0.70	BU105/02	£1.95	ZTX109	£0.10	2N3819	£0.20		
AC179	£0.25	BC169C	£0.12	BD131	£0.38	BU204	£1.70	ZTX300	£0.12	2N3820	£0.35		
AC180	£0.20	BC170	£0.10	BD132	£0.40	BU205	£1.40	ZTX500	£0.14	2N3821	£0.60		
AC180K	£0.28	BC171	£0.10	BD131/132MP		BU208/02	£2.95	2N1613	£0.20	2N3822	£0.60		
AC181	£0.20	BC172	£0.10	BD115	£0.85	E1222	£0.38	2N1711	£0.20	2N4058	£0.12		
AC181K	£0.28	BC173	£0.12	BD133	£0.40	MJE2955	£0.88	2N1889	£0.45	2N4059	£0.14		
AC187	£0.18	BC177	£0.16	BD135	£0.38	MJE3055	£0.80	2N1890	£0.45	2N4060	£0.14		
AC187K	£0.20	BC178	£0.16	BD136	£0.35	MJE3440	£0.52	2N1893	£0.30	2N4061	£0.12		
AC188	£0.18	BC179	£0.16	BD137	£0.35	MP8113	£0.52	2N1247	£0.75	2N4062	£0.12		
AC188K	£0.20	BC180	£0.25	BD138	£0.40	MPF102	£0.35	2N1248	£0.70	2N4284	£0.18		
AD140	£0.60	BC181	£0.25	BD139	£0.36	MPF104	£0.38	2N2160	£1.00	2N4285	£0.18		
AD142	£0.85	BC182L	£0.10	BD140	£0.36	MPF105	£0.38	2N2192	£0.38	2N4286	£0.18		
AD143	£0.75	BC183	£0.10	BD139/140M	£0.80	MPSA05	£0.30	2N2193	£0.38	2N4287	£0.18		
AD149	£0.60	BC183L	£0.10	BD179	£0.75	MPSA06	£0.30	2N2194	£0.38	2N4288	£0.18		
AD161	£0.42	BC184L	£0.60	BD155	£0.80	MPSA55	£0.28	2N2217	£0.22	2N4289	£0.18		
AD162	£0.42	BC207	£0.11	BD175	£0.60	MPSA56	£0.28	2N2218	£0.22	2N4290	£0.18		
AD161/161MP		BC208	£0.11	BD176	£0.60	OC22	£1.50	2N2218A	£0.20	2N4291	£0.18		
AF114	£0.35	BC209	£0.12	BD177	£0.68	OC23	£1.50	2N2219	£0.20	2N4292	£0.18		
AF115	£0.21	BC212	£0.11	BD178	£0.68	OC24	£1.35	2N2219A	£0.24	2N4293	£0.18		
AF116	£0.21	BC212L	£0.11	BD179	£0.75	OC25	£1.00	2N2904	£0.21	2N4921	£0.65		
AF117	£0.21	BC213	£0.11	BD201/202MP	£0.26	OC26	£1.00	2N2904A	£0.24	2N4923	£0.65		
AF117	£0.21	BC213L	£0.11		£1.70	OC28	£0.80	2N2905	£0.18	2N5135	£0.10		
AF118	£0.40	BC214	£0.12	BD203	£0.80	OC29	£0.95	2N2905A	£0.20	2N5136	£0.10		
AF124	£0.30	BC214L	£0.12	BD204	£0.80	OC35	£0.90	2N2906	£0.16	2N5138	£0.10		
AF125	£0.30	BC237	£0.16	BD203/204MP	£0.36	OC36	£0.90	2N2906A	£0.19	2N5194	£0.56		
AF126	£0.30	BC238	£0.16		£1.70	OC71	£1.20	2N2907	£0.20	2N5245	£0.40		
AF127	£0.32	BC251	£0.16	BDY20	£0.80	OC71	£1.05	2N2907A	£0.22	2N5294	£0.64		
AF139	£0.35	BC251A	£0.16	BDY20	£0.90	TIC44	£0.29	2N2966	£0.09	2N5296	£0.56		
AF180	£0.40	BC301	£0.28	BF457	£0.37	TIC45	£0.35	2N2926V	£0.08	2N5457	£0.32		
AF181	£0.60	BC302	£0.28	BF458	£0.37	TIP29A	£0.40	2N29260	£0.08	2N5458	£0.32		
AF186	£0.58	BC303	£0.28	BF459	£0.38	TIP29B	£0.52	2N2926R	£0.08	2N5459	£0.35		
AF239	£0.35	BC304	£0.38	BF594	£0.30	TIP29C	£0.50	2N2926B	£0.08	2N5551	£0.36		
AL102	£1.20	BC327	£0.16	BF596	£0.28	TIP30A	£0.50	2N3053	£0.16	2N6027	£0.39		
AL103	£1.20	BC328	£0.15	BF939	£0.24	TIP30B	£0.60	2N3054	£0.40	2N6121	£0.70		
AU104	£1.18	BC337	£0.15	BF940	£0.25	TIP30C	£0.60	2N3055	£0.40	2N6122	£0.70		
AU110	£1.00	BC338	£0.15	BF979	£0.28	TIP31A	£0.45	2N3414	£0.16				
AU113	£1.00	BC440	£0.30	BF980	£0.28	TIP31B	£0.47	2N3415	£0.16				
BC107A	£0.08	BC441	£0.30	BF979	£0.22	TIP31C	£0.49	2N3416	£0.29				
BC107B	£0.09	BC460	£0.38	BFX00	£0.30	TIP32A	£0.49	2N3417	£0.29				
BC107C	£0.10	BC461	£0.38	BFX84	£0.28	TIP32B	£0.51	2N3614	£1.00				
BC108A	£0.08	BC477	£0.20	BFX85	£0.24	TIP32C	£0.53	2N3615	£1.05				
BC108B	£0.09	BC478	£0.20	BFX86	£0.25	TIP41A	£0.49	2N3616	£1.05				

74 SERIES TTL ICs

BI-PAK STILL LOWEST IN PRICE FULL SPECIFICATION GUARANTEED

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
7400	£0.10	7409	£0.13	7441	£0.50	7482	£0.68	7493	£0.30	74122	£0.39		
7401	£0.11	7410	£0.12	7442	£0.54	7483	£0.70	7494	£0.75	74123	£0.38		
7402	£0.11	7411	£0.12	7443	£0.54	7484	£0.85	7495	£0.55	74141	£0.55		
7403	£0.11	7412	£0.20	7447	£0.60	7485	£0.88	7496	£0.62	74154	£0.95		
7404	£0.11	7413	£0.24	7448	£0.56	7486	£0.25	74100	£0.92	74180	£0.84		
7405	£0.11	7414	£0.50	7475	£0.29	7489	£1.05	74110	£0.45	74181	£1.60		
7406	£0.26	7416	£0.16	7480	£0.44	7490	£0.32	74118	£0.80	74190	£1.00		
7407	£0.26	7417	£0.28	7481	£0.85	7491	£0.64	74119	£1.18	74198	£1.45		
7408	£0.13	7440	£0.12			7492	£0.37	74121	£0.24	74199	£1.45		

CMOS ICs

Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price	Type	Price
CD4000	£0.15	CD4012	£0.20	CD4022	£0.90	CD4031	£2.20	CD4046	£1.30	CD4071	£0.23		
CD4001	£0.18	CD4013	£0.22	CD4023	£0.20	CD4035	£1.30	CD4047	£1.10	CD4072	£0.23		
CD4002	£0.18	CD4015	£0.98	CD4024	£0.80	CD4037	£0.95	CD4049	£0.55	CD4081	£0.20		
CD4006	£0.98	CD4016	£0.50	CD4025	£0.20	CD4040	£0.95	CD4050	£0.55	CD4082	£0.23		
CD4007	£0.18	CD4017	£0.98	CD4026	£0								

AUDIO KITS OF DISTINCTION FROM **POWERTRAN**

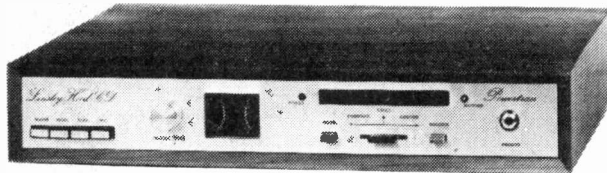


DE LUXE EASY TO BUILD LINSLEY-HOOD 75W AMPLIFIER £99.30 + VAT

This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in *Hi-Fi News and Record Review* and features include rumble filter, variable scratch filter, versatile tone controls and tape monitoring whilst distortion is less than 0.01%.

WIRELESS WORLD FM TUNER £70.20 + VAT

A pre-aligned front-end module makes this Wireless World published design very simple to construct and adjust without special instruments. Features include an excellent a.m. rejection, push-button station selection as well as infinitely variable tuning and a phase locked loop stereo decoder incorporating active filters for "birdy" suppression.

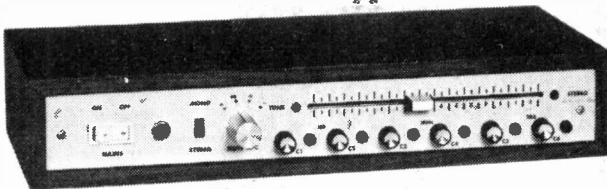
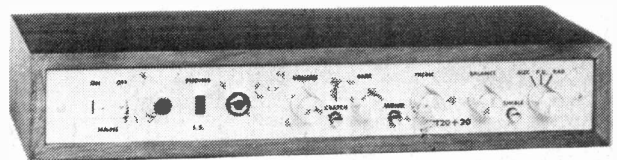


LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

This design, published in *Wireless World*, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco CRV with electronic speed control.

T20 + 20 AMPLIFIER £33.10 + VAT

This kit, based upon a design published in *Practical Wireless*, uses a single printed circuit board and offers at very low cost, ease of construction and all the normal facilities found on quality amplifiers. A 30 watt version of this kit (T30 + 30) is also available for £38.40 + VAT.

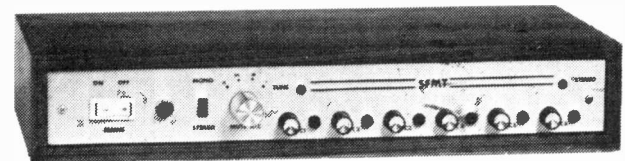


WWII TUNER £47.70 + VAT

This cost reduced model of our highly successful Wireless World FM Tuner kit was designed to complement the T20 + 20 and T30 + 30 amplifiers and the cabinet size, front panel format and electrical characteristics make this tuner compatible with either. Facilities included are pre-aligned front-end module, switchable afc, adjustable switchable muting, LED tuning indication and both continuous and push-button channel selection (adjustable by controls on the front panel).

POWERTRAN SFMT TUNER £35.90 + VAT

This is a simple low cost design which can be constructed easily without special alignment equipment but which still gives a first class output suitable for feeding any of our very popular amplifiers or any other high quality audio equipment. A phase-locked-loop is used for stereo decoding and controls include switchable afc, switchable muting and push-button channel selection (adjustable by controls on the front panel). This unit matches well with the T20 + 20 and T30 + 30 amplifiers.



COMPLETE KITS: Our complete kits really are complete. All of the projects shown on this page are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cables, nuts, bolts, etc., and full instructions — in fact everything!

All of the kits shown on this page are available as separate packs (except the Powertran SFMT Tuner) for those customers who wish to spread their purchase or perhaps make their own cabinets or metalwork. Prices are given in our FREE CATALOGUE.

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

EXPORT ORDERS: No VAT. Postage charged at actual cost plus 50p handling and documentation.

U.K. ORDERS: Subject to 12% surcharge for VAT* (i.e. add 1/8 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!

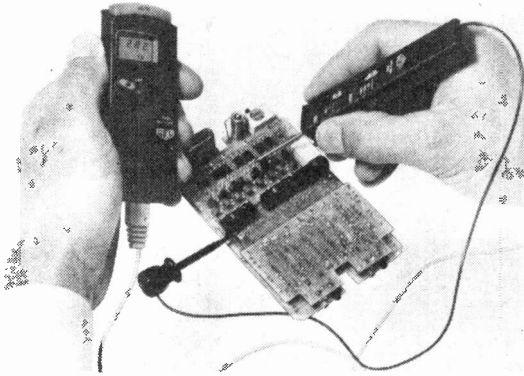
POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER HANTS SP10 3NM

ANDOVER
(0264) 64455

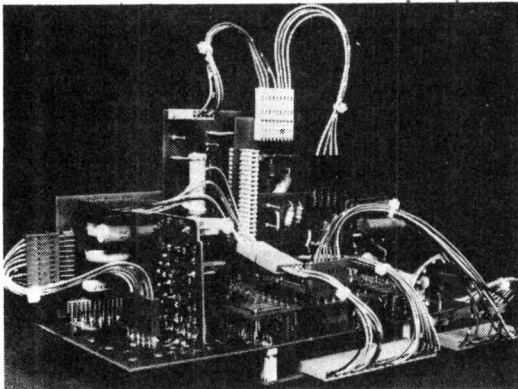
news digest

dmm(digital midget meter?)



Guinness take note — the world's smallest DMM it seems. Made by Heuer Time Ltd it measures just 4" x 1.6" x 0.5" (100 x 40 x 20mm to you Euro-people) with a probe which is 4" x 0.8" x 0.5" (you mm lot can work that out yourselves). Volts Ohms and Amps either DC or AC can be accommodated between 2V-1kV, 2mA-2A and 2k-20M although not necessarily in that order. AC measurement is true RMS. Display is 3½ digit LCD. Input 7 10M +Price around £240. Address: Heuer Ltd, Argyle House, 29/31 Euston Road, London.

the dalek connection



This lot looks like it could give Dr Who a few sleepless nights does it not? It's easy to imagine it lumbering across a smoke-circled hill and intoning "Take me to your leader. . . ."

Perhaps fortunately for the human race it is simply a noteworthy new connection system from Pressac Ltd. The PCB mounting plugs and sockets can be got at from either direction, and cable and chassis mounting assemblies are also available. Spacing can be either 2.5mm or 5.0mm and up to 40 ways are possible. Pressac Ltd, Acton Grove, Long Easton, Nottingham NG10 1FW.

eye of the tornado?

Britain and NATO's new aircraft the MRCA Tornado is to be fitted — in its inceptor role — with a Visual Augmentation System developed by Marconi. The system presents the crew with a television picture of what lies ahead of their machine using a newly-developed low-light TV camera system.

Based on an existing Marconi design for a low light camera, the equipment produces an image at ranges far in excess of what the unaided eye can manage, and in light conditions anywhere from daylight to starlight.

Every little helps. . . .

on the face of it

It had to come. Someone somewhere had to go produce an ANALOGUE digital watch. And here we have it. Must confess it looks very nice too. Texas get the credit/blame or whatever.

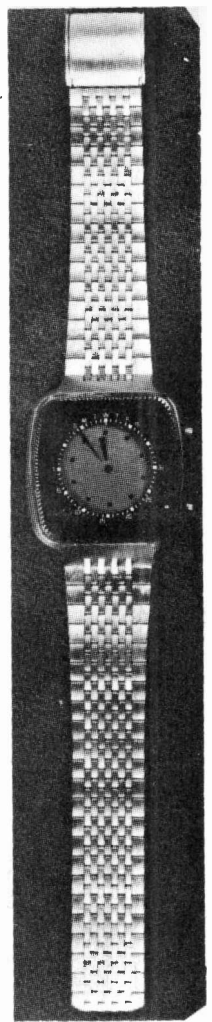
The display is beautiful. 120 segments are used to produce the illusion of the dial. On normal LCD's up to half the area is used for contacts to the segments, which would mean that with 121 contacts to provide the display would have to be pretty big — a clock yes, but no watch. Texas have gotten this by multiplexing the drive to the segments, which allows 90% of the area to be freed for usage.

The chip is I²L — and this is unusual. I²L is not normally employed in LCD units because of the problem of driving the highly capacitive elements. Bipolar drivers are used to avoid this, and are designed to drive the large capacitance with a (relatively) large 150µA initial current for about 100 µS and to provide the 100 nA 'sustain' current thereafter.

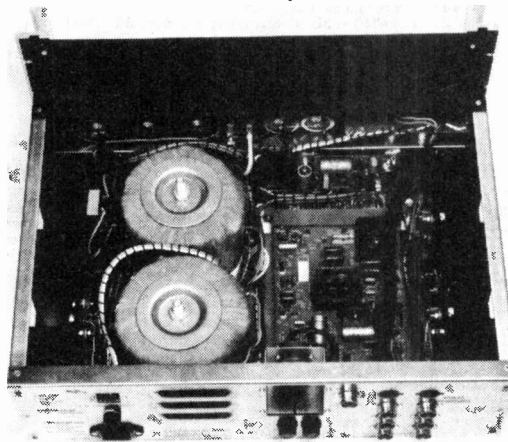
Another interesting point is that the material used for the display, a low voltage ester material would not usually be employed in watches because of its negative temp. Coeff. — higher the temp. the lower the drive required — which can lead to 'ghosting' and confusion of the display. The I²L however can compensate for this.

Naturally, since this is the first of its kind, the price of all this invention will be high initially — but the watch will function as a chronograph too and the Jones's will NEVER be able to keep up with this.

In the shops soon we hear.



watt batteries



Here is an amp to really annoy the neighbours with. If they complain about the hi-fi again, pack up the battery cassette recorder, speakers and this PAC 250 MB, drive around the back of the house and when they're least expecting it give 'em 250W a channel straight in the back door. An outflanking move to warm Napoleon's heart.

The PAC 250 you see will run quite happily from 24V DC or 250V AC. Very handy for PA as well as neighbour baiting.

Details from: Millbank Electronics Ltd, Uckfield, Sussex TB22 1PS.

Sound of safety?

A car alarm which operates on the ultrasonic area protection principle usually employed in houses is now being imported from the land of pasta and pinched bottoms.

Called the 'Break' it uses four sensors to cover the interior of any vehicle, and has adjustable sensitivity so that spurious triggering can be avoided. Once activated you have 40 secs to clear out before it goes off — so don't get stuck in the seat belt — and coming back in 10 secs to switch it off.

Once the alarm is in mid sing-song, the removal of the felon will lead to a shutdown 15 secs later. If he persists so will the alarm. Price around £50 — not including ear plugs — from:

Sofare Ltd, Stoke Heath, Market Drayton, Shropshire.

all change

This is the month when the BBC plays hide and seek with the four stations. They are gonna move 'em — you've gotta find 'em again. Fun eh? Radio One goes to 275m and 285m; Radio 2 goes to 433m and 330m; Radio 3 goes to 247m; and Radio 4 vanishes onto long wave at 1500m. VHF is unchanged thank God.

The Beebs purpose in shuffling dials is to reduce interference from overseas stations. New transmitters are being fitted in some areas, so how it behaves now is no indication of how well you'll get the station once they change it around. Radio 2 will now be better in the day, but worse at night, with Radio 3 generally better.

The movement is to fit in with new European agreements which will allow more stations with better coverage to use the MW and LW bands, so we shouldn't complain.

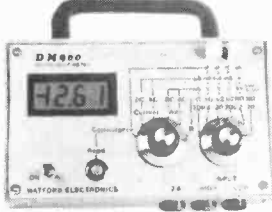
Oh yes there is one more thing. Up to the switch — November 23 will dawn with the new frequencies operating — unscheduled breaks in transmission will occur in MW and LW programmes lasting between a blink and several minutes. Don't smash your set it's the BBC's fault. They're working on the transmitters and aerials now to ready them for the big switch over, and well you never know who might drop a spanner or two. . . .

Details will be plastered all over radio, TV and Radio Times between now and then so don't worry about not hearing what's going on. It's most unlikely.

short stuff

- GI has released an appliance timer — the AY-3-1251-MPU-based it is, and can be used in such things as cookers to replace nasty mechanical things like clocks. Two versions are available and facilities include keyboard entry, direct display drive, four outputs et al.
- A new digital logic family called FAST (Fairchild Advanced Schottky TTL) is to be released soon. Power consumption is much lower than normal types — about 25% in fact. Typical delays are about 3 nS — hence the name. 66 circuits will be released by the year's end. Price? Competitive apparently, whatever that means.
- Prom programming overnight is offered by Memec Ltd of Thame Park Industrial Estate, Thame, Oxon. A 24hr turnaround is quoted and all types of PROM can be handled.
- RCA have a new chip out which a smoke detector unto itself. It requires only an ionisation chamber and horn alarm to begin detecting and alarming. The number is T-A 10451 and it will operate on either battery or line.
- Britain has produced a new design of terminal to operate with the European OTS test satellite. The idea is a joint venture between Marconi, the Post Office and the Department of Industry.
- Compe 78 will be held at Olympic this year to allow for more exhibitors. The exhibition deals with small systems, minis and micros, software and hardware and Uncle Tom Cobley and all.
- Supervisor is a remote controlled helicopter for use on the modern battlefield. It has been developed by Marconi and Westland. The machine stands about as high as a man and contains cameras and other surveillance equipment. It has just passed its first flight tests successfully and could be of great use to NATO when in service.
- Two books from GI to fill up the bookshelves usefully are the 600p Catalogue and the 300p Applications Handbook. Both will be of great use indeed to both engineers and serious home dabblers. They cost £3.00 and £1.80 respectively from any GI distributors.
- Toshiba and Rank have completed an agreement to produce TV sets and audio equipment in Plymouth and Cornwall.
- Texas Instruments new 64K RAM is at last released. Automation in production means that by 1980 each unit will require only 5 man MINUTES to produce from start to finish, and that a mere 1000 staff will be able to service entire world demand!

WATFORD ELECTRONICS



Introducing DM900 — The DIGITAL MULTIMETER with "Hidden Capacity" — It measures Capacitance too!

(as published in E.T.I. August 1978)
Away with analogue meters for with some of these you may often as not use a crystal ball to make circuit measurements instead gaze into our crystal — not a ball but the 3½ 0.5 LIQUID CRYSTAL DISPLAY — on our amazingly accurate DMM incorporating

5 AC & DC Voltage ranges, 6 resistance ranges
5 AC & DC Current ranges; 4 Capacitance ranges
The prototype accuracy is better than 1%

This is a unique design using the latest MOS ICs and due to the minimal current drain, is powered by only one PP3 battery. There is also a battery check facility.

The DM900 is an attractive hand-held, light weight device, built into a high impact case with carrying handle and has been ingeniously designed to simplify assembly.

Never before have all these features been offered to the electronics enthusiast in a single unit.

Special introductory offer **£54.50*** (p&p insured add 80p)

Calibration service charge for working Units **£5.75**. Readybuilt Units available by special order at **£78.50*** (p&p add 80p)

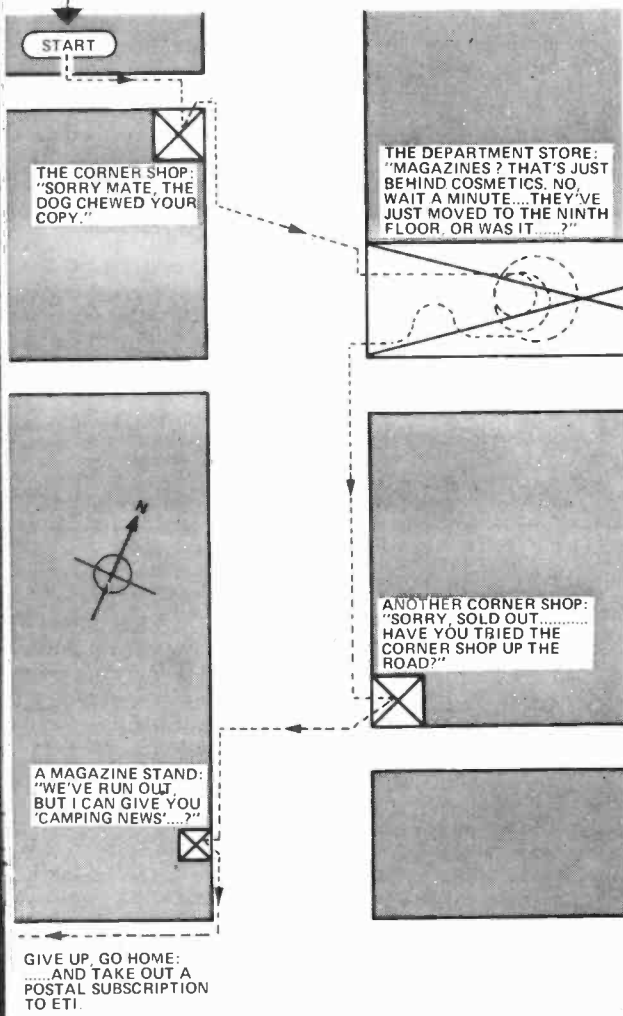
(Optional extras: Probes **£1.50***; Carrying Case **£1.50***)
(Demonstration on at our Shop)

JACK PLUGS		SOCKETS		SWITCHES*		SLIDE 250V	
Screened chrome	Plastic body	open metal	moulded	in-line couplers	TOGGLE 2A, 250V	1A DPDT	14p
2.5mm	12p	8p	8p	break	SPST	1A DPDT c/over	15p
3.5mm	15p	10p	8p	contacts	DPST	½A DPDT	13p
MONO	23p	15p	13p	4 pole	DPDT	4 pole 2-way	24p
STEREO	31p	18p	20p	4 pole on/off	DPDT	PUSH BUTTON	
			24p		SPST on/off	Spring loaded	
			15p		SP changeover	SPST c/over	60p
					SPST on/off	DPDT 6 Tag	85p
					SPST biased	DPDT c/over	65p
					DPDT 6 tags	Non Locking	
					DPDT centre off	Push to Make	15p
					DPDT Biased	Push Break	25p
DIN	PLUGS	SOCKETS	In Line	ROTARY Make your own multiway Switch. Adjustable Stop Shunting Assembly. Accommodate up to 6 Wafers 99p			
2 PIN Loudspeaker	11p	7p	18p	Mains Switch DPST to fit 34p			
3 4.5 Audio	13p	8p	20p	Break Before Make Waters. 1 pole/12 way 47p			
				2p/6 way 3p/4 way 4p/3 way 6p/2 way 5p			
				Spacer and Screen			
CO-AXIAL (TV)	14p	14p	14p	ROTARY (Adjustable Stop)			
				1 pole/2 to 12 way 2p/2 to 6 way 3 pole/2 to 4 way 4 pole/2 to 3 way 41p			
				ROTARY : Mains 250V AC 4 Amp 45p			
PHONO	9p	5p single	15p				
assorted colours	12p	8p double	—				
Metal screened	—	10p 3-way	—				
BANANA 4mm	11p	12p	—				
2mm	10p	10p	—				
1mm	7p	7p	—				
WANDER 3 mm	8p	8p	—				
DC Type	15p	20p	—				
AC 2-pin American	15p	15p	—				

VOLTAGE*

REGULATORS	TRANSFORMERS*	ALUM. BOXES*	PANEL METERS*
T03 Can Type p	6.0-6V 100mA, 9.0-9V 75mA, 12.0-12V 100mA	WITH LID	FSD
1A +ve 5V 12V	8VA: 6V-5A 6V-5A, 9V-4A 9V-4A, 12V-3A	3x2x1	60x46x
15V 18V 145	12V-3A, 15V-2.5A 15V-2.5A	2½x5¼x1½	35mm
MVRS or 12 180	12VA: 4.5V-1.3A 4.5V-1.3A; 6V-1.2A 6V-1.2A	4x4x1½	0-50µA
1A -ve 5V 12V	12V-5A 12V-5A, 15V-4A 15V-4A, 20V-3A	4x2¾x1½	0-100µA
Plastic (T092)	20V-3A (20p p&p)	4x5¼x1½	0-1mA
+ve 0.1A 5V 6V	24VA: 6V-1.5A 6V-1.5A, 9V-1.3A 9V-1.3A	4x2½x2½	0.5mA
8V 12V 15V 30	12V-1A 12V-1A, 15V-8A 15V-8A, 20V-6A	5x4x2	0-10mA
+ve 1A (T0220)	20V-6A (45p p&p)	5x4x2	0-50mA
5V 12V 15V	50VA: 6V-4A 6V-4A, 9V-2.5A 9V-2.5A, 12V-2A	6x4x2	0-100mA
18V 24V 85	12V-2A, 15V-1.5A 15V-1.5A, 20V-1.2A 20V-1.2A	7x5x2½	0-500mA
-ve 0.5A 5V 6V	1.2A 25V-1A 25V-1A, 30V-8A 30V-8A (50p p&p)	8x6x3	0-100µA
8V 12V 15V 95	100VA: 12V-4A 12V-4A, 15V-3A 15V-3A	10x7x3	0-500µA
-ve 1A 5V 12V	20V-2.5A 20V-2.5A, 30V-1.5A 30V-1.5A	10x4¼x3	595p each
5V 12V 15V 60	40V-1.25A 40V-1.25A, 50V-1A 50V-1A (60p p&p)	12x5x3	
LM309K		12x8x3	
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			
LM309K			
LM320-12			
LM320-15			
LM323K			
LM304H			
LM317H			
LM317K			
LM325N			
LM325N			
LM325N			
LM723			

NON-SUBSCRIBERS START HERE



It can be a nuisance can't it, going from newsagent to newsagent? "Sorry squire, don't have it — next one should be out soon."

Although ETI is monthly, it's very rare to find it available after the first week. If it is available, the newsagent's going to be sure to cut his order for the next issue — but we're glad to say it doesn't happen very often.

Do yourself, your newsagent and us a favour. Place a regular order for ETI; your newsagent will almost certainly be delighted. If not, you can take out a postal subscription so there's nothing for you to remember — we'll do it for you.

For a subscription, send us £7.00 (£8.00 overseas) and tell us which issue you want to start with. Please make your payment (in sterling please for overseas readers) to ETI Subscriptions and keep it separate from any other services you want at the same time.

ETI Subscription Service
Electronics Today International
25-27 Oxford Street, London W1R 1RF

TANTALUM CAPACITORS. 1uf 35v.w., 47uf 35v.w., 1uf 35v.w., 2.2uf 35v.w., 3.3uf 16v.w., 4.7uf 35v.w., 6.8uf 25v.w., 6.8uf 35v.w., 10uf 25v.w., 20uf 6v.w., 22uf 16v.w., 33uf 25v.w., 47uf 6v.w. All at 9p each.

CLOCK P.C. BOARDS with Buzzer, Mercury Switch, Transistors, Only I.C. and Display missing @ £1.

.01uf 125v.w. + 10% CAPACITORS @ 10p each

JACKSON C801 VARIABLE CAPACITORS 5pf or 10pf Both 75p each

ELECTRET MICROPHONE INSERT WITH FET PRE-AMP @ £1.85

400mW UNMARKED GOOD ZENERS 3.6v, 6.8v, 10v, 11v, 12v, 13v, 16v, 24v, 30v, 33v, 36volt. All at 10 for 40p.

X BAND GUNN DIODES with data @ £1.65.

X BAND TUNING VARACTOR DIODES 1 To 2pf or 3 To 4pf. Both £1.65 each.

10 AMP S.C.R.'s 100 PIV @ 25p, 400 PIV @ 50p, 800 PIV @ 60p.

MULLARD PRE-AMP I.C. TAA 435 with data @ 40p.

3 PIN PLUG AND SOCKET like R.S. European type with 2 Metres of Cable at 75p pair.

20 PHOTO TRANSISTORS, DARLINGTONS Assorted Untested @ £1.

T.V. S.A.W. FILTERS Untested 3 for 35p.

10 MULTI-TURN TRIM POTENTIOMETERS Assorted @ 60p.

100 MULLARD C280 CAPACITORS @ 57p Assorted.

MULLARD ELECTROLYTICS 2240uf 40v.w. @ 40p, 4500uf 25v.w. @ 40p, 5000uf 10v.w. @ 15p, 6400uf 25v.w. @ 25p.

TAA 661 F.M. I.C. By Cosem @ 50p, RCA CA 3089Q @ £1.

50 VARI-CAP DIODES LIKE BA 102 Untested @ 57p.

50 2 WATT ZENERS Untested Assorted for 57p.

ELECTROLYTICS 2200uf 100v.w. @ 60p, 3300uf 64v.w. @ 50p.

SUB-MINIATURE 4.7uf 10v.w. TANTALUMS @ 6 for 25p.

MOS PRE-AMPLIFIER I.C. TAA 320 with data @ 35p.

McMURDO 8 PIN PLUGS @ 20p, **8 PIN SOCKETS** @ 20p, **COVERS** @ 15p.

2 GHz NPN STRIPLINE TRANSISTORS @ £1 each.

20 WATT ZENER DIODES BZY 93 Types. 6.8v, 7.5v, 8.2v, 9.1v, 10v, 11v, 15v, 16v, 18v, 20v, 22v, 27v, 30v. All at 145p each.

DUAL GATE MOS FET LIKE 40673 @ 33p, 4 for £1.10.

TEN TURN POTENTIOMETERS 500 ohm, 1K, 2K, 5K, 100K All at £1.50 each.

ERIE RED CAP. .01uf 100v.w. SUB-MINIATURE CAPACITORS @ 5p.

BD 187 4 AMP NPN PLASTIC POWER TRANSISTORS @ 25p, 5 for £1.

BAW 62 HIGH SPEED DIODES 12 for 35p.

OCTAL BASE CATHODEON CRYSTAL OVEN 6 or 12 volt. with Two HC6U HOLDERS and octal Base @ £1.25.

TRANSFORMERS 240 Volt Input. Type 1. 24 volt Tapped at 14 volt 1 amp @ £1.30 (P&P 25p). Type 2. 22-0-22volt 500mA @ £1.60 (P&P 25p). Type 3. 50volt 10amp @ £5.50 (P&P 95p). Type 4. 20volt 2 Amp Twice, 10volt 1 Amp Twice @ £4.50 (P&P 95p) Type 5. 45volt 2 amp, 45volt 500mA @ £3.50 (P&P 85p).

RADAR WIDE BAND AMPLIFIER I.C.'s 10 To 150MHz Untested with data 5 for 57p.

LIGHT EMITTING DIODES 2 Dia. Red or Green 15p each.

CMOS I.C.s CD 4001 @ 15p, CD 4011 @ 15p, CD 4020 @ 60p, CD 4029 @ 60p, CD 4043 @ 60p.

FT 241A CRYSTALS 285 KHz at 20p each.

MYLAR MINIATURE CAPACITORS 50v.w., .01uf or .1uf. Both 20p doz.

MINIATURE ROTARY SWITCHES 2 Pole 4 way @ 20p, 1 Pole 10 way 2 Bank @ 40p.

Please add 20p for post and packing unless otherwise stated, on U.K. orders under £2. Overseas orders at cost.

J. BIRKETT

Radio Component Suppliers, 13 The Strait, Lincoln.

GREAT AUTUMN SALE

High Ripple Current Electrolytics . . .
YOU CAN'T MISS THESE

Sprague Powerlytic (Screwed Conns) 33,000µ F 40vdc	£2.00 inc.
Sprague Powerlytic (Screwed Conns) 3,000µ F 100vdc	£1.20 inc.
Plessey Relialytic (Screwed Conns) 15,000µ F 63vdc	£1.80 inc.
Filmcap (Screwed Conns) 15,000µ F 40vdc	£1.50 inc.

Tag Electrolytics*
4,700/40v 60p, 100/150v 40p, 33/450v & 15/450v 40p

HIGH VOLTAGE POLYESTERS*

0.1µ F / 1000vdc	5 for £1.00
0.047µ F / 1000vdc	5 for 60p
0.1µ F / 600vdc	5 for 50p
0.047 / 25v disc Ceramics	£2.00 for 100
1µ F / 400vdc Polyester Blocks Radial Leads	10 for 60p

Resistors:*

10K 1/2 watt by ITT	200 for £1.00
390R 2½ watt	100 for £1.00
Tantalum Beads* 1µ F/35v	10 for 75p
1µ F / 50v	10 for £1.00

Semiconductors*

10a / 50v Bridges	£1.50
18a / 50v Diodes Type 1N1191	5 for £1.00
Opto Isolators Type OPT601 6 pin D.I.L.	2 for £1.50

Meters*

Sangamo Weston 60mm sq. 60-0-60mA	£3.00
Taylor ½ 5 x 3 500µ A calibrated in Degrees Tilt	£3.50

The following Items are not in the Sale

Mk. 2. Metal Locator Kit	£19.60 inc. VAT and P&P
Apollo Logic Tester	£11.75 inc. VAT and P&P
S.R.B. Miniature Soldering Iron 16/18w	£3.75 inc. V.A.T. P&P

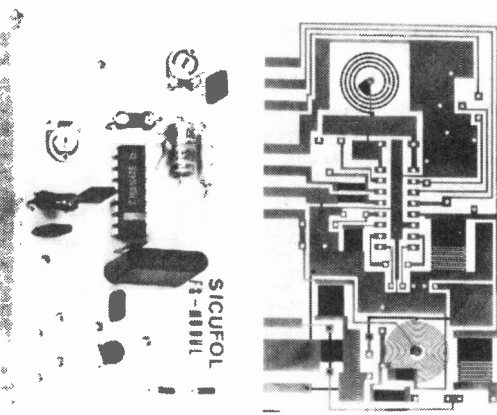
*Please include 35p P&P on orders for goods where P&P is not included. All prices include V.A.T.

R.F. EQUIPMENT SPARES LTD.

3 Lacy Close, Wimborne, Dorset BH21 1PY

Please note that our stores at Poole Road Works are open to personal shoppers on Friday afternoons and all day Saturday.

foiled again

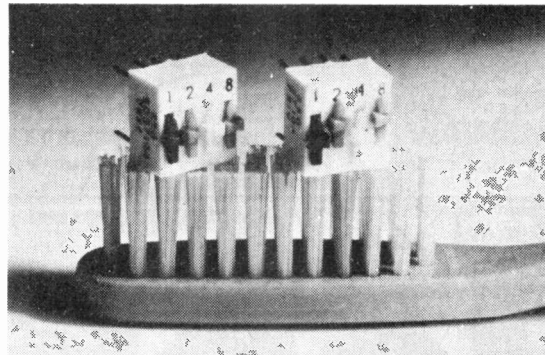


These structures made of chrome-nickel and copper represent an integrated passive circuit with capacitors, coils and resistors, the carrier being a plastic foil. The rectangular, spiral and meandrous shapes largely determine the capacitance, inductances and resistances. Using the name "Sicufol" (Siemens copper foil) Siemens is now offering modules for television sets as the first waves in this new technology.

Resistances up to 300R can be fabricated directly, capacitance to 150pf/cm² and inductances up to 10μH. By meandering the track back and forth, an increase of up to 3800 per given area is possible.

The carrier foil is a kind of Teflon so you shouldn't be stuck for ideas.

eat your heart out colgate



One might question the wisdom of a picture like this, bristling as it is with cunning. At least it's an excuse to brush up on DIL switches. These are made by ERG Components and can switch at up to 10 VA. Fitting a normal DIL format they are numbered in a standard BCD format, and can be very useful in any digital circuitry. Home constructors never seem to make much use of these components for reasons best known to themselves. ERG Components, Luton Road, Dunstable, Bedfordshire.

ooops

Please note that the prices shown on the Gould Advance Ad on Page 14 of the October issue were incorrect. The correct prices are shown on page 14 of this issue. We apologise to Gould Advance and our readers for any inconvenience caused.

TTLS by TEXAS		74283 190p		74LS240 175p		4007 18p		4543 180p		LM3900 70p		TRANSISTORS		DIODES				
7400	13p	74105	65p	74284	400p	74LS241	175p	4008	80p	4553	450p	LM3911	130p	BFY51/2	22p	2N4125/6 22p		
7401	14p	74107	34p	74285	400p	74LS242	175p	4009	40p	4560	250p	LM4136	120p	2N4228	20p	2N4289 20p		
7402	14p	74109	50p	74290	150p	74LS243	175p	4010	50p	4583	90p	*MC1310P	150p	TIP42C	82p	2N4401/3 27p		
7403	14p	74110	55p	74293	150p	74LS244	170p	4011	17p	4584	90p	MC1458	55p	BLY83	700p	TIP2955 78p		
7404	17p	74111	70p	74294	200p	74LS245	170p	4012	18p	40014	90p	MC1495	400p	BRY39	45p	TIP3055 70p		
7405	18p	74116	200p	74385	150p	74LS252	120p	4013	50p	40085	200p	*MC1496	100p	BSX19/20 20p	TIS43	34p	2N5087 27p	
7406	32p	74118	130p	74366	150p	74LS259	175p	4014	84p	40097	90p	*MC3340	120p	BU105	190p	TIS93	30p	2N5089 27p
7407	32p	74119	210p	74367	150p	74LS298	248p	4015	84p	14411	£10	*MFC360	120p	BU108	250p	ZTX108 12p		
7408	18p	74120	110p	74368	150p	74LS373	200p	4016	45p	14412V	£10	*MFC4000B	120p	BU205	220p	ZTX300 13p		
7409	19p	74121	28p	74390	200p	74LS374	180p	4017	80p	14433	£11	MK50398	750p	BU208	240p	ZTX500 15p		
7410	15p	74122	48p	74393	200p			4018	80p					BU406	145p	ZTX502 18p		
7411	24p	74123	55p	74490	225p			4019	45p					MJ481	175p	ZTX504 30p		
7412	20p	74125	55p					4020	100p					MJ491	200p	2N4574 250p		
7413	30p	74128	80p					4021	110p					MJ2501	225p	2N696 35p		
7414	80p	74128	75p					4022	100p					MJ2955	100p	2N697 25p		
7416	27p	74132	75p					4023	22p					MJ3001	225p	2N697/8 40p		
7417	27p	74136	75p					4024	50p					MJE340	65p	2N5450 40p		
7420	17p	74141	70p					4025	20p					MJE340	65p	2N5460 20p		
7421	40p	74142	200p					4026	20p					MJE2955	100p	2N708A 20p		
7422	22p	74145	90p					4027	50p					MJE3055	70p	2N918 45p		
7423	34p	74147	190p					4028	84p					MJE102	45p	2N930 18p		
7425	30p	74148	150p					4029	100p					MFP103/4	40p	2N6254 130p		
7426	40p	74150	100p					4030	50p					MFP105/6	40p	2N6290 65p		
7427	34p	74151A	70p					4031	200p					MPSA12	50p	2N6292 65p		
7428	34p	74153	70p					4032	180p					MPSA12	50p	3N128 120p		
7429	34p	74154	100p					4033	180p					MPSA56	32p	3N140 100p		
7430	17p	74155	90p					4034	200p					MPSU06	83p	3N201 110p		
7431	30p	74156	90p					4035	110p					MPSU56	78p	3N204 100p		
7433	40p	74156	90p					4036	110p					OC28	130p	3N204 100p		
7437	35p	74157	70p					4037	80p					OC28	130p	3N2369A 16p		
7438	35p	74159	190p					4038	90p					OC33	130p	3N2484 30p		
7440	17p	74160	100p					4039	100p					OC33	130p	3N2646 50p		
7441	70p	74161	100p					4040	130p					OC28	130p	3N2904/5 25p		
7442A	60p	74162	100p					4041	80p					OC28	130p	3N2904/5 25p		
7443	112p	74163	100p					4042	80p					OC28	130p	3N2904/5 25p		
7444	112p	74164	120p					4043	90p					OC28	130p	3N2904/5 25p		
7445	100p	74165	100p					4044	90p					OC28	130p	3N2904/5 25p		
7446A	93p	74166	140p					4045	130p					OC28	130p	3N2904/5 25p		
7447A	70p	74167	200p					4046	130p					OC28	130p	3N2904/5 25p		
7448	80p	74170	240p					4047	100p					OC28	130p	3N2904/5 25p		
7450	17p	74172	720p					4048	55p					OC28	130p	3N2904/5 25p		
7451	17p	74173	120p					4049	32p					OC28	130p	3N2904/5 25p		
7453	17p	74174	93p					4050	48p					OC28	130p	3N2904/5 25p		
7454	17p	74175	85p					4051	80p					OC28	130p	3N2904/5 25p		
7460	17p	74176	90p					4052	85p					OC28	130p	3N2904/5 25p		
7470	35p	74177	90p					4053	80p					OC28	130p	3N2904/5 25p		
7472	30p	74178	180p					4054	125p					OC28	130p	3N2904/5 25p		
7473	34p	74180	93p					4055	135p					OC28	130p	3N2904/5 25p		
7474	30p	74181	200p					4056	20p					OC28	130p	3N2904/5 25p		
7475	36p	74182	90p					4057	100p					OC28	130p	3N2904/5 25p		
7476	35p	74183	150p					4058	22p					OC28	130p	3N2904/5 25p		
7480	50p	74185	100p					4059	20p					OC28	130p	3N2904/5 25p		
7482	84p	74190	100p					4060	116p					OC28	130p	3N2904/5 25p		
7483A	90p	74191	100p					4061	120p					OC28	130p	3N2904/5 25p		
7484	100p	74192	100p					4062	115p					OC28	130p	3N2904/5 25p		
7485	110p	74193	100p					4063	120p					OC28	130p	3N2904/5 25p		
7486	36p	74194	100p					4064	55p					OC28	130p	3N2904/5 25p		
7489	210p	74195	95p					4065	22p					OC28	130p	3N2904/5 25p		
7490A	33p	74196	95p					4066	22p					OC28	130p	3N2904/5 25p		
7491	80p	74197	80p					4067	22p					OC28	130p	3N2904/5 25p		
7492A	46p	74198	150p					4068	22p					OC28	130p	3N2904/5 25p		
7493A	33p	74199	150p					4069	20p					OC28	130p	3N2904/5 25p		
7494	84p	74201	160p					4070	30p					OC28	130p	3N2904/5 25p		
7495A	70p	74202	160p					4071	22p					OC28	130p	3N2904/5 25p		
7496	65p	74203	160p					4072	22p					OC28	130p	3N2904/5 25p		
7497	180p	74204	160p					4073	22p					OC28	130p	3N2904/5 25p		
74100	130p	74205	160p					4074	22p					OC28	130p	3N2904/5 25p		
74104	85p	74206	160p					4075	22p					OC28	130p	3N2904/5 25p		

AUDIO AND TEST EQUIPMENT CENTRE

MICROCOMPUTERS LEVEL I AND II TRS80 IN STOCK

ALL PRICES INCLUDE VAT

Only regular stocks listed — other makes and models available.

Telephone your order with Access and Barclaycards



4D10A



DM235



TE20D

LONDON'S TEST GEAR CENTRE
OPEN 6 DAYS A WEEK 9 am-6 pm

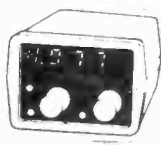
SCOPES — IN STOCK

3" 5MHz single beam	92.50
4B10, 5MHz single beam (4)	107.00
MS15, 15MHz Batt./mains, portable	286.00
MS215, Dual trace version of above	360.00
Super 6/4S6 Scope x 6MHz single beam	149.00
Super 10/4D10A, Scope x 10MHz Dual trace	229.00
4D25, Scope x 25MHz Dual trace	338.00

LOW COST
New 5MHz mains portable scope now in stock
£92.50

LED AND LCD DIGITAL MULTIMETERS

DM235 Sinclair portable 3 1/2 digit LED	52.90
PDM35 Sinclair Pocket 3 1/2 digit LED (30kV Probes 18.25, Mains adaptors 3.75, DM235 carrycase 8.95)	29.95
LM3A 3 Digit Miniature with large LED displays	96.00
LM3.5A 3 1/2 Digit Recharge Batts and charger 17 ranges	106.00
LM40A 4 Digit	210.00
LM300 3 digit Miniature battery operated 17 ranges	87.00
LM350 3 1/2-digit with LCD displays 1 1/2 A/mV resolution	96.00



LM3.5A

MULTI-METERS — GENERAL PURPOSE & ELECTRONIC

Multi-Range Instruments featuring AC/DC volts, DC current Resistance Ranges all with mirror scales except T1/IT1-2/T12/TM3A (TM3 AC volts only) some with AC current etc.

TM11 incredible 120 Range Electronic Multi-meter	136.00
TM3B AC Micro voltmeter 3MHz - 4 Megohm	130.00
TM6B Broadband voltmeter, 300KHz-400MHz	196.00
360TR 100k/volt 23 Range (plus transistor checker), Large scale	35.50
PROE 20k/volt 26 Range, Large scale	32.00
7081 50k/volt 36 Range Multi-meter	23.50
TMK500 30k/volt 22 Range Multi-meter (plus Continuity Buzzer)	21.00
680R 20k/volt 52 Range Pocket Multi-meter	34.50
7200 20k/volt 22 Range Double Multi-meter	17.95
Micro80 20k/volt 26 Range Pocket Multi-meter	17.90
IT1-2 20k/volt 16 Range Popular Multi-meter	11.95
LT22 20k/volt 19 Range Pocket Multi-meter with carry case	14.50
T12 5k/volt 13 Range Pocket Multi-meter	8.95
LT101 1k/volt 12 Range Pocket Multi-meter	7.50
EM2000 FET IC VOM 2D Ranges 10 Meg Input	55.00
K200 FET VOM 38 Ranges	77.00
GT101, 20k/Volt 23 Ranges/Transistor Checker/Continuity Checker	17.95

AVO 8s and a large range of replacement tests leads in stock

GENERAL EQUIPMENT

TE7 Signal Tracer	8.95
SWR50 SWR/Power Meter	19.50
LP30 30MHz Low Pass Filter	4.95
CX3A 150Watt 3-way AE Switch	7.50
CD25KV 100 Meg HV Probe	11.95
9 Value CAP Subs Box	2.95
DR510 36 Value Resis. Box	3.90
FX2000 Xtal Marker	11.95
TR1000 Transistor checker in/out circuit	11.95
MOD83 Signal Injector	7.50
TT169 in Circuit TR Checker	49.95
LB1 Transistor/Diode Checker	21.50
3101 Clamp Meter 0/1 K ohm. 0/150/300/600 AC Volts 0/300 Amp	32.95
C3042 SWR & FS Meter	9.95
MS319 2x100 Watt Audio Watt Meter	17.50
500V Megohmmeter 500 Megohms	48.00
1000V Megohmmeter 1000 Megohms	55.00
2 1/2 Amp Variable Transformer	19.95
5 Amp Variable Transformer	33.00
10 Amp Variable Transformer	46.00

Decade Resis. Boxes:

1-11, 110 ohm in steps of 1 ohm	33.00
10-111, 110 ohm in steps of 10 ohms	33.00
1-1,111, 110 ohm in steps of 1 ohm	42.50

Cap. Decade Box:

10pF - 111, 110pF in steps of 10pF	33.00
------------------------------------	-------

MICROPHONES, SPEAKERS AND COMPONENTS LARGE RANGE IN STOCK

GENERATORS

TG152 Series RC Oscillators Sine/Square output, 3Hz-300KHz	75.00
TG152D TG152 Dm (with meter)	95.00
TG200 Series RC Oscillators Sine/Square output, 1Hz-1MHz	100.00
TG200D TG200 Dm (with meter)	121.00
TG200 Dmp (Meter & Fine control)	126.00
TG66A Digital Sine Wave Decade control 0.2Hz-1.22MHz	267.00
TE22D (audio) 4 bands, Sine 20-200KHz	65.00
Square 20-150KHz	65.00
TE20D (RF) 6 bands, 120KHz-500MHz	57.00

LOGIC PROBES AND MONITORS

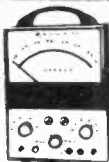
LT2000 Economy Probe, 10MHz	11.95
LM1 Monitor	31.00
LP1 Probe 10MHz	33.48
LP2 15MHz	19.44
16 Pin IC test clip	2.20

PIEZOELECTRIC HORN TWEETERS

Up to 100 watts each. No x-over reqd. Only 4.95 each (P/P 20p)



TM3



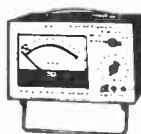
TM11



TMK500



FM7 7 Digit 60MHz Rock. Batt. Freq. counter 156.00
SCS 512MHz Prescaler for above 81.00
MAX100 100 MHz 8 digit batt. operated counter 83.75



TM3

CALL IN AND SEE FOR YOURSELF

AUDIO ELECTRONICS

301 EDGWARE RD., LONDON W2 1BN
01-724-3564. OPEN 9-6, MON-SAT.

ALSO AT 248 TOTTENHAM COURT ROAD, W. 1.

FREE CATALOGUE

SEND STAMPED (12" x 6")
ADDRESSED ENVELOPE (MIN 9" x 6")
FOR YOUR COPY NOW

WANTED



Editorial Assistant for ETI and Hobby Electronics

If YOU have a genuine interest in electronics and project building and an above-average ability to express yourself in writing, you could be the person we're looking for. We are being serious.

We are looking for someone to join the editorial team and reckon that an enthusiastic reader is likely to be the type to join us. Not an uncritical reader — we want to continue to improve. The work will entail dealing with articles and news — licking them into shape — and making them better than anyone else's articles and news. The applicant will work on both ETI and our new sister publication Hobby Electronics. Readers employed in journalism at the moment will be considered but we are not primarily looking for someone with magazine experience.

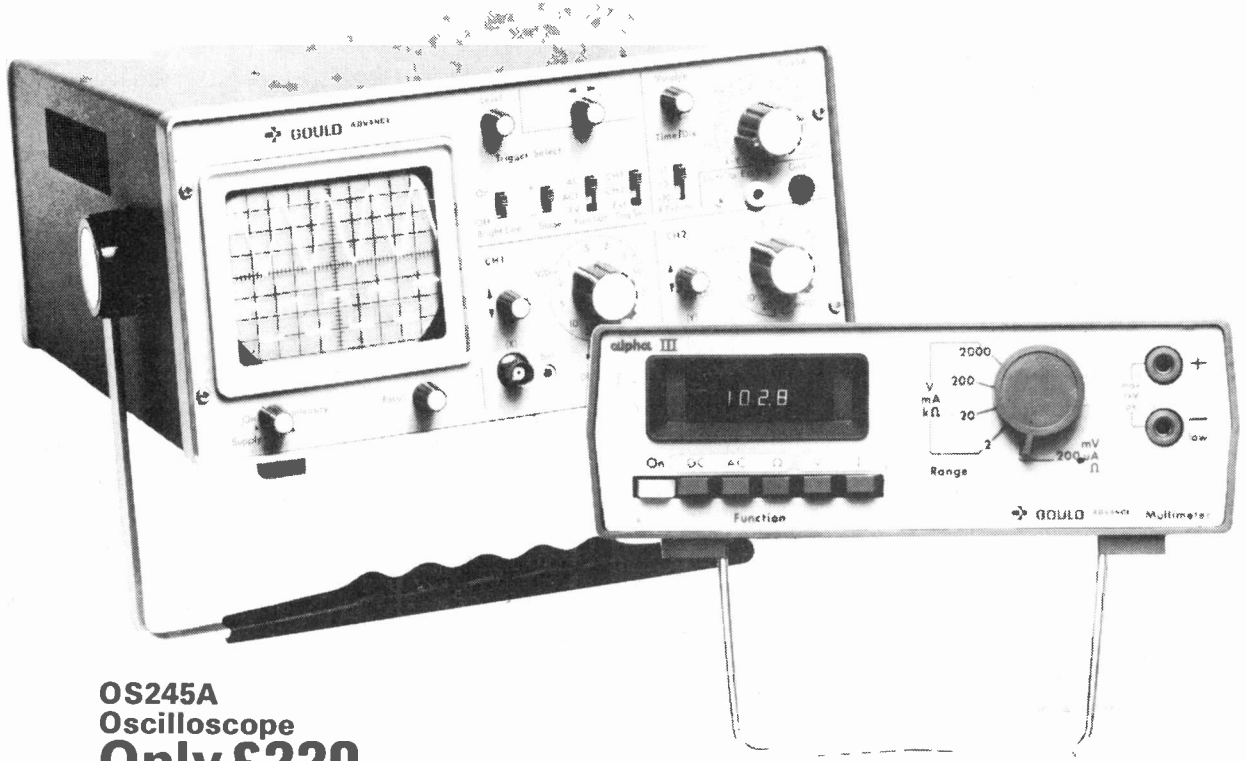
We are flexible about age and experience but imagine that the person who gets the job will be between 21 and 28. Salary will depend upon age and experience but will be in the range £3,700 to £4,100, possibly more for someone with exceptional qualifications.

Experience has told us that people who read ads like this think a) that it doesn't apply to them b) that their own knowledge is far too limited or c) that ads of this type are only put in because we have to fill half a page. None of these is true.

Apply in writing to:
Halvor Moorshead,
Editor,
Electronics Today International,
25-27 Oxford Street,
London W1R 1RF.

Applications should reach us as soon as possible with C.V. Prospective applicants may telephone the Editor for further details but this must be followed by written application.

Gould Advance Instruments— Professional quality at a realistic price.



**OS245A
Oscilloscope
Only £220** (excluding VAT)

**Alpha III Digital
Multimeter Only £99** (excluding VAT)

OS245A Oscilloscope

Fault-finding, circuit testing or servicing – an oscilloscope is indispensable. It saves time, prevents costly mistakes, and enables you to tackle bigger, better projects.

Now, Gould Advance offer you this professional-quality, dual-trace instrument, at a price which brings it within reach of the amateur enthusiast.

Just look at these great Gould Advance features – then compare the OS245A for value!

- *DC-10MHz bandwidth
- *Dual trace
- *Clear controls, simple operation
- *Fully guaranteed for 2 years
- *5mV/div. sensitivity
- *Time-base speeds to 100 ns/div.
- *4" CRT with 8 / 10 div.

Gould Instruments Division,
Roebuck Road, Hainault, Essex IG6 3UE.
Telephone: 01-500 1000 Telex: 263785.
Registered Number 263834 England.

Alpha III Digital Multimeter

With a choice of 25 ranges and basic accuracy of $\pm 0.2\%$, the Alpha III is a professional's multimeter, yet it is versatile enough to cover every amateur application.

And although it is offered at such a modest price, it shares the advanced design features of the more expensive Gould Advance instruments – in particular, the purpose-built chip, incorporating all analogue and digital circuitry.

- *2,000 scale length (100mV resolution)
- *Tough, attractive moulded case
- *Bright red LED display
- *25 ranges
- *Fully guaranteed for 2 years



TO Bob Wheeler, Gould Instruments Division,
Roebuck Road, HAINAULT, Essex IG6 3UE.
Essex IG6 3UE.

PLEASE SEND ME:—

AN OS245A OSCILLOSCOPE at £240.84 (inc. p&p and VAT) *

AN Alpha III DIGITAL MULTIMETER at £110.16 (inc. p&p and VAT) *

I enclose
 CHEQUE * POSTAL ORDER * CASH *

for the amount of £ _____

Or please charge my Access *
 Barclaycard *

Account for the amount of £ _____

MY ACCOUNT NUMBER IS

Signature _____ (I am over 18)
 Surname _____
 Initials _____ (Mr/Mrs/Miss)
 Address _____

 Postal Code _____

ET4

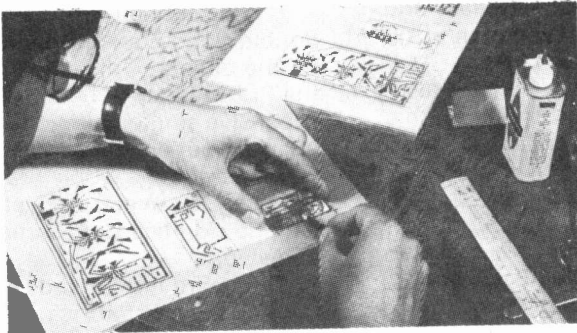
*Tick which appropriate Block Capitals Please

Note: This offer applies to the U.K. and Ireland only.

ETIPRINTS

ETIPRINTS are a fast new aid for producing high quality printed circuit boards. Each ETIPRINTS sheet contains a set of etch resistant rub down transfers of the printed circuit board designs for several of our projects. ETIPRINTS are made from our original artwork ensuring a neat and accurate board. We thought ETIPRINTS were such a good idea that we have patented the system (patent numbers 1445171 and 1445172).

HOW IT WORKS



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!

BUYLINES

ORDER TODAY

Send a cheque or P.O. (payable to ETI Magazine) to —

ETI PRINT
ETI MAGAZINE,
25/27 OXFORD STREET, LONDON W1R 1RF.

75p inc p&p

PARTS LIST

001	3 Channel Tone Control Spirit Level Clock A Digital Thermometer Skeet Game Compander	Oct 77 Oct 77 Nov 77 Oct 77 Nov 77 Nov 77
002	House Alarm Rev Monitor Clock B	Jan 78 Dec 77 Dec 77
003	Race Track Game Hammer Throw Freezer Alarm	Jan 78 Jan 78 Dec 77
004	Metal Locator Mk II Ultrasonic Tx/Rx 5 Watt Stereo Amp (modified)	Feb 78 Feb 78 Jan 77 Feb 78 Feb 78
	Metronome Shutter Time	Jan 77 Feb 78 Feb 78
005	Op-Amp Supply Frequency Shifter LCD Panelmeter Light Dimmer (3 times)	Mar 78
006	CMOS Switched Preamp From Experimenters P.S.U. 555 Boards (twice)	"Electronics Tomorrow"
007	Star Trek Radio CD Ignition CCD Phaser White Line Follower	May 78 May 78 May 78 April 78
008	Tank Battle Helping Hand	May 78
009	AM/FM Radio Bridge Oscillator CMOS Stars & Dots	June 78
010	Bench Amplifier Freezer Alarm Marker Generator LED Dice Watchdog (2 PCBs) Stars & Dots PSU	Project Book Six
011	Noise Generator General Preamp Flash Trigger Compander Active Crosscover (2 PCBs)	Project Book Six
012	Disco Lightshow Stereo Simulator Digital Thermometer	Project Book Six
013	Amplifier Module Amplifier PSU Equaliser Equaliser PSU	Project Book Six
014	Skeet Game Sweep Oscillator Burglar Alarm GSR Monitor	Project Book Six
015	UFO Detector Torch Finder (twice) Etiwet (twice)	July 78 July 78 Aug 78
016	Stac Timer Xhatch Gen Wheel of Fortune	Sept 78
017	Complex Sound Gen Tele Bell Extender Power Bulge	Oct 78
018	RF Power Meter Proximity Switch Audio Oscillator (2)	Oct 78 Oct 78 Nov 78

ONE BOARD HOME COMPUTER

ETI, Transam and Mike Hughes, who designed the system, present the Triton — a one board computer that includes all the features expected in a machine providing the basis of a really powerful home system.

ADD A STANDARD domestic TV set and a cassette recorder to the TRITON and you have a complete home computing system that is equal to, indeed in some areas superior to, many of the commercial ready built systems now on the market.

The TRITON has been designed on a single board, which means that construction should not pose any problems providing an adequate standard of soldering is maintained throughout. The case, designed specifically for the TRITON, means that the finished unit can safely and attractively be housed. In use, with the TV set on top of the case, the TRITON will be easy and convenient to operate.

The TRITON is based on the 8080

MPU, a device which has proven itself over a number of years. This MPU has a vast amount of software available for it and the TRITON's 1K monitor system allows for easy entry and subsequent modification of such material.

The 2K TINY BASIC that is also resident in the TRITON, allows this popular, easy to learn, language to be used in conjunction with the TRITON's versatile graphic character set and unique VDU function to develop everything from games to education programs quickly and easily.

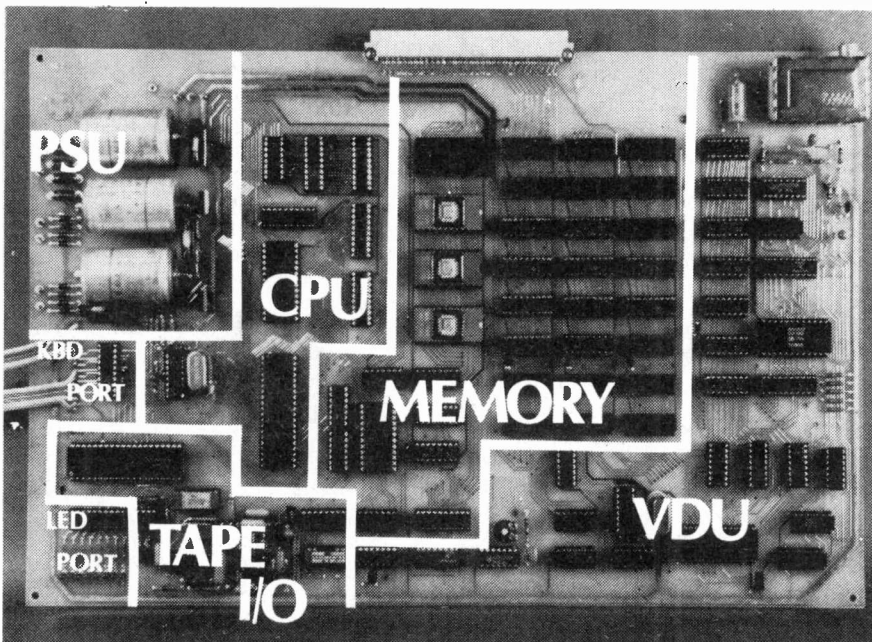
The TRITON has space for 3K of user RAM on board but the machine has been designed in order to make expansion a simple matter. All the

signals necessary to add further memory, I/O devices etc. are brought out to an edge connector at the back of the board.

It is essential to use a top quality double sided plated through board for the project. Unlike many projects the PCB is likely to be the most expensive single item you have to invest in but it is this component which brings the whole project into scope for the average constructor with no significant theoretical knowledge.

The board has been designed to keep all the most intricate wiring on the top side — in particular the connections that run between IC pins. The latter are the most vulnerable to a heavy hand on the soldering iron but this is not saying that you can afford any carelessness underneath! Use the smallest soldering iron you can lay your hands on and the bit must, certainly, be no greater than 3/32in diameter. As stated, **all** soldering operations should be carried out on the underside of the board; the through hole plating will route all necessary connections to the topside.

Wherever possible it is worth trying to re-inforce the through hole plating by getting molten solder to creep through the hole by capillary action, therefore hold the soldering iron in place long enough for the heat to flow through the hole and take the solder with it. A couple of seconds longer than your usual soldering time should suffice. You will notice that on the underside of the board there are hundreds of IC pin lands that do not appear to be connected to anything. These lands **must** be soldered in **all** positions because nearly all of them go somewhere on the top side!



The single board that carries all of the Triton's circuitry with the areas concerned with various parts of the system indicated.

See John Coll's
comments on the Triton
in Computing Today

Transam Components Ltd
of 12 Chapel St, will be
sole suppliers of the Tri-
ton and will also supply
individual parts for the
computer.



Construction Commences

Take your time with the soldering — even at a slow pace you can complete this project in a couple of days — because it is very easy to miss a connection or produce a dry joint. We recommend that you insert one component at a time and solder it in completely before moving on to the next; a visual check of each joint is essential and if you have any doubt don't be afraid to use a magnifying glass. A few seconds wasted doing this can save hours — if not days — trying to find a single missed connection!

All the holes on the board have been pre-drilled to the correct diameters but in the event of you having a device which will not quite go through the hole do not UNDER ANY CIRCUMSTANCES attempt to drill out to size — you will ruin the through hole plating! The ONLY holes you may drill out are the fixing holes for the board and the mounting holes for the extender socket. If you have a stubborn component try scraping down the diameter of its lead with a sharp knife or use a needle file to reduce its dimensions slightly. Probably the only offender you will find in this respect is the modulator which has rather large fixing lugs that sport a taper. These

might vary a little from device to device.

We recommend the use of sockets for all the integrated circuits as it is virtually impossible to remove ICs from a double sided THP board.

Start construction by soldering in all the DIL sockets while the board is flat — it makes life much easier — and then insert all resistors and diodes. Next insert the nine board pins which connect to the transformer and IC1 (the off board voltage regulator). Proceed to solder in the in line strip sockets and the extender socket. When the latter is firmly soldered you should carefully drill out the board mounting holes with a drill using the connector's holes as a guide and then bolt it firmly into place.

Switched On System

Insert the three transistors for the tape I/O. Proceed then to the capacitors and LEDs. Leave the three large smoothing capacitors till last and be very careful that you insert the LEDs the right way round. You will have to look very careful at the solid tantalum capacitors to find their polarity. You should then insert, and solder in the three preset potentiometers.

Before progressing further check

the polarity of all the diodes and electrolytic capacitors you have inserted.

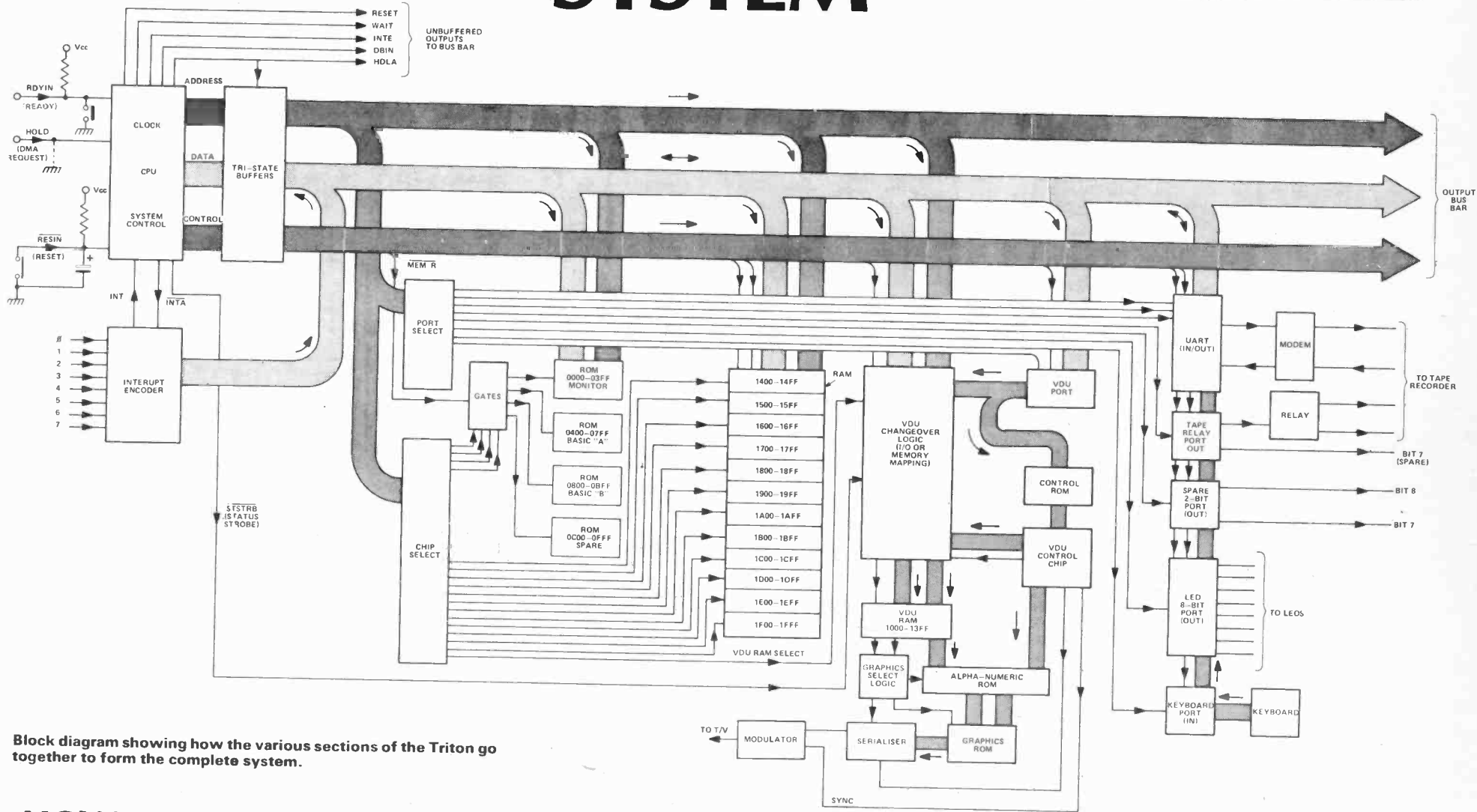
You can now insert, and solder in the three crystals making sure you have them in the correct positions. The crystals have their frequencies stamped on them (usually in kilohertz).

Continue with construction by putting in the modulator and the two on board regulators. Make sure you have the regulators in the right position. Ensure that you insert them the right way round. The metal fin should be on the face of them furthest away from the main smoothing capacitors.

Temporarily mount IC1 on its heatsink and run flying leads to the three pins allocated to it.

The great moment is close at hand but before inserting any integrated circuits give the power supply a dry run. Connect up the remaining six board pins to their corresponding terminals of the transformer and apply power. Use a voltmeter to see that you have the correct voltage rails present. You should get +5 V and +12 V at the output pins of ICs 1 and 2 respectively and -12 V at the output of IC3. You should read -5 V

SYSTEM PROJECT: Computer



Block diagram showing how the various sections of the Triton go together to form the complete system.

HOW IT WORKS

The heart of the system is the microprocessor (MPU) itself — the faithful old 8080A. This MPU has a very simple to understand instruction set which is remarkably versatile for those who like to dabble in work at machine code level and because of its years of experience there is a great variety of software freely available to use with it. In addition it is one of the cheapest MPUs on the market.

The MPU will sequence through a list of

These eight lines are decoded to activate any one of 256 possible external devices through what are called PORTS.

Before moving on from the heart of the system it is worth mentioning some of the single lines depicted on the illustration. When the computer is initially switched on it is necessary to give it the right instruction to start with so that it can sequence on from there to complete the program in a sane manner. For this reason it is usual to have the

operation on the VDU screen and to do a re-initialisation without clearing all the memory (which would otherwise happen if one pressed the reset button). There are five remaining lines one of which is brought out to a spare push button on the front panel and the rest are piped down the multiway socket along with the busbars. The interrupt request lines have to be encoded and formatted into an eight bit data byte. When this is done the interrupt encoder tells the CPU with the INT

decoding the least significant eight bits of the address bus) through the Port Select logic and issues a I/O control signal will data from the keyboard be placed on the data busbar. Working in the opposite direction, the Output Port driving a bank of eight on board LEDs is a set of eight latches which catch and hold whatever data is on the busbar when they receive a coincident pair of signals from the port selector and the I/O line of the control bus. These onboard LEDs

instructions held in memory as 8 bit bytes and on receipt of each instruction will carry out an operation which ranges from getting another byte of data from somewhere else in memory to carrying out simple logical or arithmetical operations on that data. It is not within the scope of this article to cover the inner workings of the MPU itself or, for that matter, to explain every operation that the 8080 can offer.

As it operates sequentially the MPU needs clock. In this case the master frequency is 7.20MHz which is divided down to clock the MPU every 1.25µs. This time is the duration of a microcycle and it takes from 4 to 11 microcycles for the MPU to complete an instruction.

The MPU itself has quite a large number of lines leading to it. The 8 data lines are in the form of a bi-directional busbar (i.e. can carry data to or from the MPU). To cut down on the number of wires coming from the MPU the data busbar serves a secondary purpose. It carries what is called "STATUS" information at a certain point in time within an instruction cycle. This status information is in the form of an 8 bit byte and is decoded by the System Controller. When decoded the Status byte feeds one of 5 lines with a logical "o" which tells the rest of the system what sort of instruction the MPU is executing during that cycle. These lines are grouped together to form the CONTROL BUSBAR and are designated INTA (meaning that the computer has just been interrupted by an external "Interrupt Request"), MEMR (reading data from a memory location), MEMW (writing — or storing — data into an internal memory location), I70R (inputting data from an external source — such as a keyboard or a tape system) and I/OW (outputting data to an external destination such as a VDU or a tape system).

The 16 lines which carry a 2 byte WORD which is used to ADDRESS a specific byte of memory form the uni-directional ADDRESS BUSBAR. Using 16 binary lines one can therefore address up to 65,536 (decimal) memory locations. We have limited the capacity of the TRITON to 8K of memory but the address busbar (in common with the data and control busses) are buffered and can be fed to the outside world through a multiway connector thus allowing easy expansion to maximum capacity with add on boards.

The address bus also serves a duplicity of roles depending on whether the instruction cycle is a memory addressing or an I/O addressing cycle. As already stated all sixteen lines are used to address memory locations but during an I/O read or write cycle the CPU is limited to providing address data on the eight least significant address lines.

first instruction at address location zero. We can reset the MPU by depressing a push button or at switch on by the POWER ON RESET.

Those that want to can use the line marked HOLD for applications involving DMA (Direct Memory Access). Basically this means that by making this line go to logic "1" one can isolate the internal CPU from all three busbars (using the tristate facility of the buffers) and allow an external device to do what it will with the internal memory. We have strapped this line to "0" with a removable link so the facility is there for those who want it. RDYIN is used if any memory of peripheral is incapable of responding as fast as the computer desires. The external device can make this line go to "0" for any period of time (usually set by a monostable) and when this happens the MPU goes into a WAIT state and it does just that. It simply stops operating as long as this line is low and when the RDYIN signal is removed it carries on as if nothing had happened. The only thing it does do during this time is issue a signal to the outside world called WAIT. You can see the WAIT line designated as one of the unbuffered outputs. In addition by connecting RDYIN via a push button switch to ground one can halt the computer momentarily in the middle of any operation. Facility for bringing this out to a push button is not made on the board but it is a simple matter to pick up the right point on the top side and take it via a single wire to the front panel — see the circuit diagram of this section.

The RESET output goes high momentarily when the reset button is pressed and can be used to carry a synchronous reset on external equipment; the HDLA output tells the outside world that the computer has gone into a HOLD (or DMA) state — if anyone takes the HOLD Line high; the INTE Line tells the outside world that the computer is permitting itself to be interrupted (the mnemonic stands for Interrupt Enabled) and the DBIN line indicates which way the computer expects data to be flowing on the bi-directional data bus. It goes high when the CPU is expecting data to flow INTO it.

We are using the \overline{STSTRB} (STATUS STROBE) signal — to synchronise the memory mapping of the VDU — more is said about this in the relevant section.

As already implied the 8080 will allow itself to be interrupted in mid program provided that the program sets the Interrupt Enable flag. There is facility for eight possible interrupts but only seven can really be used on this machine (Interrupt 0 is redundant as it duplicates RESET). An interrupt is entered into the machine on a single interrupt request line. Of the seven usable lines we are using two within the machine to do a clearing

signal that an interrupt has been received. When the CPU is ready to be interrupted it issues an Interrupt Acknowledge signal INTA which is used to place the encoded byte on to the data bus. This byte enters the MPU and directs the computer to operate the desired subroutine. At the end of the routine the computer reverts to the main program continuing at the point where it was interrupted.

The memory of TRITON is split into three types on the main board. There are locations for up to 4K of Read Only Memory (ROM) which is split between four 2708 Erasable ROMs. These occupy address locations 0000H to 0FFFH. The standard TRITON uses the first 1K to hold Monitor and Utility routines necessary to initialise the machine and re-vector interrupts. The next 2K holds a BASIC INTERPRETER and the fourth 1K block is left spare for future expansion.

There is 1K of Random Access Memory dedicated to the VDU. This starts immediately above the ROM area starting at 1000H. Normally this RAM is addressed in synchronism with the VDU line scan by the VDU control circuitry but the CPU can take over addressing under program control (in effect interrupting the VDU). The VDU RAM can only be written into by the computer.

The rest of memory is made up of RAM which is both read and write. This area is used to hold the stacks and tables of the MONITOR and BASIC INTERPRETER (512 bytes) and the main work area starts at 1600H for a further 2½K ending at 1FFFH. This represents the full capacity of the on board memory. There is no reason, however, why further read write memory should not be added externally starting from location 2000H.

The ROM and VDU RAM areas are blocked into units of 1K — to fall into line with the types of integrated circuits used. However, the stack and work area RAMs are laid out in blocks of 256 bytes.

The high order lines of the address busbar are used to decode which block is being addressed — this is done by the Chip Select decoder. Note that the ROM chip selects are gated with the MEMR signal from the Control Bus whereas this control signal and MEMW go straight to the RAM chips. This is because the 2111 Random Access Memory ICs used have internal chip select gating and output enables.

With the exception of the VDU which is "hybrid" the rest of the system is made up from a variety of I/O stages. The most important of the latter is the Keyboard Input. The keyboard data and strobe lines are fed on to the data busbar via tri-state buffers which form the keyboard input port. Only when the computer's software addresses this port (by

help to make the TRITON system more versatile and can be used for test purposes or in specialised development applications. The LEDs themselves could be discarded and the eight lines brought to the outside world as a spare general purpose output port.

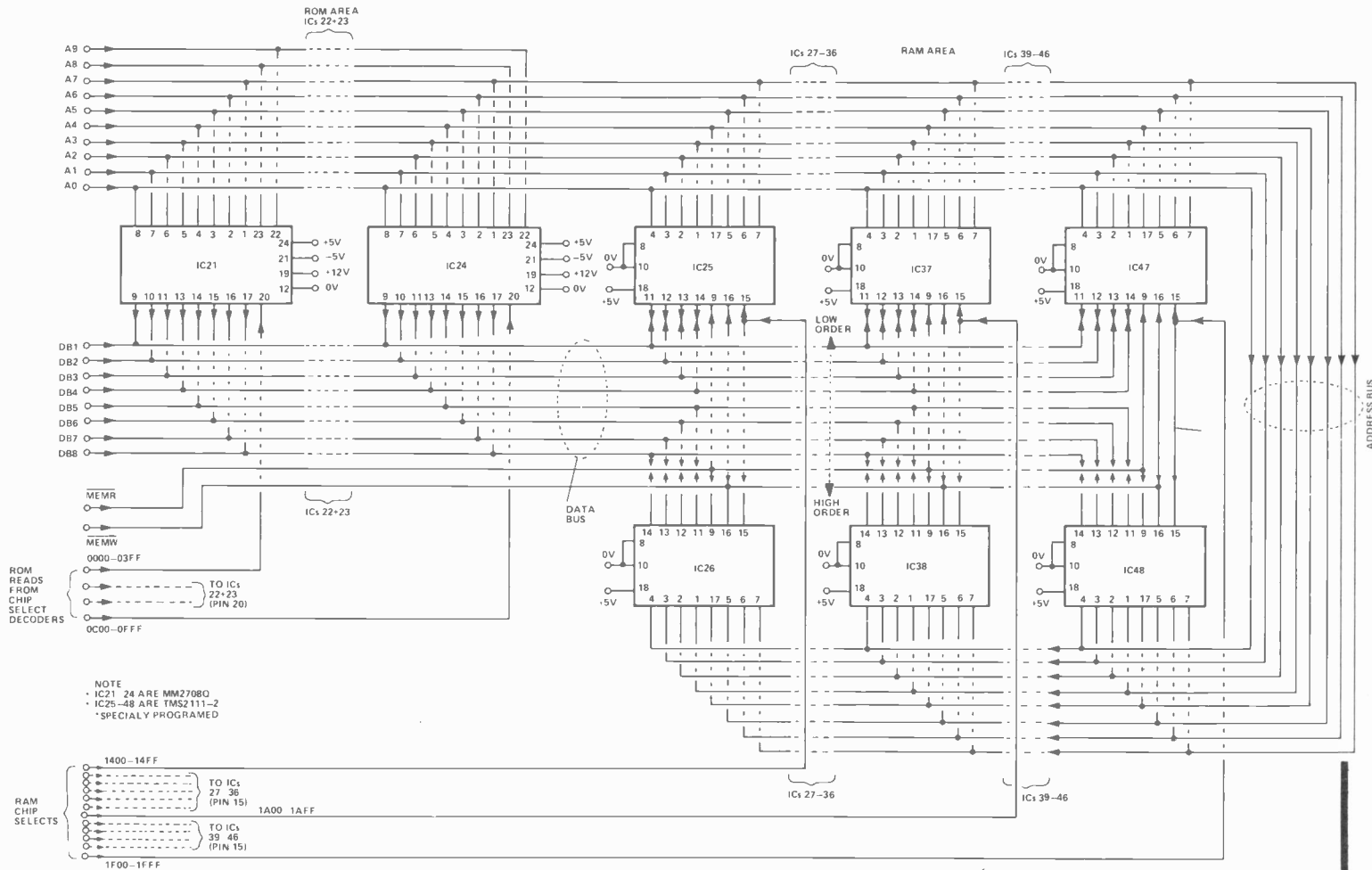
By making use of a couple of spare latches on the board it was possible to provide two spare output lines on one port and a spare line on the port which also feeds the tape recorder power control relay.

The UART (Universal Asynchronous Receiver/Transmitter) is the device which converts the eight bit wide parallel data on the busbar to a specially formatted serial stream to feed the tape recorder modulator. It also carries out the complementary function of converting a received serial stream into parallel data bytes. The device operates as if it were two input ports and one output port. One of each sort of port would be obvious for a device which receives and transmits but the requirement for a second input port may not be so obvious. Because the device operates asynchronously from the main computer (it has its own clock operating at 300 baud) it is necessary to make the computer wait from time to time to allow the slower operating UART to complete a transmission cycle. This is indicated by the UART activating a flag which is regularly monitored by the second input port.

The VDU portion of the computer is based on the Thomson-CFS Control chip and operates in a unique manner for this integrated circuit. Not only can one output to the VDU through an output port (in similar manner to using a teletype) but one can use the computer to write data directly into the VDU's memory at extremely high speeds.

A further extension is the way the control chip has been used to handle Graphics. Instead of the usual six bit wide RAM seven bits are used in this VDU application. This way enables the use of the complete set of ASCII codes. 64 extra character codes are therefore available by using those normally associated with lower case "alpha" characters and all the control codes. Within the overall context of the computer some of the control codes serve dual purposes and the VDU control ROM inhibits printing a graphic when a control code is issued for genuine control purposes!

The graphic select logic looks at the two most significant bits of the ASCII code, determines whether or not the symbol is graphic or alpha-numeric, then proceeds to select the standard alpha-numeric ROM or the specially programmed graphics ROM. There is quite a lot of extra logic associated with this operation as well as the Memory Map/I/O changeover but we shall reserve comment on this to the section describing the circuit in detail.



Circuit diagram of the ROM and RAM circuitry. Note that in the basic machine IC 24 is omitted as are ICs 33-48.

HOW IT WORKS

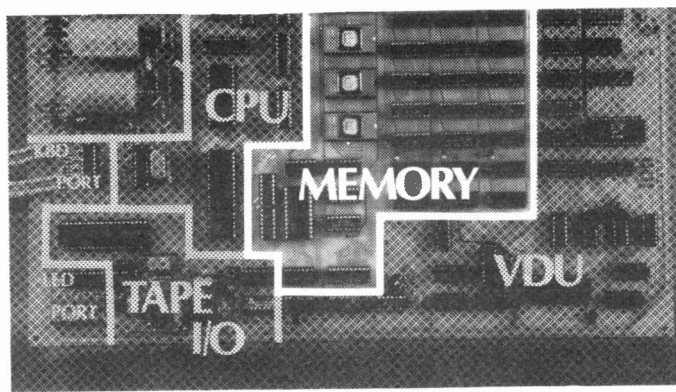
The circuit diagram of this section has been abbreviated as most of the memory circuitry is a repeat of the same theme. You can clearly see the difference between the ROMs and the Read/Write RAMs. There are four of the former – all 2708s but in the standard machine only three are used immediately. The 2708 is an ultra violet erasable ROM which contains 1,024 (decimal) bytes of memory each being 8 bits wide. To access a specific byte within it you need a 10 bit address and A0 through A9 are used for this purpose. The eight output pins are tri-state which are enabled by a “0” on pin 20 (the chip select input). The respective outputs from each of the ROMs can therefore be commoned together on the data bus. The “Programming Enable” pin (18) is only used when the devices are being programmed and therefore is left disconnected within the system. We use the block select signal gated with MEMR to provide the Chip Select strobe for the ROMs (this is described elsewhere).

The Monitor program is located within IC21 which starts at address location 0000H so that the computer will always go through a firmware initialisation routine when switched on. The Power On Reset ensures that the first instruction the CPU reads will be the one located at 000H. BASIC is located within ICs 22 and 23.

The RAM area of memory comprises TMS 2111-2 chips. These each contain 256 locations that are four bits wide. As we need to store eight bit bytes of data two chips are required for each 256 byte block of memory. The odd number designations IC25 to IC47 correspond to the low order nibble of the byte while the respective even numbers (IC26 to IC48) correspond to the high order. Only eight address lines (A0 through A7) are required to uniquely select a byte within this organisation of a chip pair but we need to specify which pair by means of the Chip Select lines (these have been decoded elsewhere in the system).

The 2111s have internal chip select and Read/Write gating so we are able to drive the MEMR and MEMW inputs direct from the control busbar.





at the junction between R1 and the zener diode. If all is well here; systematically check that you have the correct voltages at the sockets of **every** integrated circuit. Use the schematic diagrams to help you identify the pin numbers.

Finally check that you have inserted the single wire link to the right of the extender socket.

Insert all the integrated circuits making **absolutely sure** that you have them orientated correctly and have them in the correct locations. Use the dot on the UART to locate pin 1 (the notch can be misleading). Note that the orientation of ICs varies a lot on the board and you must check each one individually. Insert the 2708 EROM chip that is marked MONITOR V4.1 into the socket for IC21; the one marked BASIC L4.1 "A" into the socket for IC22 and BASIC L4.1 "B" into IC23. Insert eight TMS 2111-2 devices in IC locations 25 to 32 inclusive. The only gaps you should have on the board are the IC24 and ICs 33 to 48.

Do not bother with a keyboard at the moment but simply make up a coaxial lead to go from the modulator to the aerial socket of a standard 625 line television set. Switch the TV on and allow it to warm up checking that a raster is just visible and tune it to approximately channel 36.

Set the three on board potentiometers to their mid way

The table shows the decimal and hex codes associated with the Triton graphics and, where applicable, the key on the keyboard. The symbols may be used within a BASIC print statement or with the OUTCH monitor routine.

positions and apply power to the TRITON. You should see some change on the television screen even though you may not be spot on tune. Try adjusting the tuning over the whole range until a strong signal is locked in. You should see the welcome message:

TRITON READY
FUNCTION: PGIOLWT

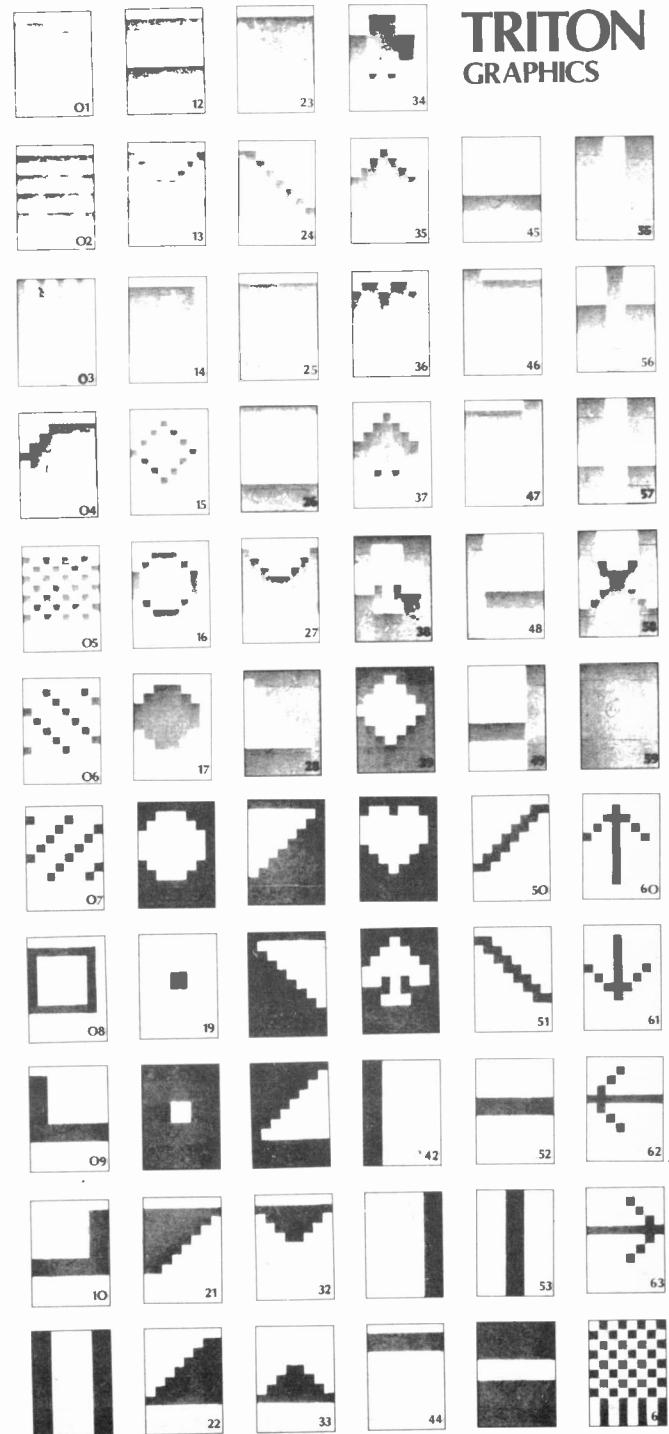
It may respond with INVALID as the keyboard is not fitted — do not worry this is still an indication that everything is working.

Hopefully this will be the case and you can rest assured that your computer is working! Switch the computer off; wait a few seconds and switch it on again. For a fraction of a second you will see a load of rubbish on the screen which will rapidly clear and the previous message will be repeated.

Switch off and make up an umbilical cord of wires to go from the keyboard socket on the board to the keyboard and associated push switches. Use colour coded wire and ensure that you make no mistake when connecting the relevant leads to the keyboard Cinch connector. It is double sided and you must make sure to hold it with the correct

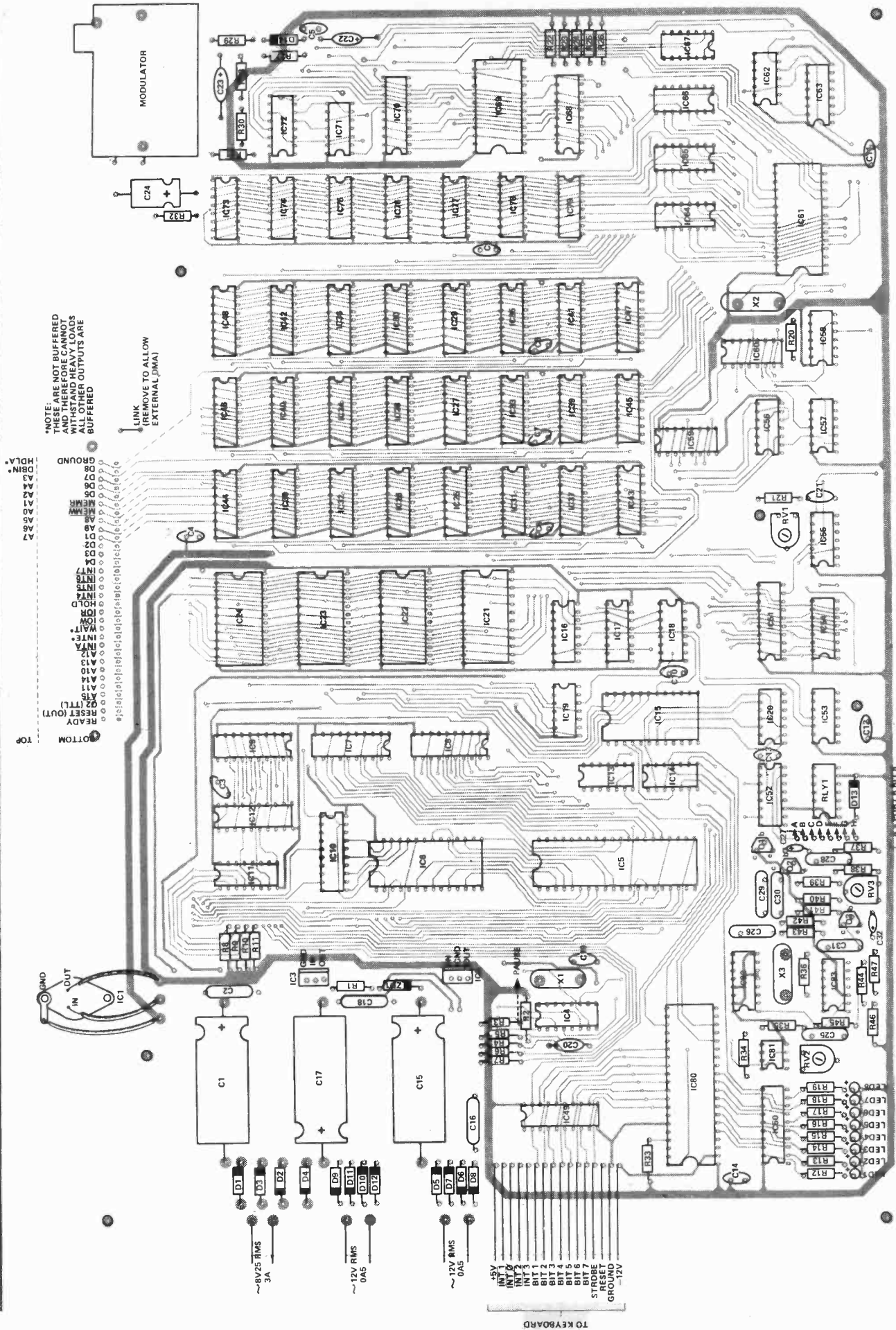
GRAPHIC DEC. HEX

1	0	00	
2	1	01	CONT A
3	2	02	CONT B
4	3	03	
5	4	04	
6	5	05	CONT E
7	6	06	CONT F
8	7	07	CONT G
9	8	08	
10	9	09	
11	10	0A	
12	11	0B	
13	12	0C	
14	13	0D	
14	14	0E	CONT N
16	15	0F	CONT O
17	16	10	CONT P
18	17	11	CONT Q
19	18	12	CONT R
20	19	13	CONT S
21	20	14	CONT T
22	21	15	CONT U
23	22	16	CONT V
24	23	17	CONT W
25	24	18	CONT X
26	25	19	CONT Y
27	26	1A	CONT Z
28	27	1B	
29	28	1C	
30	29	1D	
31	30	1E	
32	31	1F	
33	96	60	a
34	97	61	b
35	98	62	c
36	99	63	d
37	100	64	e
38	101	65	f
39	102	66	g
40	103	67	h
41	104	68	i
42	105	69	j
43	106	6A	k
44	107	6B	l
45	108	6C	m
46	109	6D	n
47	110	6E	o
48	111	6F	p
49	112	70	q
50	113	71	r
51	114	72	s
52	115	73	t
53	116	74	u
54	117	75	v
55	118	76	w
56	119	77	x
57	120	78	y
58	121	79	z
59	122	7A	
60	123	7B	
61	124	7C	
62	125	7D	
63	126	7E	
64	127	7F	RUBOUT



TRITON
GRAPHICS

PROJECT: Computer



PARTS LIST

RESISTORS (all 1/4W 10% unless stated)

R1	82R 1/2W 10%
R2, 34, 44	10k
R3-19, 22-26, 30, 33, 35, 37, 38, 40, 46, 47	1k0
R20, 36	4M7
R21, 31	220R
R27	470R
R28, 29	330R
R32	15R
R39	4k7
R41, 45	220k
R42, 43	100k

POTENTIOMETERS

RV1	100R sub. min. horiz. preset
RV2, 3	10k sub. min. horiz. preset

CAPACITORS

C1, 15, 17	4 700u 25 V electrolytic
C2, 16, 18	470n polyester
C3-14	47n ceramic
C19	47p ceramic
C20, 23, 27, 32	47u 6V3 tantalum
C21	82p ceramic
C22	10u 6V3 tantalum
C24	100u 25 V electrolytic
C25, 29, 30	15n polyester
C26, 28	100n polyester
C31	220n polyester

SEMICONDUCTORS

IC1	LM323K
IC2	LM340T-12
IC3	LM320T-12
IC4	8224N
IC5	8080A
IC6	8228N
IC7, 8, 10, 49	74LS244
IC9	74LS245
IC11	74LS148
IC12	74LS240
IC13, 58	74LS00
IC14, 19, 67	74LS32
IC15	74LS154
IC16	74LS138

IC17, 18	74LS139
IC20	74LS02
IC 21, 22, 23, 24	MM2708Q
IC25-48	2111-2
IC50, 51, 68	74LS374
IC52	74LS75
IC53	74LS74
IC54	74S287
IC55	74LS132
IC56, 57, 71	74LS08
IC59, 60, 64, 65, 66	74LS157
IC61	SFC96364
IC62	74LS86
IC63	74LS163
IC69	RO-3-2513
IC70	74S472
IC72	74LS165
IC73-79	2102-2
IC80	AY-5-1013/TMS6011NC
IC81	555
IC82	MC14412VL
IC83	LM339N
D1-4	1N5400
D5-12	1N4001
D13, 14	1N4148
ZD1	5V1 400mW
Q1, 2, 3	BC148
LEDs 1-8	LD35Y (0.1" spacing)

TRANSFORMER

T1	12V + 12V at 0.5A, 8V25 at 3A
----	-------------------------------

SWITCH

PB1	DPDT Mains
PB2-5	SPST

CRYSTALS

X1	7.2000 MHz
X2, 3	1.0000 MHz

MISCELLANEOUS

PCB, Case, DIL Reed Relay type, 15005, neon, 3A fuse plus holder, modulator (Astec type 1111E36), Full ASCII Keyboard, 64 way PCB plug and socket (optional) Type CS/CP64, 16 way inline PCB plug and socket Type A23-16, 8 way inline PCB plug and socket Type A23-8, edge connector to suit keyboard, 2 x 5 PIN DIN sockets, IC holders and heatsink (at least 90 x 100mm-matt black).

orientation or you may have disastrous consequences with the power lines. Different types of keyboards have different connections. We refer you to the connection details supplied with your keyboard. The only comment we should make is that the specified keyboard, and some others, give you an option for bit 6 of the data. One option gives you upper case characters only while the other gives both upper and lower case. This application needs the latter. The strobe is the static strobe which goes to "1" as long as a key is depressed.

Procedure

The specified keyboard does not have any built in direct function keys and these have to be provided by separate push buttons. These have to be mounted on the front panel and are used to provide RESET, INT1 (Clear Screen), INT2 (Reset without clearing memory), INT3 (Spare) and TAPE MANUAL OVERRIDE — ganged with PAUSE (see descriptions elsewhere). The first four push switches all have a common ground and are "push to make" with a spring return. Use the Common lead and the respective signal leads to go to each of these switches. The fifth switch must be double pole "push to make — push to break". One pair of contacts should take the special "PAUSE" line to ground when it is on. This line does not exist in the umbilical cord coming from the board socket but must be soldered to the end of R3 going to pin 3 of IC4. The other pair of contacts is connected across the tape power control pins of the respective DIN socket.

You can make up all the above on flying leads to test the unit fully before putting it into its cabinet.

Power up again and get the initialisation message. Try pressing any key on the keyboard EXCEPT PGIOLW or T and the computer should respond by saying INVALID. Press CONTROL C and the screen should clear and re-initialise. Press RESET. When the button is released the same should happen. Try INT2 and the machine should, again, reinitialise. When you try INT1 the screen should clear without the message appearing. To get something back on the screen press any keyboard key except those in the "key character" message (P.G.I.O.L.W.T). You should, once more, get INVALID. Depress CONTROL C once more and your computer is re-initialised and ready for test.

Program

We must assume at this stage that you do not know anything about programming so simply follow the instructions and check that you get what is described.

Depress P on the keyboard. You will get:

P
PROG START =

(The computer is asking you to tell it the address of part of memory you wish to inspect)
Type in 0000 followed by carriage return.
The display will now show:

P
PROG START = 0000
0000 31 (31 is the data in location 0000)

Depress carriage return repeatedly and you will get the following as you step through the Monitor program instructions

```
P
PROG START = 0000
0000 31
0001 80
0002 14
0003 FB
etc
```

Reinitialise with CONTROL C and then type L. The computer will again ask you for a start address but this time will list out the contents of 15 adjacent locations starting from that address. We can use this to test that our memory is there and working in the RAM area.

Answer the computer with the address 1600 and a carriage return (if you make a mistake before you press CR you can backspace with CONTROL H and change an entry but you must then type through the rest of the line on the screen). The computer will list the contents against the memory addresses and then stop and ask for "MORE?". If all is well you should see 00 in all locations. To continue type Y and keep doing this checking all the locations up to the highest order RAM on the board. Above that address the computer will read FF which indicates that there is no memory there. If you see any data above address 15FF that is anything other than 00 or FF you can be sure you have a bad connection to the RAM IC which contains the data in question. This test only holds true immediately after first initialisation and cannot be used if you have attempted to write programs.

To get out of LIST type any character other than Y and the computer will reinitialise. Carry out this or any of the other reset procedures already described and proceed to check the G function. This is to facilitate running a machine code program. The computer will acknowledge

```
G
RUN
PROG START =
```

(this means it is ready to run but wants you to tell it from where in memory it should get its first instruction). Give it this information by typing 02B9 followed by CR. You will actually be running a re-initialisation program in the Monitor which should just acknowledge with



The Triton's board mounted in its case. Note that the extender socket is available on the right hand side of the case and that the output of the modulator is brought out to a UHF socket on the back panel. The back panel also carries the DIN sockets and the mains fuse.

FUNCTION? P G I O L W T

You are now back where you started so you can try typing W which turns the computer into nothing more than a video display typewriter. You can type away to your heart's content testing out all the alpha numeric and graphics characters using the keys in unshifted, shifted, and control mode. Do this while inspecting the coding tables shown in the section describing the VDU and get used to the cursor move commands. Type a full line of characters and adjust RV1 for best line length. To get out of this mode of operation use CONTROL C or any of the other methods of resetting.

The next test sees BASIC L4.1 in action; depress T. The computer acknowledges with

```
T
BASIC L4.1
OK
>
```

Type in NEW followed by CR to make sure the memory is cleared and the computer re-acknowledges with the BASIC header. Very carefully

type in the following message line by line with a CR at the end of each line. Remember you can correct by backspacing with CONTROL H before you hit CR.

```
> 10 FOR A = 1 TO 10
> 20 PRINT "HELLO"
> 30 NEXT A
> RUN
```

You should not re-type the "greater than" prompt signs — the computer is prompting YOU with these. When you press CR after typing RUN we hope you will be surprised — you have just written your first program!

You can now be pretty well assured that your computer is working correctly and it only remains to test and adjust the Tape I/O circuits. This must be done in stages.

First check the Tape Output software. Connect an audio monitor (simple amplifier or crystal earpiece) between the "Tape Out" socket on the board and ground. You should hear a continuous tone. Call up BASIC by typing T and enter the above program again. Once you have done this get back to the Monitor without erasing your BASIC program

(use CONTROL C). Now press O to call up the Tape Output routine.

The computer will ask you for a TAPE HEADER which can be anything you like written in alpha- numerics. Preferably do not use a title longer than 20 characters as you might run out of input buffer space! We suggest you type in TEST ROUTINE. Follow this with CR while listening to the tone on the ear piece. Nothing will happen on the VDU but after a pause of between 5 and 6 seconds (longer if you are using a master clock crystal lower than the 7.20MHz as specified) you will hear about 1 second of regular high speed pulses followed by a few seconds of what can best be described as "burble" (this is your program going out). The burble will stop and you will hear just the continuous tone you heard at the beginning. After a further 5 or 6 seconds the VDU will confirm that the file has finished by displaying END followed by the re-initialisation heading.

On A Plate

Repeat this exercise but this time connect a continuity meter across the tape power control sockets on the board. (The manual override switch must be open circuit). While you type in the tape header code the meter should show that the relay is open circuit but as soon as you depress the CR to start the operation the relay closes and stays closed until the VDU types END. It is obvious that the 5-6 second delay at each end of the routine is to allow a portion of blank tape to go by to reduce the chance of you overlapping files or missing the start of the active tape at the beginning of a new cassette.

You must now set the Baud rate for your system. The simplest way is to use a frequency meter connected to pin 3 of IC81. Adjust RV2 until the meter reads exactly 4800 Hz. A better way, and probably more viable for most constructors, is to use a standard test tape. It is better because different tape recorders might operate at different speeds which would influence the play back baud rate of your system. This does not matter if you are only recording a playing back your own programs but if you wish to use those from other sources your *overall system* MUST operate at 300 baud. Using a standard test tape calibrates your overall system to 300 baud as viewed from the outside world.

Monitor Manipulation

To carry out this test properly you must have a master clock crystal having a frequency greater than 4.5MHz otherwise the VDU may not print out as fast as the data is coming in from the tape. You must also enter and run a special machine code program to facilitate the test. We will not explain how the program operates in this article except say that it accepts any data on the tape and displays it, verbatim, on the VDU. If garbage is received and decoded garbage will be printed. The test tape contains the alphabet followed by CR and Line Feed repeated many times over a period of a few minutes. All you have to do when the program is running is set RV3 to its midway position and adjust RV2 until you get the alphabet reliably repeated on the screen. If, at the best setting of RV2 you still get the occasional bit of rubbish try altering RV3 for best sensitivity. You should, of course, be using the phono output from your tape recorder but if you do not have this use the extension speaker socket with the volume set about 20% up from minimum.

TRITON Trials

Carry out the following instructions TO THE LETTER!

Initialise the computer with RESET; type in P and enter the start address for the program as 1600. For zero always use 0 and not o. Press CR and location 1600 will be shown to contain 00. Now use the memory change facility to start writing your program. Simply type in the following list of hexadecimal instructions — each pair of digits should be followed by CR. You will end up with a column showing address locations to the right of which is a column showing what was in that location (should have been 00 in all cases) and to the right of that the new data you have just typed in. When you have typed in the complete list of instructions use CONTROL C to re-initialise then type L and list from location 1600 (as previously described). Check that the codes in each location correspond **exactly** with those in the published program. Use CONTROL C to re-initialise and then type G. Enter 1600 without pressing CR at this stage. Make sure your tape recorder

is properly connected to the board and switch on the recorder in PLAY mode. Press CR and proceed to adjust RV2 as previously described. You should see:

```
ABCDEFGHIJKLMN OPQRSTUVWXYZ-
XYZ
ABCDEFGHIJKLMN OPQRSTUVWXYZ-
XYZ
ABCDEFGHIJKLMN OP etc
```

until the recording ends or you switch off the tape recorder. While this is happening your computer is locked within a program loop and you will *not* be able to get out of this with CONTROL C. You will have to use INT2 to re-initialise.

Here is the program you must type in:

Address location	Data you must enter
1600	CD
1601	27
1602	03
1603	CD
1604	1D
1605	03
1606	CD
1607	13
1608	00
1609	C3
160A	03
160B	16

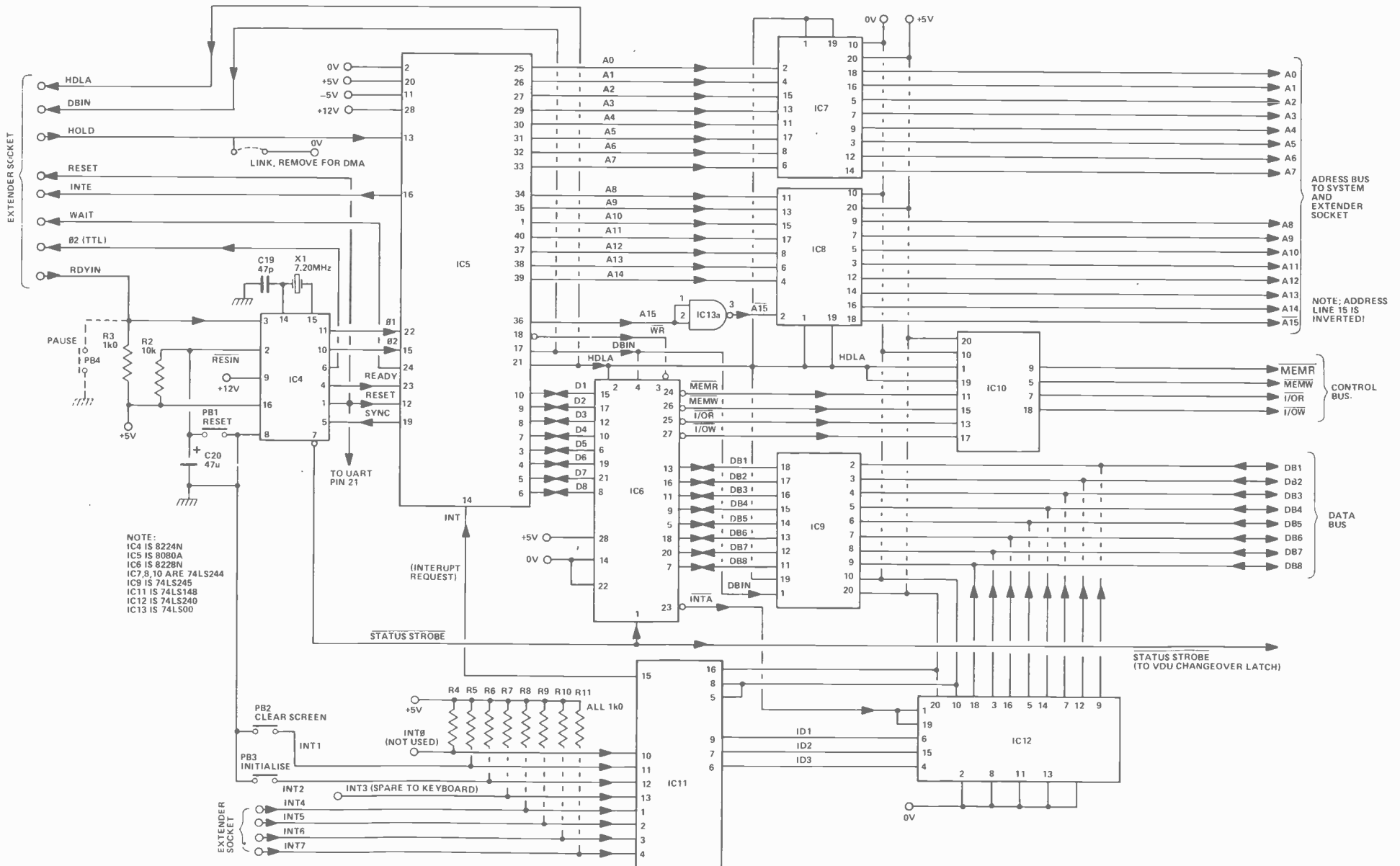
Your computer is now completely set up and ready for use. You have already been shown how to enter and run simple programs in BASIC and Machine Code. Why not now read the further articles in the Supplement which will show you how to make more full use of the TRITON. You have made an extremely powerful computer whose applications are only limited by your own imagination and the development of more sophisticated software — coupled with extender boards to give you extra I/O functions (Floppy Disks, Line Printers, extra Tape Recorders, more Memory etc). Keep reading ETI for further exciting applications and developments.

The following pages contain the circuit diagrams and descriptions for the complete Triton design. 'How It Works' sections refer to the diagram they accompany.

Computing Today carries an article on using the Triton's BASIC and a review of the machine by John Coll.

A fuller description of the Triton's monitor will follow in next month's Computing Today.

CPU



HOW IT WORKS

IC4 is the master clock oscillator which contains divider circuits to provide the two phase clock ($\phi 1$ and $\phi 2$) for the 8080. You can use different frequency crystals for X1 but the ideal value is 7.20MHz and this value should not be exceeded. Lower frequency devices are fine but the system will operate proportionally slower. If you put in a higher frequency crystal not only will you run into memory access time problems but the system will be operating at a rate faster than the VDU can handle. The Monitor program has provided the maximum permissible print out rate for a clock frequency of 7.20MHz.

A TTL compatible output of $\phi 2$ is available but not used on the main board; this is fed to the extender socket. The chip also contains gating circuits to synchronise the externally generated RDYIN command before feeding this to the CPU. An internal Schmitt Trigger on the reset input line (RESIN) allows a very simple charge up circuit comprising R2 and C20 to provide power on reset. Manual reset is carried out by momentarily taking RESIN to 0 volts via a push button. The clock receives a feedback signal (SYNC) from the CPU which is gated with $\phi 1$ to give a STATUS STROBE pulse at the precise moment the data busbars are carrying the status byte. The pulse (STSTB) is fed to the System Control chip (IC6) to latch the status byte and is also used by the VDU to enable Memory Mapping changeover.

IC19 discourages the crystals from harmonic operation. This shifts the operating frequency by about 10Hz but this is of no real significance.

A description of the inner workings of the CPU (IC5) is beyond the scope of this article. It's general operations will however become apparent as this How It Works is read.

Note that certain outputs (namely HDLA, DBIN, INTE and WAIT) are taken to the extender socket directly from the CPU. These are unbuffered and account should be taken of this if you expand the system. Each line will adequately drive a single TTL load and maybe a handful if you use low power devices.

The HOLD line going to pin 13 of the 8080 is not used within the main board and is used to carry a DMA request which, via the HDLA signal puts all the busbar buffers into a high impedance state. This could facilitate a take over of the complete memory of this system by a peripheral device or, possibly, another computer. Normally this line should be at logic level "0" so we have hard wired it thus with a board link. This link **MUST** be removed, or a switch substituted, if use is made of this line!

RDYIN is normally held at level "1". If taken to "0" it causes the CPU to stop operating. Nothing happens as long as the signal is low and the contents of all internal registers within the MPU are maintained. When the signal returns to "1" the MPU carries on operating as if nothing had happened. By taking pin 3 of IC4 via a push switch to ground we have a ready made "PAUSE" control which will enable the TRITON to stop in mid program; say, the middle of long high speed VDU output to inspect the screen.

The chances are very high that you will not need RDYIN for external systems so the feature could be built in permanently. Note should be made that it is bad practice to have a push switch hard wired to ground on this line if at any time in the future you derive the RDYIN signal from a gate. Press the button and bang goes the output stage of one innocent gate.

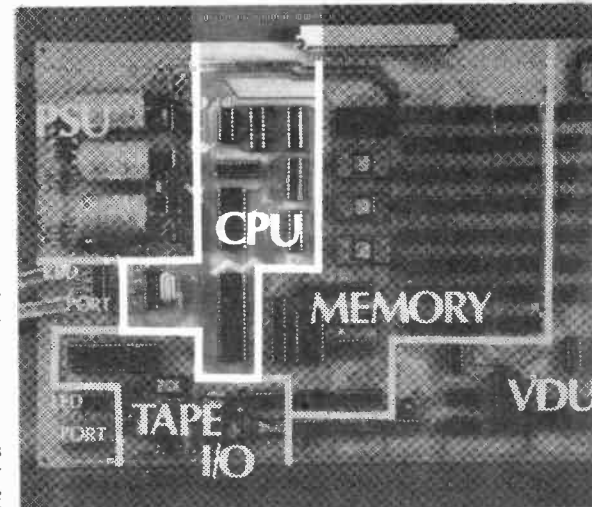
IC6 is an 8228N 8080 System Controller which gates out the five main control busbar signals from the status byte at the time of STSTB and holds these on latches. The chip also comprises a set of bi-directional buffers for the data busbar; the direction of these buffers is controlled by DBIN and their outputs are disabled on the receipt of a DMA request by the HDLA signal. We were not happy that this buffer alone would be capable of supporting a fully extended system hence a further buffering stage in the shape of IC9 (74LS245). Like the System Controller the latter chip is supervised by the HDLA and DBIN signals. Integrity of any DMA request is maintained on the data bus.

ICs 7 and 8 are uni-directional tri-state buffers which should allow the address busbar to feed a fully extended system. Note that we have inverted A15 prior to putting it on the bus. By doing this we have been able to economise on chip select decoding circuitry elsewhere in the main board system. This

should present no problems to anyone working with extender boards provided that this fact is remembered.

Remember, you must disable the push switch in this mode, that is why we have shown it dotted in and why Transam have not built this facility into their PCB in an obvious way. Why not use common sense and make use of this extremely valuable facility — all that is needed is the cost of 20cms of wire! You do not even need another push switch because you can use a spare pair of contacts on the Tape Control Manual Override. It does not normally matter if you press this button provided the cassette recorder is switched off with its own control.

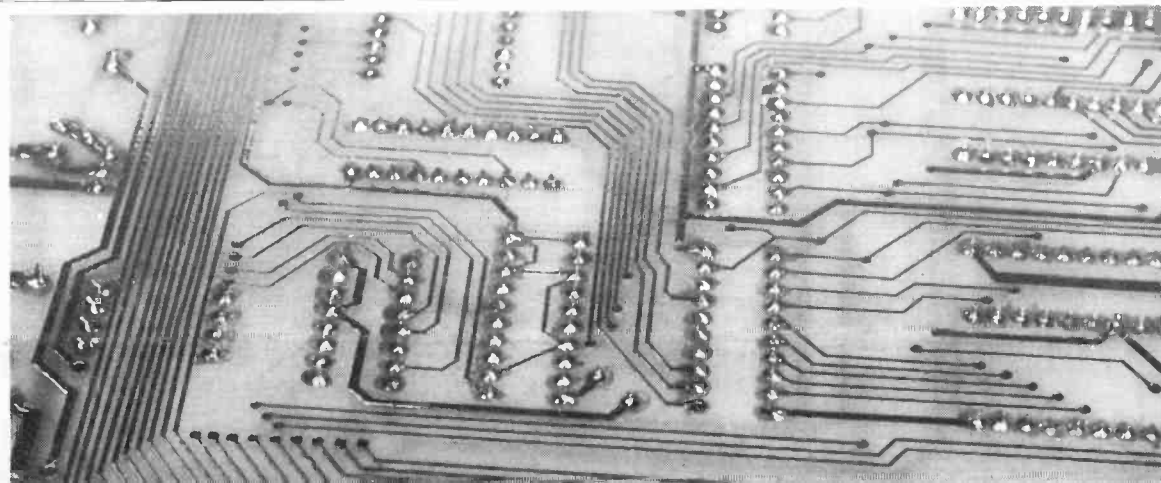
IC11 is the Interrupt Encoder which has eight lines going in to it. These are normally held high by pull up resistors R4 to R11. The encoded three-bit nibble is output at pins 6, 7 and 9. If all the inputs are high all the outputs are high and a "0" is placed on the Enable Output line at pin 15 (the latter is used to generate the INT signal — Interrupt Request — to the CPU). If any single input is pulled to 0 volts, via the push switches or external logic, an equivalent code to describe that line number is output as the Interrupt Data Nibble and pin 15 goes high telling the MPU that an interrupt has been requested. The MPU will carry on operating until it reaches a perisable point in its cycle to service the interrupt. When this point is reached the MPU outputs an Interrupt Acknowledge signal (INTA) through the status byte which is decoded and latched by the System Controller. This signal is used to activate the Output Enable of IC12 (an eight wide tri-state inverting buffer) which formats the ID nibble to make an eight bit Interrupt Data byte which is then accepted by the CPU as a RESTART instruction. The program counter jumps to one of eight fixed locations in memory — the location is defined by the ID byte — while the STACK preserves all current register data



and status information. The MPU then operates on the interrupt routine and returns to its main program when it comes to an RET instruction.

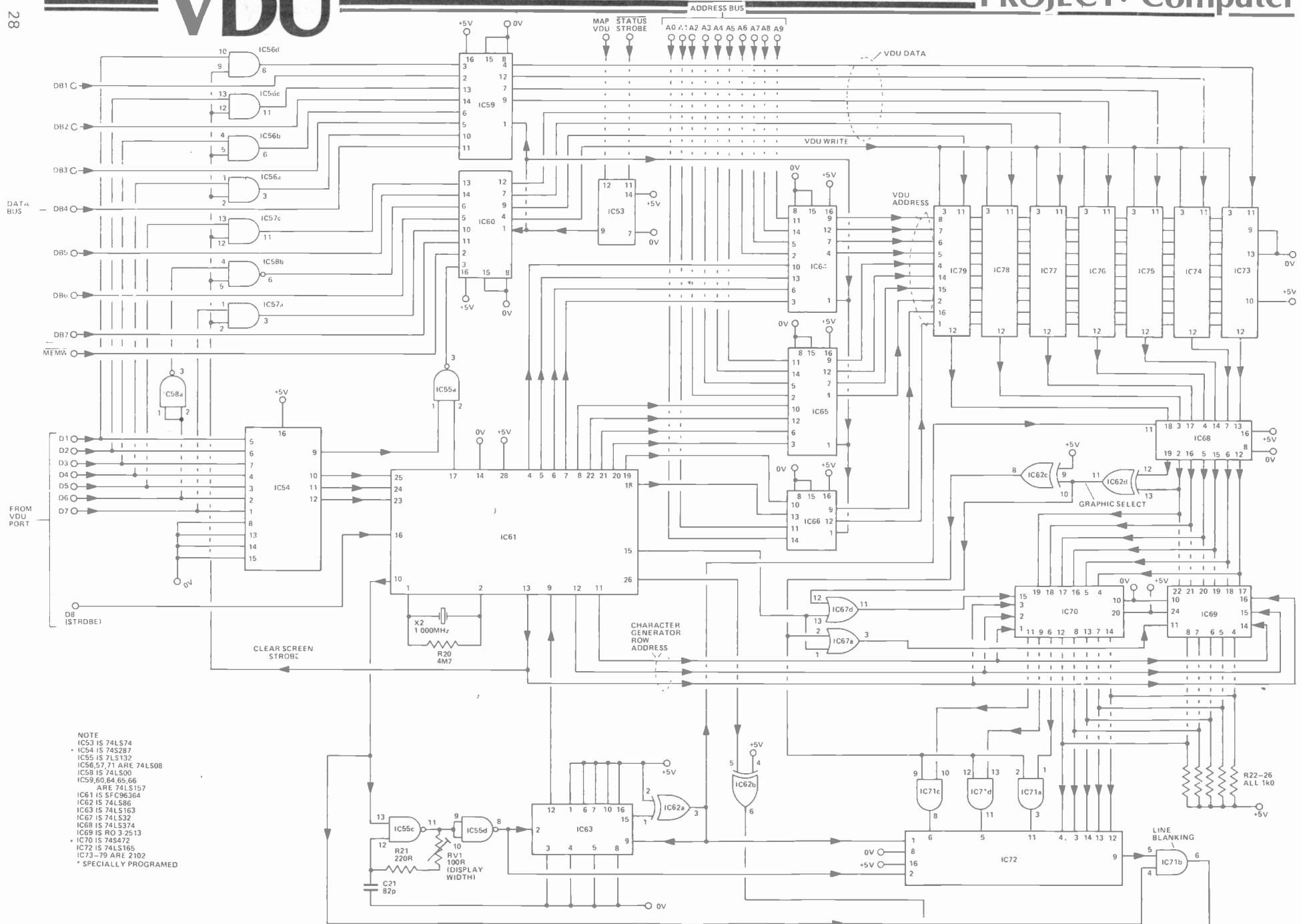
Interrupt 0 should not be used even though it is available on the PCB. It simply duplicates the manual reset operation but would create problems if used with the TRITON's Monitor program. INT1 is dedicated by the Monitor to provide a Clear Screen and Reset Cursor facility which can be carried out at any time. INT2 is also a dedicated function. The Monitor includes memory test facilities as part of the power up routine and use of the reset button will clear all memory. To by-pass this problem we are using INT2 as a non-destructive reset which, as far as any programs that are running are concerned, is just like reset and the system will re-initialise but the memory will not be cleared. ALWAYS use INT2 for reset unless one of your programs has corrupted the Monitors stack!! Only then should you press manual reset or carry out a Power On Reset by switch switching the machine off and on.

Photo of the underside of a section of the Triton's PCB. Note that although it appears that there are no connections to some IC pins — ALL pins must be soldered as these pins are used on the topside of the board.

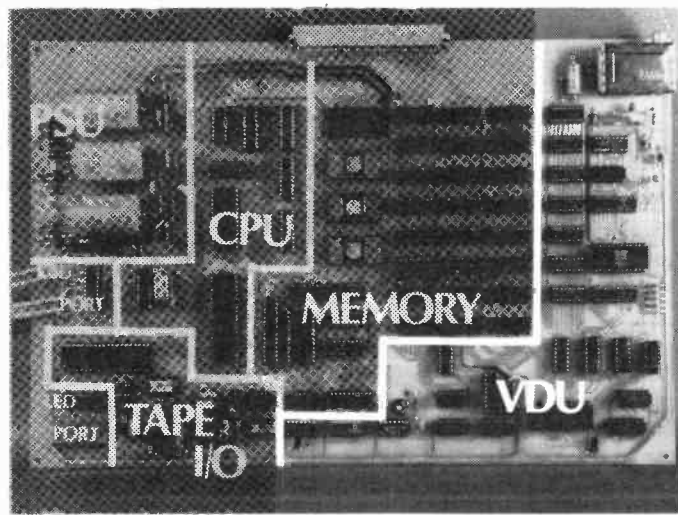


VDU

PROJECT: Computer



NOTE
IC53 IS 74LS74
IC54 IS 74S287
IC55 IS 74LS132
IC56,57,71 ARE 74LS08
IC58 IS 74LS00
IC59,60,64,65,66
ARE 74LS157
IC61 IS SFC96364
IC62 IS 74LS96
IC63 IS 74LS163
IC67 IS 74LS32
IC68 IS 74LS374
IC69 IS 74LS165
IC70 IS 74S472
IC72 IS 74LS165
IC73-79 ARE 2102
* SPECIALLY PROGRAMED



HOW IT WORKS

IC61, the Thomson CFS VDU control integrated circuit, has a built in clock which generates standard TV synchronisation pulses (line and field sync) on pin 26. Random interlace is used and a simplified field sync train is generated as opposed to the full CCIR specification.

The chip, synchronously with this train of pulses, generates addresses for the VDU RAM so that the correct code of the character is selected as the TV raster spot is traversing the respective part of the television screen. An external "Picture Point Oscillator" (IC55c and d) in conjunction with a divider chain (IC63) sets the horizontal width of a character and steps the address of the control chip, output from pin 12 (IC63) to pin 9 (IC61). The inverted output of IC63 pin 15 is used to latch the data being addressed by the controller into IC68 (a seven wide latch), latch the picture point pattern generated by the character generator ROM into the serialiser (IC72) and reset the picture point divider chain (IC63) at the end of each character width.

The picture point width (hence the character width and number of characters per line) is set by the frequency of the oscillator control RV1.

We are using a 7 bit wide RAM to hold the FULL ASCII code — we need this to provide capacity for graphics. The outputs of the latches feed both the standard alpha-numeric character generator (IC69) and a specially programmed ROM (IC70) which contains picture point data for the 64 graphic symbols. We use the EXCLUSIVE OR function (IC62d) on bits 6 and 7 of the ASCII code to select either the graphics or alpha-numeric ROM. The select signals go through further gating (ICs67a and d) to ensure that the integrity of the cursor generating pulse (pin 15 of IC61) is not corrupted.

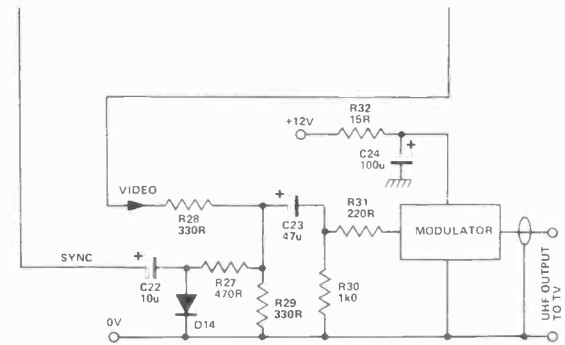
Three further address lines from the VDU controller (pins 11, 12 and 13) address the picture point data ROWS in both ICs 69 and 70. Due to a limitation caused by the internal operation of IC61 chip the row address code 000 is output for the top row and the bottom four rows of the character cell. Normally rows 0, 8, 9, 10 and 11 are used to provide inter line gaps for alpha-numeric displays while rows 1 to 7 carry alpha-numeric picture point data. We have had to take this into account when designing the font of graphics symbols — some of which cannot fill the complete character cell rectangle on the screen. Look at the table of graphics characters and you can see how we have adjusted the graphics to suit this restriction.

Further complications caused by this limitation are that a graphic must not appear on the topmost line of the television screen if that graphic contains picture points in its top row. IC61 requires there to be zeros present here in order to derive field blanking. This problem could be overcome with extra gating but this would have been at the expense of simplicity.

A similar problem (involving line blanking) is resolved by gating the video output with the INI function (pin 26 of IC61) in IC71b. Without this any graphics symbol having a picture point in its most left hand column would have caused a "wrap around" while a line that interferes with the DC level of the line sync pulse. The only problem that remains in this respect is that you will now get a single "extra" picture point showing to the right of the 64th character down a line if you use a graphic in the most left hand position of a line. This does not happen with all graphics — only those that have picture points in their most left hand column.

The five outputs from the alpha-numeric ROM are wire ORED with five of the eight

VDU section of the Triton.



outputs from the graphics ROM and held high via pull up resistors R22 - 26. They are then fed to the correct positions in the serialiser shift register IC72. Note that the remaining three outputs from the graphics ROM have to be ANDED with a signal defining whether or not the character is a graphic (done by ICs71a, c and d). This is to ensure that if alpha-numeric are printed there is a correct inter-character gap.

So far we have avoided talking about how the VDU RAM is addressed by the control chip. Let's deal with that now.

We are allowing the CPU to memory map the VDU RAM. To do this we have had to allow the MPU to take over addressing control of the VDU RAM. This is done by taking all the address lines from IC61 and their equivalents from the system's busbar to a set of data selectors (ICs64, 65 and 66). If the MPU addresses the VDU memory location (any address between 1000H and 13FFH) the block select line (MAP VDU) is activated. This of course, could happen if ever the address busbar went into a high impedance state (during HOLD etc) so to prevent any spurious pulses affecting the operation we gate the VDU block select line with STSTB which only occurs when valid address information is on the busbar. We do the gating in a D type latch so that during the complete cycle of a VDU memory map the data selectors are set to allow the computer address bus to be transmitted to the inputs of the VDU RAM. At the end of that cycle and at all other times the data selectors hand over address control to IC61.

A similar transfer of responsibility takes place between the normal input data to the VDU (which gets to it via an output port) and the main system data bus. In this case the data is selected by ICs59 and 60. These also receive their changeover instruction from the changeover latch IC53. Note that we also have to do a changeover between the internally generated memory write command (pin 17 of IC61) and the MPU's MEMW strobe. This is done within IC60.

It only remains to describe the gates on the VDUs internal data lines and IC54. The former are used to force the ASCII code for "Space" on to the data lines when pin 13 (IC61) is at "0" in coincidence with a writing

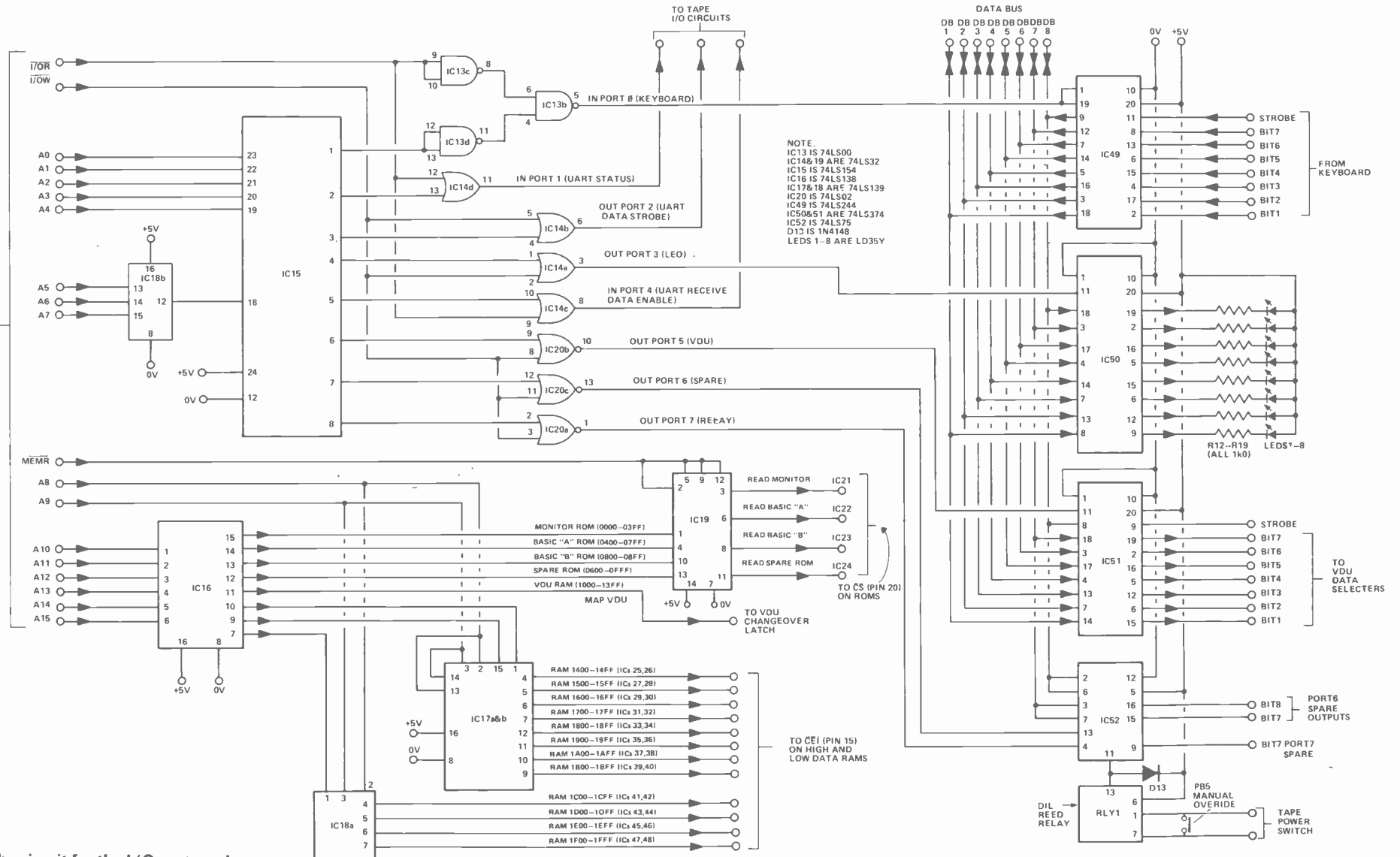
pulse to the VDU memory. This is to allow for the very useful internal function provided by the IC61 to clear the screen and reset the cursor in one operation.

The VDU controller carries out a number of non writing functions as well as entering and addressing data within its memory. By using some of the ASCII codes as control it is possible to do such things as move the cursor in steps to any position on the screen, reset the cursor, carry out a line feed or do a carriage return clearing only the unused part of the line. There are also a couple of control codes that we wish the VDU to ignore — OOH and O4H — respectively these are NUL (or no operation) and EOT (end of text) flags. Recognition of all these special codes is carried out by the VDU CONTROL ROM (IC54). This has had to be specially programmed for the TRITON.

To get best use from the TRITON and its VDU you need to know hexadecimal and decimal values of all the ASCII codes that are used to generate alpha-numeric, graphics, and control characters. You also need to know which of the keyboard keys correspond to each graphic character. To help you we show all the graphics with their respective codes and key names in Fig. 00. Alpha-numeric codes are shown in Fig. 00 and the control codes in Fig. 00.

Normally you may output a character to the VDU for printing in I/O mode every 8.3mS. The standard TRITON monitor errs on the safe side and has a built in delay which outputs a character roughly every 9mS. If ever you write your own software you must take this speed limitation into account. Furthermore there are two I/O operations which take a considerably longer time: these are "Clear Screen and Home Cursor" and "Home Cursor". These instructions must be followed by a delay of at least 132mS. Again the TRITON's monitor makes allowance for this but you can get direct access to these functions if you use either the "PRINT CONTROL" or "VDU" commands which exist in BASIC L4.1. If you use these in BASIC you MUST follow them with a delay loop having a time constant greater than 132mS. (In practice we found that a 200 step "FOR — NEXT" instruction was quite safe.)

KBD PORT



The circuit for the I/O ports and memory select.

HOW IT WORKS

During an INPUT or OUTPUT instruction cycle the MPU will generate the address of the I/O port required on the least 8 significant bits of the address busbar. This has to be decoded to provide a single line signal which will activate the port. It is not sufficient to provide this address on its own because there is no way that the port can tell whether the select signal has come from a genuine port select instruction or whether it is the low order byte of a memory read/write cycle. Furthermore there are times within the machine cycle when the address busbar can be in a transient, or high impedance state which could cause indeterminate address information to be decoded by the port select circuits.

To prevent these problems and also to differentiate between input and output ports the decoded port line is gated with either the I/OR or I/OW control line. One or other of these lines goes to "O" after the ports select address has been placed on the busbar and terminates **BEFORE** the address data changes. This pulse is of the correct duration to strobe the I/O data on the data bus into or out of the port in question. Take, for example, the control of the Keyboard INPUT port. The port itself is simply an eight wide set of non-inverting tri-state buffers permanently connected to the data bus.

Pins 1 and 19 enable the output of the port when they go to level "O". Normally these pins are at "1" and held there by the output of IC13b and keyboard data cannot affect the data bus. IC18b and 15, between them allow 16 lines to be uniquely decoded from address bits 0 to 7. We only use 8 ports on the main board so part of this facility is redundant hence not all the outputs from IC15 are used. IC18b is a 2 to 4 line decoder operating as a 3 input NAND gate. The reason for this is that the device was one left over in a half used package and its use avoided having to put in an extra IC just for the sake of one 3-input gate. When address 00H is present on the bus pin 1 of IC15 goes low which points to Port 0 (the Keyboard). This signal is ORED with I/OR by IC13c, d and b so when there is coincidence IC49 receives "0" on pins 1 and 19. Whatever data is coming from the keyboard is transmitted on to the data bus and then accepted by the CPU as genuine input data. The reason for using three NAND gates

to provide the OR function is again to use spare capacity in partly used ICs.

While on the subject of the keyboard port some might question the use of only ONE port for the keyboard instead of having a second one to check the status. We get around this apparent deficiency in the INCH (Keyboard Input) sub routine of the monitor. Interconnections with the keyboard put the 7 bits of ASCII on bits 1 to 7 and instead of parity we are using bit 8 to carry the keyboard strobe. Output port 3 works in similar fashion. IC15 decodes its address on pin 4 and IC14a ORs it with, in this case, I/OW. The resultant pulse is used as a clock to the D type latches within IC50. The data is entered into the latches on the rising (trailing) edge of the pulse. Using the trailing edge does not matter here. There is just sufficient current sinking capacity in a 74LS374 (IC50) to drive a small LED direct through a 1k0 limiting resistor. The byte of data is therefore transferred from the busbar to the latches and displayed in binary fashion on the LEDs. Note that the LEDs are illuminated when a "0" is output.

The VDU, when operating in I/O mode, is situated at PORT 5. This works in much the same way as the LED port but we are using a NOR gate to give a positive going port enable pulse. Bits 1 to 7 carry ASCII data and bit 8 the VDU strobe which is formatted to have the correct timing characteristics by the OUTCH (VDU Output) sub-routine of the Monitor program.

A further output port was required to switch the relay of the tape recorder power control (to effect automatic starting and stopping of the tape). Theoretically a single bit port was all that was required but as things turned out in the design this would have required a new integrated circuit (there were no spare latches left over anywhere else!). Because of this it was felt sensible to use a 74LS75 (IC52) which contains four latches connected as two pairs. This way we were able to provide a tape control signal to the relay at pin 11 (the Q output of one latch) by using data bit 7 and this left a spare line on that port (bit 7) which can be used by the experimenter as an output line. The port to call for this line is number 7. At the same time the other pair of latches in IC52 are used as OUTPUT PORT 6 which comprises bits 7 and

8. These are also spare.

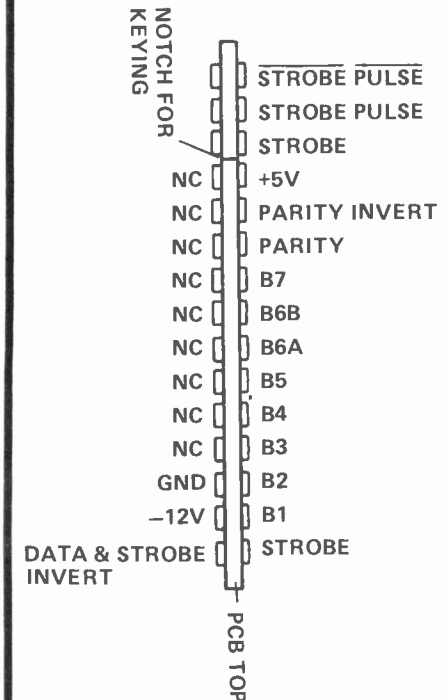
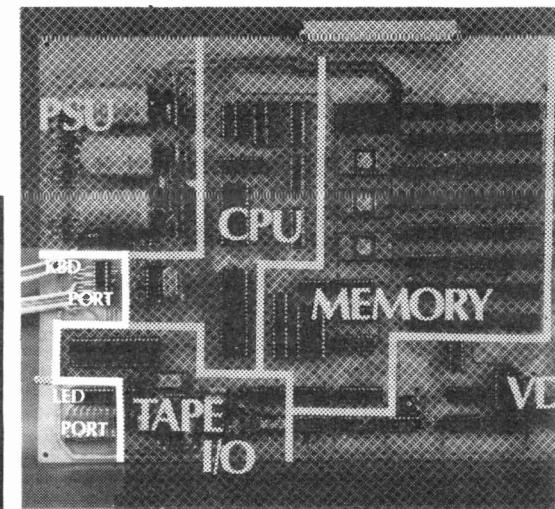
As we've moved on to the subject of tape control take note that there is a push button switch connected across the relay contacts. This is to allow manual override so that the cassette recorder can be rewound etc. under manual control without having to unplug the remote control lead. See the relevant section for more details about the serialiser I/O ports and MODEM for the tape recorder.

The memory of TRITON comprises four 1K blocks of ROM, one 1K block of VDU RAM and twelve 256byte blocks of Read/Write RAM. The high order addresses are used to decode individual lines which enable each block while low order addresses point to a specific location within the previously decoded block.

IC16 is a 3 to 8 line decoder but we are able to use it to decode, uniquely, eight individual blocks of 1K from the six most significant address lines. This is made possible by using A15 in inverted form and the internal gated Select inputs of the 74LS138. The four lowest order selected lines correspond to memory blocks which start at 0000H, 0400H, 0800H and 0C00H respectively and these hold the MONITOR, BASIC "A", and BASIC "B" read only memories. The block starting at 0C00H is a spare block reserved for ROM expansion. The line decoded at pin 11 of IC16 addresses the block of VDU RAM and the remaining three lines are fed to three 2 to 4 line decoders ICs 17 and 18a along with address bits A8 and A9.

The latter three decoders break down the remaining 1K blocks into 12 blocks — each containing 256 bytes. Each of these 12 lines goes to a specific pair of random access memory integrated circuits that form the main work area of the computer.

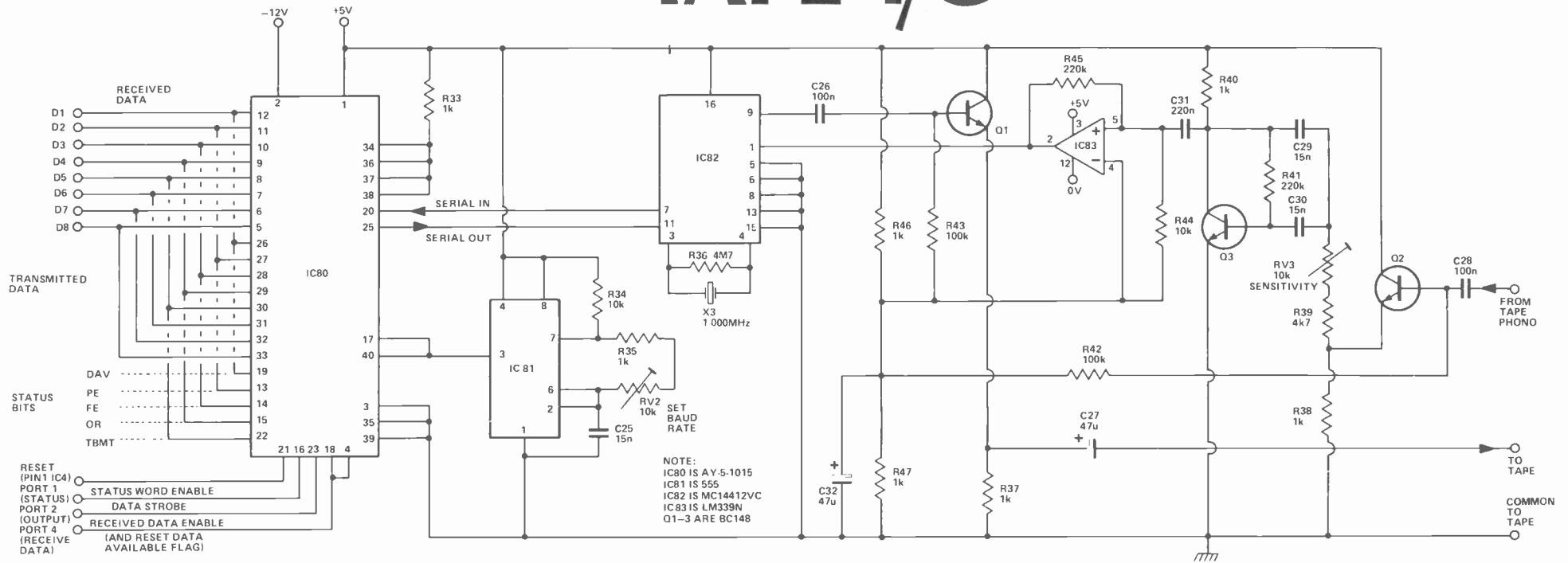
Except for the ROMs, gating with MEMR and MEMW is carried out within the memories themselves. The 2708 read only memories only boast a chip select input and it is necessary to gate the MEMR control signal with each of the chip select lines prior to making connection with the appropriate pin. This gating is carried out by the quad 2 input OR gates contained within IC19.



The connection details for the keyboard recommended for the Triton.

TAPE I/O PROJECT: Computer

32



The tape I/O section of the Triton system.

HOW IT WORKS

The AY-5-1013 Universal Asynchronous Receiver transmitter features tri-state outputs for received data and all status bits. Note that respective bits of the data in and data out terminals of the chip are commoned together before joining the TRITON's data bus. The Status bits of the UART are similarly commoned with the DAV (Data Available) bit tied to bit 1 on the bus; PE (Parity Error) to bit 2; FE (Framing Error) to bit 3; OR (Over Run Error) to bit 4 and TBMT (Transmitter Buffer empty) to bit 5. Note however that TRITON's standard Monitor only samples DAV and TBMT.

The DAV and TBMT flags are used to tell the system when the UART has received and has ready a complete byte of new data or when the UART has finished a current serialising cycle and is ready to accept a new byte for transmission. In actual fact the UART will accept a second byte while it is still transmitting the first due to the double buffering nature of its transmitter buffer.

should be set on a frequency meter.

In order to transmit data the TRITON Monitor first checks to see whether the UART transmitter buffer is empty by activating the STATUS WORD ENABLE which is, in effect, PORT 1. This places the status word on the data bus and the MPU checks to see whether bit 5 (TBMT) flag is at "1". If so it indicates that the UART is ready and the Monitor then outputs its data on to the busbar while activating the DATA STROBE (PORT2). DATA STROBE starts the transmission serialising cycle and the serial data is output to the MODEM (IC82) at pin 25. If the TBMT flag was at "0" the Monitor goes into a loop and waits until the UART is ready.

In order to receive data the MPU asks for status information, again through input port 1 but this time checks bit 1 (the Data Available flag). This goes high as soon as a complete serial byte has been received and formatted into parallel form in the UART's

byte of data is received. Clearly the software cycle, which carries out this operation, MUST have a shorter loop period than the period between one received byte and the next otherwise overrun errors will occur.

The Motorola single chip MODEM seemed highly attractive from the word go as it is extremely economical on external components and needs no adjustment.

The MC14412VL is such a versatile chip that it was again difficult to decide which mode it should be used in. Eventually, in order to have a frequency pair that would give best reliability with most tape recorders and to allow the MODEM to receive at up to 600 baud (not that this is used at present) we opted to go for the USA standard "originate" mode in which the transmitted frequency pair is:

MARK ("1") = 1,270 Hz
 SPACE ("0") = 1,070 Hz

Clearly we need to be able to demodulate the same pair of frequencies so have to

The MODEM interfaces directly with the UART and only needs a crystal and resistor to lock it to the correct frequency pairs. It is most important that a crystal of exactly 1.0000MHz is used here otherwise you will not be able to use pre-recorded tapes! The transmitted carrier of the MODEM is an eight level digitally synthesised sine wave of about 300mVrms which is buffered by TR1 before being fed via C27 to the tape recorder phono input.

To carry out a demodulation satisfactorily the MODEM IC requires a very precise unity mark/space waveform at pin 1. The tolerance on the mark/space ratio has to be better than $\pm 4\%$. If the carrier being played back from the recorder carries any harmonic distortion this will result in an asymmetric sinusoid which will be difficult to convert to a square wave of the above specification. To further purify the sine wave it is amplified and filtered by Q3. To some extent the input sensitivity can be adjusted by RV3 but under

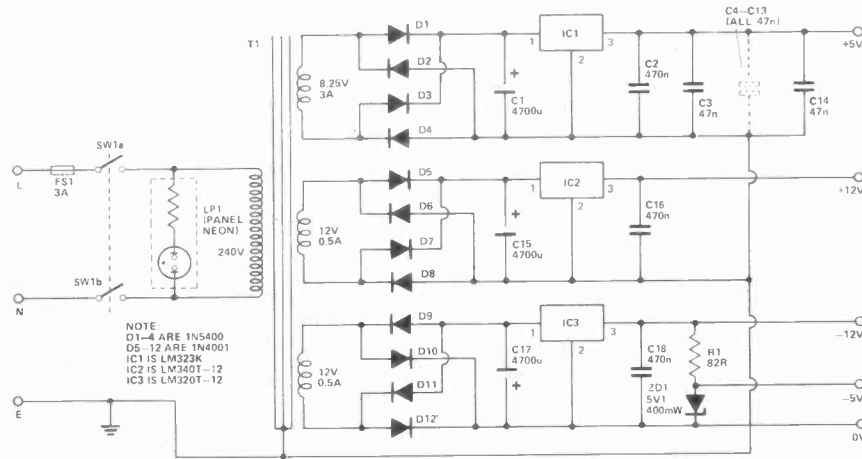
The format of serialised data in TRITON is a START bit, 8 data bits, a parity bit and 2 STOP bits. These are transmitted at a rate of 300 baud set by the clock comprising IC81 (an NE 555). Baud rate is adjustable by about ± 50 percent by means of RV2 and, of course, it is important that this is accurately set if tapes from other sources (recorded in TRITON's format) are to be played back. To obtain a rate of 300 baud the oscillator must run at precisely 4800 Hz and ideally this

output latches. The MPU will loop until this condition is met. When the flag goes to "1" the MPU uses port 4 to send a "Received Data Enable" strobe to the UART. This enables the outputs of the receiver buffer latches and places the data byte on the system busbar. To prevent the system reacting a second time to the same DAV flag the pulse from port 4 is also used to reset DAV which then stays low until a completely new

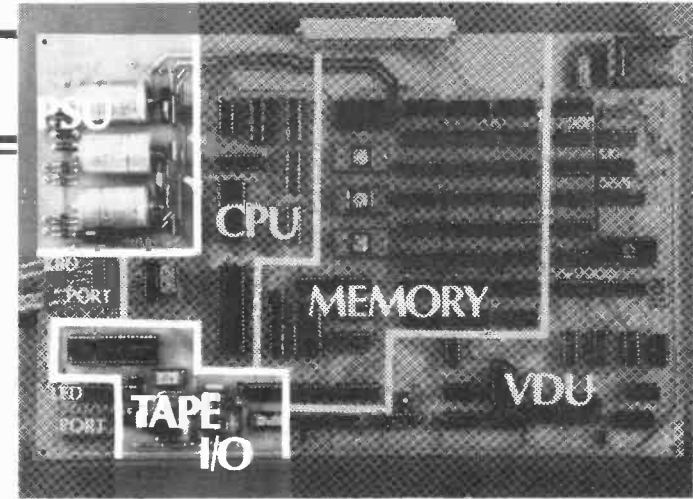
operate in Simplex mode hence pins 2, 10 and 14 of IC82 are allowed to be "1". Internal pull up resistors within the chip do away with the need for external pull ups hanging on these pins! Pin 2 actually is the "Self Test" control input which makes the MODEM's receiver demodulate the same frequency pair that is being transmitted. Keeping this active prevents any ambiguity as to whether one is "originating" or "answering".

normal circumstances (within the range of input voltages mentioned above) this should always be set in its mid-point position. The high purity sinewave at the collector of Q3 is fed to IC83 which is a zero crossing comparator which will sense the zero crossing of a sine wave to within about 3mV. With a good input signal this results in a square wave that more than adequately meets the input specification of the MODEM.

PSU



The power supply section of the Triton is based on three terminal regulators.



A close-up photograph of the PSU. Note the orientation of the IC regulators.

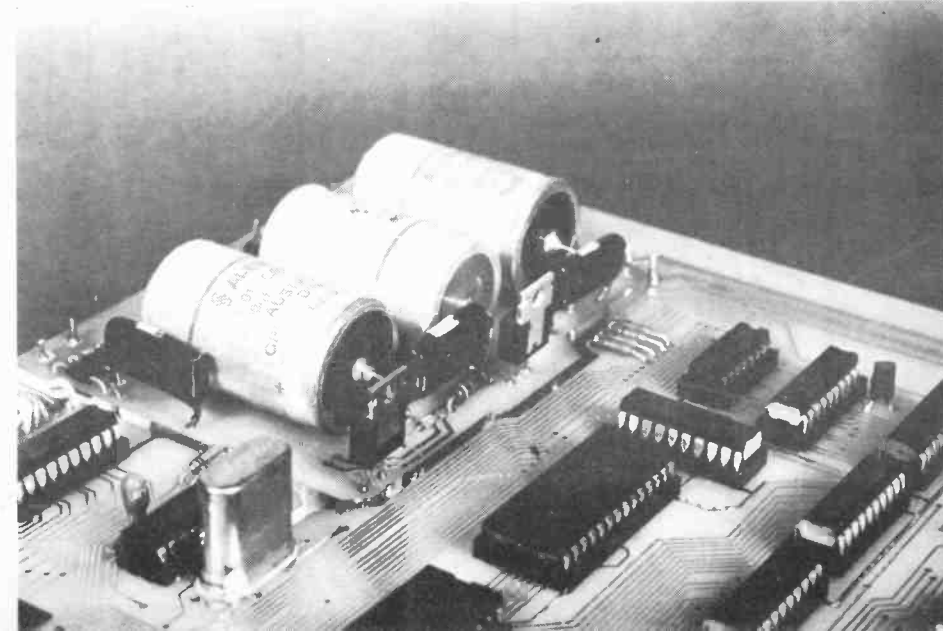
HOW IT WORKS

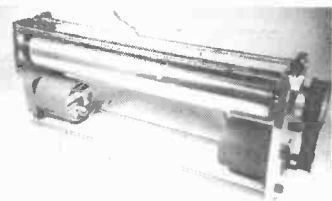
THE POWER supply has been kept as simple as possible, utilising three IC regulators to provide the main rail supplies which are +5 V at 3 A (the TRITON does not draw all this but do not rely on there being any to spare if you are thinking of hanging any other bits and pieces on this line!) +12 V at 0.5 A and -12 V at 0.5 A. A few milliamps are needed by the ROMs and the 8080 at -5 V and this is catered for by a simple zener shunt off the -12 V rail.

The ± 12 V rails are straightforward. Dissipation by the regulators is low and no heat

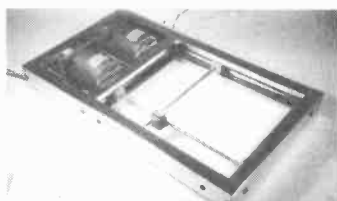
sinks are necessary. The 470n capacitors on the outputs of the regulators are to prevent any parasitic oscillations. Note that the +5 V rail has a dozen 47n capacitors (C3 to C14) shunted across it. These are anti-spiking devices and have been placed in strategic places on the board.

To avoid excessive dissipation in the main +5V regulator (IC1) we decided on a specially wound mains transformer, hence the rather obscure specification for an 8.25 V winding.





BARREL TYPE X-Y PLOTTER ASSEMBLY



X-Y PLOTTER ASSEMBLY

BARREL TYPE X-Y PLOTTER ASSEMBLY

120V Stepping Motor. Provision for Pen (Pen not supplied). AS PICTURE £55 ea. With alternative motor for non-reversible requirements recorder/printer applications etc £48 ea. With Pen and Paper guides £78. With Pen, Sprocket and Paper guides £88. Other voltage options available. P&P all units £2.50.

X-Y PLOTTER ASSEMBLY

Consisting of frame with X & Y assemblies. (No pen but provision) Bed size 12" x 9". Motor options 120V only £43.45 ea. 120V (can be changed to 12/24V), data supplies £51.15 ea. 12/24V £70.40 ea. P&P all versions £2.50.

STEPPING MOTORS ONLY

Motors as used in plotters etc. All motors 200 steps per revolution. 20 oz inch torque. 120V 1000-0-1000 ohm. Can be changed with care to 12/24V. Data supplied £8 ea. P&P £1. Supplied for 12/24V operation £13 ea. P&P £1. Just think about the uses!

OSCILLOSCOPE TUBES

Brand New Boxed — Carriage all tubes £3.25. Telequipment S52 £10 ea. D51 £15 ea. S42 £10 ea. D53A £20 ea. D52 £15 ea. S31 £10 ea. Bradley 200 £85 ea. Advance OS3000 £85 ea. GEC types 924F £25 ea. 924E £17.50 ea. 1496B £75 ea. Brimar D13-51GH £65 ea. D10-210GH/32 £40 ea. D13-46GM £35 ea. **NOT BOXED — NEW — WARRANTED.** Telefunken D14-131 replacement for Solartron CD1740. Cossor CDU150. S.E. labs SM112 and GEC/MOV 1474 at £55 ea.

BUILD YOUR OWN BUS

Approx. 1 1/2 metre multiway ribbon cable terminated each end with a 50-way female edge connector. Takes 0.1 printed circuit board £2 ea. P&P 75p.

NOW — INCREASE AREA GIVEN TO PICK-A-PACK AT 50p per lb

Large volume of new components you can't afford to miss

TELETYPE ASR33 with 20ma loop. Good condition. **Special low price £395 ea**

1/2" MAG TAPE

Approx. 1,500 ft. Now 20p each. P&P £1. Or 7 for £1. Carr. £3.25.

FOR THE VDU BUILDER tube M28-13GH 23 x 17cm at £12. Base connections supplied.

PLESSEY VDU. No keyboard — weird electronics £60 ea. **TELETYPE KSR33** from £275 each. Limited quantity of 35R0 — 20ma loop — can be changed to ASC11 code (3 hours' simple work and £10 parts) **OUR PRICE EXCLUDING PARTS REQUIRED £70 ea**

Ex-Ministry Teletype Punches 8 level 110 char per sec. £50 each **AMPEX TM7.** Nice condition £225. Polished Wooden Cases to take normal 'QWERTY' KEYBOARDS. or can be carefully cut to take any size. £3 each. P&P £1.50.

74S00	12p	74S10	5p	74H51	7p
7401	5p	7417	14p	7453	5p
74S02	12p	74S38	10p	74H74	12p
74S04	12p	7451	5p	74S74	12p

75325 — Memory Core Drivers. 600ma capability. Fast. Other uses. RIDICULOUS at £1 ea.
75453 — Dual Peripheral or Drivers 75p ea.

AUDIO AMPLIFIER BOARD. Size 4 1/2 x 2 1/2. Output pair of TIP31s. Circuit supplied £1.50 ea. P&P 30p.

DIGITAL 24-hour CLOCK with built in Alarm as used in Braun Digital clocks. Silent running. Large illuminated numerals. AC mains. Size 6 1/2 x 2 3/4 x 2 3/4. Only £4.25 ea. P&P 50p.

ITT-CREED

Punches and Prints on 1/2" paper. Complete with Power Supply Solid State. Size 15 x 1 1/4 x 2 1/2" deep £13 ea.

5 LEVEL PAPER TAPE READER

Reversible. Small size approx 5 x 3 x 4 £2 each. P&P £1

★ TRANSISTORS/DIODES/RECTIFIERS, ETC. ★

Guaranteed all full spec devices. Manufacturers' Markings

At 5p each
BC147, 2N3707; BC172B; BC251B; BC348B; BC171A/B; BC413; D10; BAX13; 1N937; BA102BE; BZX83; TIS61, 2N5040

At 10p each
1N4733A; SN7451N; BYX10-15KV 0.36A; BY210 15p ea. TIP34A — 50p ea. BD538 — 40p ea. Heavy Duty Bridge Rectifier — 20p ea. CA3123E — £1 ea. BDY55 — £1 ea. 2N3055 — 40p ea. TIP31B 12p ea.
TBA560CO £2 ea. 1N4436T-T03 Flat mount 10A 200piv £1 ea. 2N5879 with 2N5881 Motorola 150W Comp. pair £2.
8D535, 8D538 Comp pair — 75p.
Linear Amp 709 — 25p ea.
P&P Extra on all items

FINNED HEAT SINK — single TO3 — size 4 1/4 in x 3 in x 1 1/4 in 50p ea. P&P 75p.
Texas Bridge Rectifier 5SB05-50V 5A. 60p ea. P&P 20p.

MOTOROLA POWER TRANSISTORS type W0993/441. TO3 Min voltage 500. 20p ea. P&P 15p.
BFY51 — 12p
BU208 £1.20 ea. P&P 15p.

CABLE NEATERS — neaten up your wire on a chassis with these push-on clips. 10 for 20p. 100 for £1.50. P&P extra.

TELEPHONES. Post Office style 746 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 each. P&P £1

HANDSETS only 706 style £1.75 each. Older style £1. P&P 75p.

TELEPHONE EXCHANGES. Eg 15-way automatic exchange only from £95.

★ 1000F Feed thru Capacitors 10 for 30p. P&P 15p.

HIVAC Miniature NEONS. App 60V Brand New 10 off 20p. P&P extra

GRATICULES 12 x 14cm high quality plastic 15p ea. P&P 10p

LARGE RANGE OF ELECTROSTATIC VOLT-METERS. From 0-300V 2" £3, to 20KV max. General guide 5KV 3 1/2" £5. Thereafter £1 per KV. P&P 75p.

DON'T FORGET YOUR MANUALS. S.A.E. with requirements.

POWERFUL MINIATURE GERMAN 12V REVERSIBLE MOTOR. No load current 70mA, excessive load 400MA. Size 1 1/2 x 1 3/16" dia. Shaft 5/16 x approx 1/16" dia. 50p each. P&P 40p

A MILLION MUST GO

HIGH NOISE IMMUNITY LOGIC. DUAL IN LINE 16-PIN CERAMIC. 12V Rail Conventional TTL package. Guaranteed full spec. devices. Full data 2p ea. MIXED PACKAGE — £1 P&P 25p.

NEW ITEMS

ALMA Min. PUSH BUTTON REED SWITCHES. High reliability 18 x 27 x 18mm. Ideal for **KEYBOARD** 50p ea. P&P extra

MOTOROLA MC 4028 60p ea

MOTOROLA MC 7441 40p ea

IC 7402 12p ea

MINIATURE FANS 3 square (like muffins) 115V £5 ea. P&P 75p

HONEYWELL HUMIDITY CONTROLLERS 25p ea. P&P 25p

SPRAGUE 100mfd + 500mfd 210VDC working. Brand new 5 for 50p. P&P 50p.

REED SWITCHES. Sub-min. Size 20mm 10p ea

SMITHS encapsulated transistorised **AUDIBLE WARNING DEVICES** 4V-12V. Can be driven from TTL 50p ea. P&P 25p.

Attractive **GRILLS** — speaker covers/ventilation. Size approx 4 x 7. (Size may vary slightly). Plastic 20p ea. Metal 35p ea. P&P extra.

BURROUGHS 9 digit **PANAPLEX** numeric display. 7 segment 0.25 digits with red bezel. With data £1.95 ea. P&P 30p.

MINIATURE NIXIE TUBE type ITT 5870ST. Digit size 0.5. Wire ended. 50p each. P&P 20p. 4 for £1.75 P&P 35p

TRANSFORMERS 115V AC input. Secondary 30V and 2.6V 10VA. 50p ea. P&P 50p.

21-WAY SELECTOR SWITCH. Single pole with reset coil 240V AC coils. Additional switch contacts for auto reset etc. £1.45 ea. P&P 75p.

As ABOVE with additional 240V relay on base plate and full black plastic cover £2.45 ea. P&P £1.50

SNAIL BLOWER 110V AC 500 MA. Brand new by Airflow Developments. Quiet and very good looking. £2.50 ea. P&P £1.

POTTER & BRUMFIELD 18-48V DC Relay. 3 pole c/o. Heavy Duty. Plug-in type with base 50p ea. P&P 25p

MINIATURE KEYBOARD. Push contacts, marked 0-9 and A-F and 3 user definable keys. £1.75 ea. P&P 35p.

MULLARD CORE LA4245 at 15p ea. P&P 10p

CLARE REED RELAYS 24V DC Coil. Single pole make. Size 1 1/4 x 7/16" x 7/16" at 25p ea. P&P 10p

ROTRON CENTAUR FANS. Size 4.5" x 4.5" x 1.5" 115V 5-blade. £4 ea. P&P 75p.

Min. PLUG-IN type RELAYS. Plastic covers. 2-pole c/o 24V. 25p ea. P&P 15p

CROUZET/MURTEN SCHWEIZ MOTORS. 110V 50HZ 4 rpm. Gearbox can be removed. 75p ea. P&P 75p

FRAMCO MOTORS. 115V 50HZ Input single phase. 1/12th HP. 1450 rpm. on silent mount. As new £1 ea. P&P £1.75

PYE DYNAMICS THICK FILM 1MHZ Clamping Osc. 5V supply. Size 19x25x6mm. Drives one TTL load. 72p ea. P&P 15p

COMPRESSOR UNIT. Compact. 115V 50HZ single phase 1.5A continuous 1425 rpm. Outside piston housing approx. 3" £18 ea. P&P £2

MAGNETIC DEVICES. Plug-in RELAYS 240V AC. 3-pole c/o. Heavy duty 10 amp. Complete with base. Ex-brand new equipment. NOT USED 3 on sub assembly £2.50. P&P £1 or £1.25 ea. P&P 45p

SMALL MAINS TRANSFORMER 240V Pri. 12V 100MA sec. 60x40x42mm. 50p ea. P&P 75p

G.I. BRIDGE RECTIFIER type W01 (ideal for above) 17p ea.

FAIRCHILD FND10 7 segment display 0.15 Red. Common cathode 65p ea. P&P 15p. Info supplied

MULLARD TUNER MODULES — with data

LP1171 combined AM/FM IF strip 10.7MHZ £3.50 ea

LP1179 FM front end with AM tuning and 87.4MHZ to 104.5MHZ tuning. 10.7MHZ IF £3.50 ea. P&P 50p each unit.

The Pair £5.75 P&P 75p

POWER UNIT MODULE containing 2 small, 3 med & 1 large ferrite cores; 3-T03 power transistors, caps, resistors, high powered diodes, 9 transistors, 3 min fuse holders, etc. £1.50 ea. P&P £1.25

GENERAL ELECTRIC OPTO-ISOLATORS type H15VX504 65p ea. P&P 15p. 10 for £5. P&P £1

MINIATURE REED SWITCHES 9p ea. P&P 15p

ROTARY SWITCHES. 250V 10A 10p ea. P&P 15p

LEDEX ROTARY SOLENOIDS 115V DC. No switch assembly. 25p ea. P&P 25p

POTTER & BRUMFIELD TIMER RELAYS. 24/48V. Heavy duty 2-pole c/o with 5 secs delay at 48V increasing with voltage reduction. Timing can be altered by changing value of resistor/capacitance 50p ea. P&P 25p

BROOKE CROMPTON & PARKINSON extractor fan assembly 115V operation. £1 ea. P&P £2. OR TWO for £1.50. Carr. £3.25

LARGE QUALITY OF TEST GEAR ON VIEW AT LOW COST — CALLERS WELCOME

DON'T FORGET YOUR MANUALS S.A.E. WITH REQUIREMENTS

Minimum Mail Order £2. Excess postage refunded. Unless stated — please add £3.25 carriage to all units

VALUE ADDED TAX not included in prices — Goods marked with * 12 1/2 % VAT, otherwise 8%

Official Orders Welcomed. Gov./Educational Depts., Authorities, etc., otherwise Cash with Order.

Open 9 a.m. to 5.30 p.m. Monday to Saturday



CHILTMHEAD LTD



7/9 ARTHUR ROAD, READING, BERKS (rear Technical College, King's Road). Tel: Reading 582605

ETI BOOK SERVICE

BEGINNERS

Beginners Guide to Electronics Saurer £2.65
Beginners Guide to Transistors Reddihough £2.65
Electronic Measurement Simplified C. Hallmark £2.20
Electronics Self Taught Ashe £4.40
Beginners Guide to Integrated Circuits Sinclair £3.15
Principles of Transistor Circuits S. Amos £4.75
Understanding Electronic Circuits Sinclair £4.10
Understanding Electronic Components Sinclair £4.10
Beginners Guide to Radio King £3.15
Beginners Guide to Audio Sinclair £3.10
Beginners Guide to Audio I. R. Sinclair £3.20

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

APPLICATIONS

Advanced Applications for Pocket Calculators J. Gilbert £4.20
Build Your Own Working Robot D. Heiseman £3.55
Electronics and Photography R. Brown £2.30
Fire and Theft Security Systems B. Wels £2.00
How To Build Proximity Detectors and Metal Locators J. Shields £3.35
How To Build Electronics Kits Capel £2.10
Linear Integrated Circuit Applications G. Clayton £5.40
Function Circuits Design & Applications Burr Brown £15.95
110 Electronic Alarm Projects R. M. Marston £3.45
110 Semiconductor Projects for the Home Constructor R. M. Marston £3.25
110 Integrated Circuit Projects for the Home Constructor R. M. Marston £3.25
110 Thyristor Projects Using SCRs R. M. Marston £2.95
Handbook of IC Circuit Projects Ashe £2.30
Practical Electronic Project Building Amlic and Colwell £2.45

TV AND HI-FI

Audio Handbook G. King £6.50
Cassette Tape Recorders J. Earl £5.25
Solid State Colour TV Circuits G. R. Wilding £6.35
Hi-Fi Loudspeakers and Enclosures Cohen £8.20
How To Build Speaker Enclosures Radmateff £3.10
Master Hi-Fi Installation King £2.80

LOGIC

Logic Design Projects Using Standard ICs J. Wakerin £5.10
Practical Digital Design Using ICs J. Greenfield £12.50
Designing With TTL Intergrated Circuits Texas Instruments £9.05
How To Use IC Circuit Logic Elements J. Sreeter £3.65
110 COSMOS Digital IC Projects for the Home Constructor R. M. Marston £3.20
Understanding CMOS Integrated Circuits R. Melin £3.90
Digital Electronic Circuits and Systems R. M. Morris £3.50
MOS DIGITAL ICs G. Flynn £4.60

COMPUTING

Microprocessors and Microcomputers B. Sawick £18.00
Microprocessors D. C. McGlynn £8.40
Introduction to Microprocessors Aspinall £5.90
Modern Guide to Digital Logic (Processors, Memories and Interfaces) £4.30

OP - AMPS

Applications of Operational Amplifiers Graeme (Burr Brown) £8.30
Designing With Operational Amplifiers Burr Brown £13.75
Experiments With Operational Amplifiers Clayton £3.40
110 Operational Amplifier Projects for the Home Constructor R. M. Marston £2.95
Operational Amplifiers Design and Applications G. Tobern (Burr Brown) £7.40
Op-Amp Circuit Design & Applications I. Carr £4.00

TEST INSTRUMENTS

The Oscilloscope In Use Sinclair £3.10
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

SERVICING

Electronic Fault Diagnosis Sinclair £3.20
Rapid Servicing of Transistor Equipment G. King £2.95
Tape Recorder servicing Manual Gardner Vol 1: 1968-70 £8.50
Vol 2: 1971-74 £8.50
FM Radio Servicing Handbook King £4.80
Basic Electronic Test Procedures I. M. Gottlieb £2.45

COMMUNICATIONS

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

THEORY

Introduction to Digital Filtering Bigner £9.40
Transistor Circuit Design Texas Instruments £9.35
Essential Formulae for Electrical and Electronic Engineers N. M. Morris £1.65
Modern Electronic Maths Clifford £6.70
Semiconductor Circuit Elements T. D. Towers £6.40
Foundations of Wireless Electronics M. G. Scroggie £4.45
Colour Television Theory Hudson £6.20

REFERENCE

Transistor Tabelle (Includes physical dimensions) £4.10
Electronic Engineers Reference Book (Ed. 4) L. W. Turner £27.70
Solid State Circuit Guide Book B. Ward £2.25
Electronic Components M. A. Colwell £2.45
Electronic Diagrams M. A. Colwell £2.45
Indexed Guide to Modern Electronic Circuits Goodman £2.30
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. Bell £2.60
Master Transistor/Integrated Circuit Substitution Handbook £5.60
World Radio TV Handbook 1978 (Station Directory) £8.00
Radio, TV and Audio Technical Reference Amos £24.85
TV Technicians Bench Manual (New Ed.) Wilding £5.10

MISCELLANEOUS

Integrated Electronics J. Milman £7.70
Microelectronics Hallmark £3.90
Practical Solid State DC Supplies T. D. Towers £6.20
Practical Triac/SCR Projects for the Experimenter R. Fox £2.25
Printed Circuit Assembly Hughes & Colwell £2.45

Fallen behind recent advances?
Just starting out?
Need a decent reference book?
ETI Book Service provides an easy
way of getting your hands
on the right title.

How to order: Make cheques etc payable to ETI Book Service. Payment in sterling only please. Orders should be sent to: ETI Book Service, PO Box 79, Maidenhead, Berks. All prices include P&P.



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 ● GOODMAN'S ●
 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



TARGET ELECTRONICS

FORMERLY "THE RADIO SHOP"

16 Cherry Lane
 Bristol BS1 3NG

Telephone:
 0272-421196

Official orders welcomed. Govt./Educational Depts. etc.



Size 60 mm x 45mm x 40mm

T21	0-50µA	T30	0-1Amp
T22	0-100µA	T33	0-50v AC
T23	0-500µA	T34	0-300c AC
T24	0-1mA	T35	"S" Meter
T25	0-5mA	T36	Vu Meter
T26	0-10mA	T40	50-0-50µA
T27	0-50mA	T41	100-0-100µA
T28	0-100mA	T42	500-0-500µA
T29	0-50mA	T43	0-30v DC

Price £4.65

PANEL METER with ILLUMINATION WIRING

Dials are clearly figured on bright white for easy reading. 2.5% F.S.D. accuracy. Zero adjustment at front. Cushioned pointer stops. Complete with mounting nuts and washers.

Prewired and have lamp terminals installed on rear.

Snap off front cover and insert Lamp Kit (opp extra) 65p

Two 6.3V bulbs for press-in fitting onto pre-wired connector blocks which require 12.6V external power through the rear terminals already fitted.

TRANSFORMERS

PRIMARYS 240V

TR1	6-0-6	100MA	80p
TR2	9-0-9	75MA	83p
TR3	12-0-12	50MA	90p
TR4	12-0-12	100MA	£1.10
TR1A	6-0-6	100MA	92p
		Int screen	
TR2A	9-0-9	75MA	£1.00
		Int screen	
TR3A	12-0-12	50MA	£1.10
		Int screen	

● MOT Output Transformer 1.2K-8ohm 200MW 27p

P&P for above 75p



NASCOM 1 Z80 MICROCOMPUTER KIT

Includes interface for: TV or Monitor — cassette, dump — Teletype — spare, PIO, Expansion RAM-BOARD up to 32K.

Potential: High Level Language, Mini Floppy Disk, Excellent Z80 evaluation kit. £197.50 + VAT. P&P £2.50

● Please add 12 1/2% VAT Remainder 8% VAT

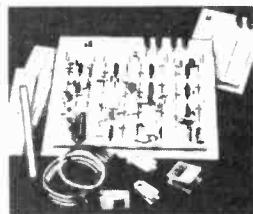
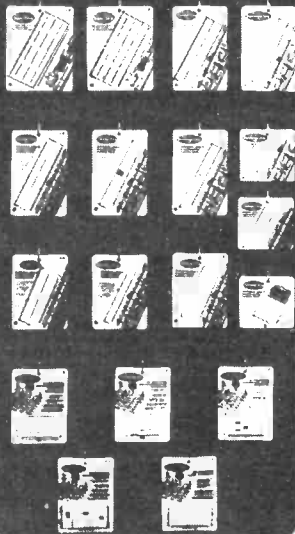
Large selection of aluminium boxes & Instrument Cases. Phone in your Access or Barclaycard order. Catalogue 25p post paid.



BONA FIDE UK TRADERS ONLY

Faster and Easier
 with A.P. PRODUCTS

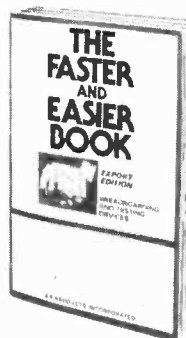
CIRCUIT
 BREADBOARDING
 AND TESTING
 DEVICES



THIS IS THE PLACE
 FASTER AND EASIER BEGINS.



A.P. PRODUCTS INCORPORATED



A Fast and
 Easy Profit
 Message
 from
 Lektrokit

For hobbyists and home project constructors, Lektrokit have put together the most comprehensive range of breadboarding and testing devices on earth.

For you, Lektrokit have display racks, window

stickers and catalogues to help you sell the entire range — faster and easier.

For you, too, Lektrokit will be advertising to hobbyists and home project constructors continuously — telling them about the Lektrokit products that you supply.

If, of course, you have the stocks. And that's up to you.

Launch dates for Lektrokit's exciting new range are November 21-25 — at BREADBOARD 1978 — but you can get in on it NOW! Just use the coupon.

LEKTROKIT completes the circuit!

To Lektrokit Ltd., Sutton Industrial Park, Earley,
 Reading, Berks RG6 1AZ. Telephone 0734 669116.

I am a bona fide UK trader. Please send full information about faster and easier profit by Lektrokit.

Name _____ Address _____

Tel. _____

ETI 1

VENUS PROBE

Venus, the shrouded planet of Edgar Rice Burroughs and Ray Bradbury, has fascinated men and telescopes for many decades. It was the favourite choice to house monsters and the scientists' choice for life of a more mundane type. Conditions are not that favourable, however, but are still interesting enough to warrant the launch of the Multiprobe which should tidy up some of the mysteries remaining.

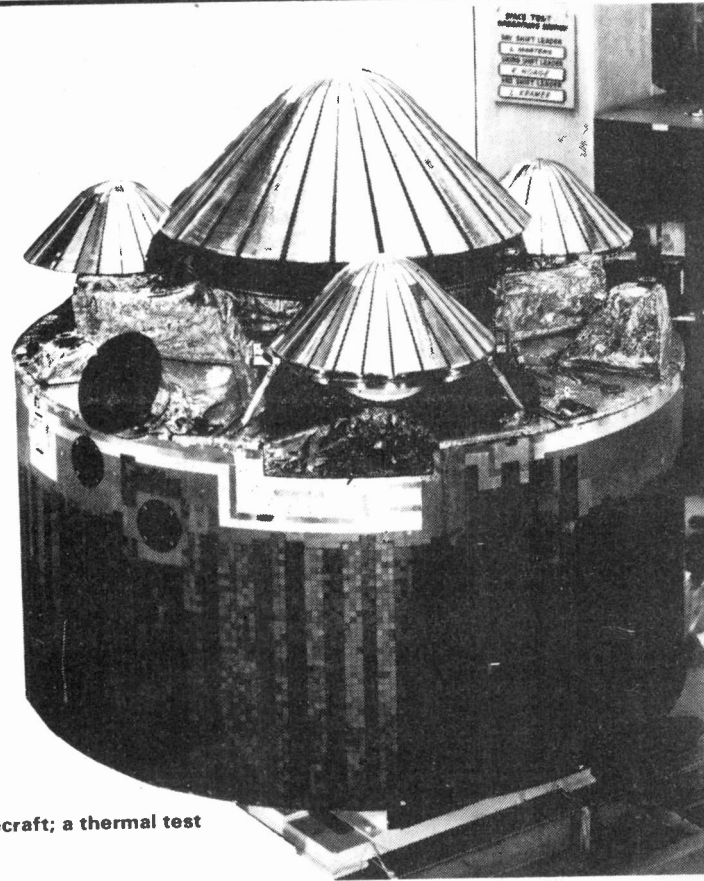


Fig. 1. The Pioneer Venus Multiprobe spacecraft; a thermal test model is shown.

THE TWO Pioneer spacecraft should reach Venus around the end of this year, being scheduled to reach orbit on the 4th December. One of these probes, known as the 'Orbiter', will circle the planet for at least one Venusian year. It will collect data on the upper atmosphere of the planet (including field strengths and the types of particle present) and will also record events occurring on a global scale on or around the planet over a fairly long period of time.

The other spacecraft will consist of a transporting vehicle, known as a 'Bus', which will convey one large probe and three small probes to Venus. All five parts of this spacecraft will enter the Venusian atmosphere at widely separated points and will transmit data back to earth. The four probes will fall to the surface of the planet and should provide much information about the lower atmosphere at four widely separated points.

Although Venus is our closest planetary neighbour, it is always covered in very thick cloud; our knowledge of this planet is therefore very limited, especially as regards its lower atmosphere. The early probes have shown that Venus has a high surface temperature and an atmospheric pressure nearly one hundred times that of the earth, but a great deal of work remains to be carried out. It is expected that the two Pioneer spacecraft will increase our knowledge of this planet by a factor of about ten. They will also greatly increase our knowledge of the solar system and are expected to provide much information which will add to our theories about the origin of the earth.

Pioneering Spirit

The Pioneer missions were conceived as long ago as 1970 as a result of recommendations made by the Space Science Board of the US National Academy of

Sciences who decided that there is a need for relatively low cost orbiter and probe landing systems for Venus investigations. Overall responsibility and control of the mission has been given to the National Aeronautic and Space Administration (NASA) Research Centre at Moffett Field, California.

The Hughes Aircraft Company gained a contract to manufacture both space vehicles for the Pioneer mission in February 1974 after a series of competitions which started in 1972. The scientific instrument payloads were selected in June 1974, thirty instruments being included on the list. The spacecraft will be launched on top of Atlas SLV-3D Centaur D-1AR rockets from Cape Canaveral, Florida. The vehicle tracking, command signal transmission and data reception will be carried out by the established US Deep Space Network stations in California, Spain and Australia.

The Multiprobe Mission

The Bus, the large probe and each of the small probes include payloads of scientific instruments. The Bus will be destroyed by burn-up in the Venusian atmosphere after its two instruments have transmitted data back to earth. It is, perhaps, somewhat surprising that work on the atmosphere and weather on Venus is expected to teach us more about the weather on earth.

The multiprobe vehicle is a circular, spin-stabilised craft with an array of solar cells around its exterior. The large probe will examine the atmosphere surrounding the planet, measuring the clouds, the atmospheric composition, etc. The three identical small probes will separate and enter the atmosphere some 7,000 miles apart two of them on the dark (night) side. They will collect information on the general circulation of the lower atmosphere.

Structure

The structure of the multiprobe unit is shown in the exploded view of Fig. 2. The cylindrical solar panel is 2.54 m (100 inches) in diameter and 1.22 m in length. The equipment shelf is 2.47 m in diameter, the electronic units and the scientific instruments being mounted on this shelf.

The large probe is at the centre of the spacecraft on an inverted conical structure, whilst the three small probes are symmetrically placed around the main probe. Each probe is fixed by spring loaded clamps which can be released (pyrotechnically) about 20 days before the craft arrives at Venus so that the five sections move independently.

The probe weight, including the interfacing connection with the launching vehicle, is designed to be 920 kg. Great care has been taken in the thermal design of the craft to ensure that the temperature is kept between suitable limits; heaters and thermal blankets are included and appropriate materials with suitable thermal properties are used.

The control system employs a sun sensor and a solid state sensor which can detect the radiation from 24 stars. The vehicle contains two tanks which will be filled with 32 kg of liquid hydrazine propellant. When this liquid is allowed to pass into a chamber containing a suitable catalyst, it decomposes into nitrogen and provides a thrust of about 0.5 kg as a jet for controlling the spacecraft's trajectory, attitude and spin rate.

The power for the spacecraft is obtained from the cylindrical array of solar cells which has an area of just over 6 square metres. This provides 228 W when the

spacecraft is near the earth, but extra power can be obtained for a limited time from two 7.5A-hr nickel-cadmium batteries. The solar cells and batteries provide a 28 V supply; overload protection and undervoltage detection circuits are included in the power supply system.

Command signals are transmitted from the Deep Space Network ground stations to the Bus at 4 bits/second using pulse code modulation or frequency shift keying. The electronic on-board equipment can store command instructions for execution at some later time. Six command output modules on the equipment shelf can distribute 384 pulse commands and 12 quantitative (or analogue) commands to scientific instruments and to the spacecraft units. Commands from the earth stations modulated onto a 2115 MHz carrier wave are received by the spacecraft transponders.

Data for transmission to the ground is convolutionally encoded, assembled into 8 bit words in a 64-word frame and modulated into a data stream. Eight data input modules on the equipment shelf can receive the signals and establish up to 253 data channels with the telemetry processor for transmission to earth.

The data is transmitted on a 2300 MHz beam at a power of 10 or 20 W using one of three antennas and a data rate of between 8 and 2048 bits/second. The antennas comprise two omnidirectional types (forward and aft) to provide spherical coverage at both the transmit and receive frequencies together with a medium gain horn antenna at the aft end of the craft.

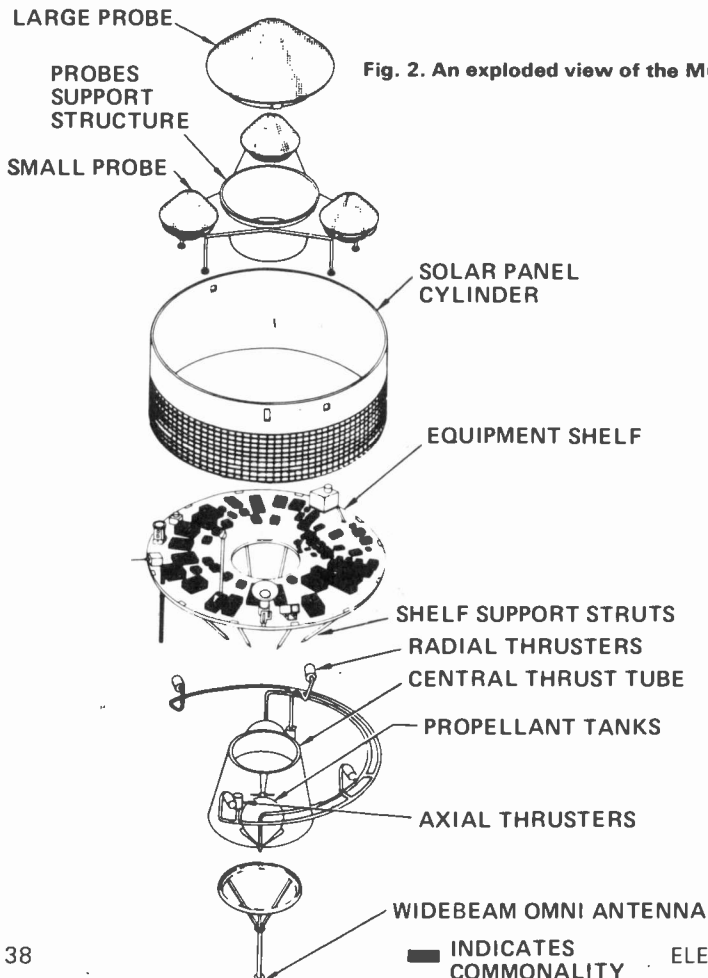


Fig. 3. The large probe with shield and pressure vessel

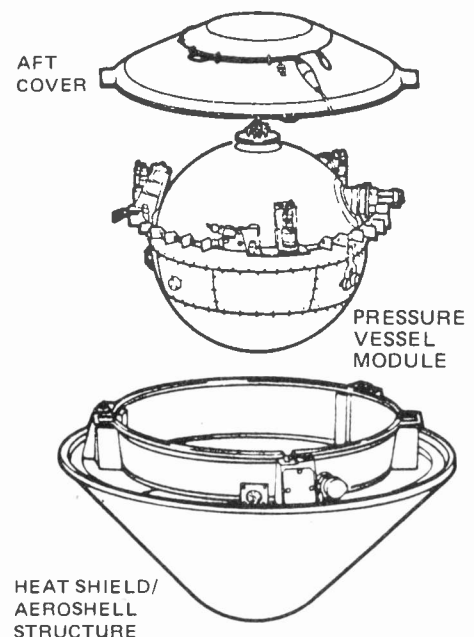


Fig. 4. An exploded view of the Orbiter spacecraft

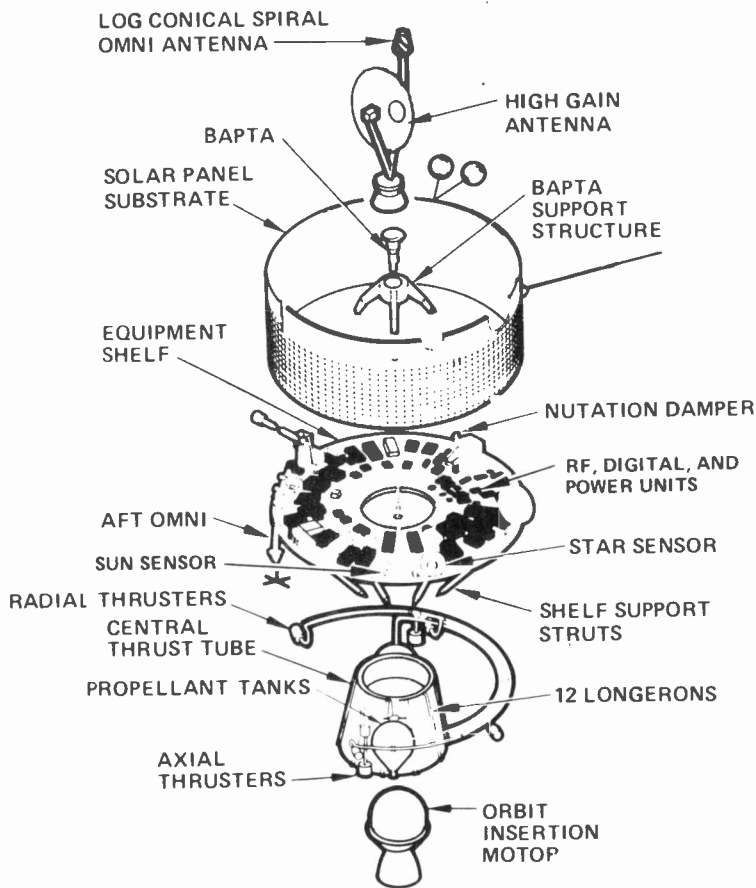
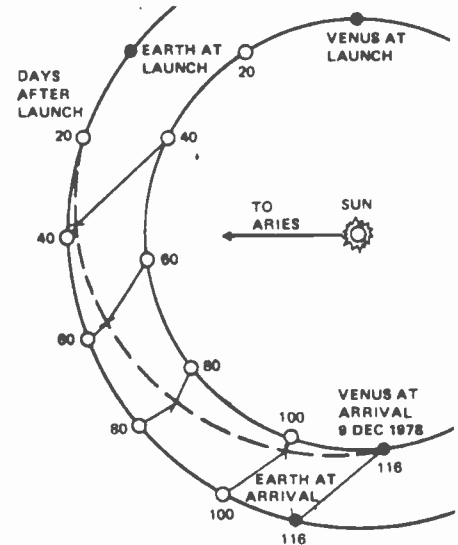


Fig. 5. Trajectory of the Multiprobe unit on its flight to Venus.



To Boldly Go . . .

The launching vehicle will place the multiprobe spacecraft into an earth parking orbit about 167 km above the earth where it will remain for 18 to 23 minutes before adopting the interplanetary trajectory shown. The spacecraft will initially be spinning at 5 RPM, but it is expected that contact with the ground station at Canberra will occur within four hours from launch and the rate of revolution will then be increased to 15 RPM by a command from the ground.

During the passage of the spacecraft towards Venus, the forward antenna will be employed to communicate with the 26 metre diameter dish aeriels of the Deep Space Network. A velocity correction of up to 12 m/s can be made five days after launch and further corrections at 20 days after launch, etc. Command signals for these corrections will be transmitted from one of the huge 64 metre diameter earth station aeriels.

The large probe will be separated from the Bus about 24 days before arrival at Venus. The spacecraft axis will then be precessed so that the medium gain horn can be used for earth communication. A velocity correction of 5.1 m/s will be made to achieve the required small probe trajectory and the three small probes will be released about 20 days before reaching Venus. The spin rate will have been previously increased to 48.5 RPM so as to provide a suitable tangential velocity at separation for the small probes to acquire the desired trajectory.

The velocity of the Bus will be corrected 18 days before its arrival at Venus to achieve the desired arrival point and to delay its arrival by 90 minutes so that all of the probes will have impacted on the surface of the planet by the time the Bus arrives in the upper atmosphere. Burn-up will occur at some 120 km above the planet.

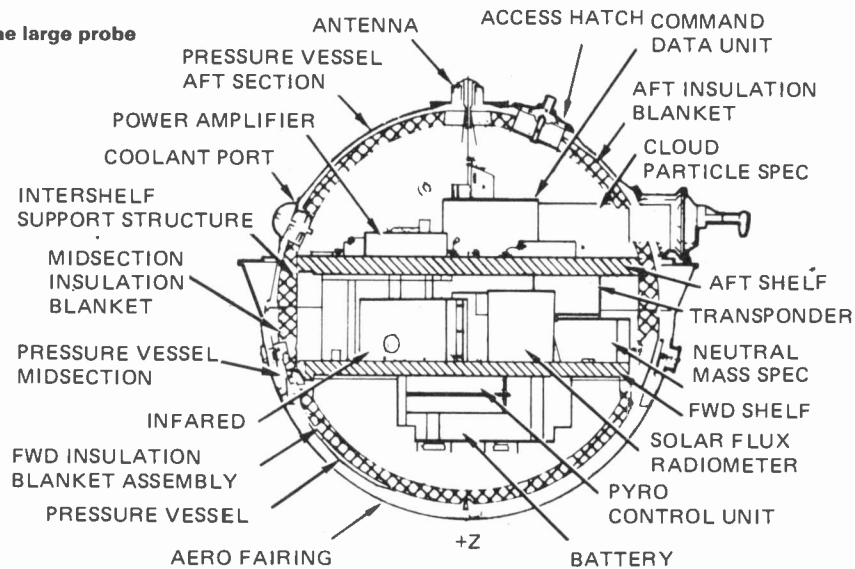
All five vehicles will enter the atmosphere in a two hour period and all will be transmitting simultaneously, so the time of entry will be arranged to be one at which two of the Deep Space Network stations can simultaneously receive signals to avoid possible loss of data.

Large Probe Mission

The large probe is to be aimed at a point on the daylight side of Venus, decelerations of up to 400 g being possible at times during entry. The large probe parachute opens at a height of 67 km and for the next 18 minutes the probe descends under the stabilising influence of the parachute to a height of 46 km at which point the parachute is jettisoned. The probe then falls to the surface of the planet over a period of some 38 minutes.

The probe is not required to survive impact with the surface of the planet, but will withstand the pressure and temperature at the surface. This requirement together with the requirement that the probe can withstand the fierce acceleration presents many design problems unique to this mission. ▶

Fig. 6. The interior of the large probe



The large probe and its deceleration module have a total weight of some 316.6 kg. The deceleration module provides thermal protection during atmospheric entry; it consists of a pointed nose cone of 45° angle with a diameter of 1.42 m. The base of the probe is thermally protected by a coated fibreglass aft cover.

The dacron main parachute has a diameter of nearly 5 m and is deployed by a much smaller pilot chute 0.76 m in diameter ejected by a mortar. The pull of the parachute extracts the pressure vessel module from the deceleration module.

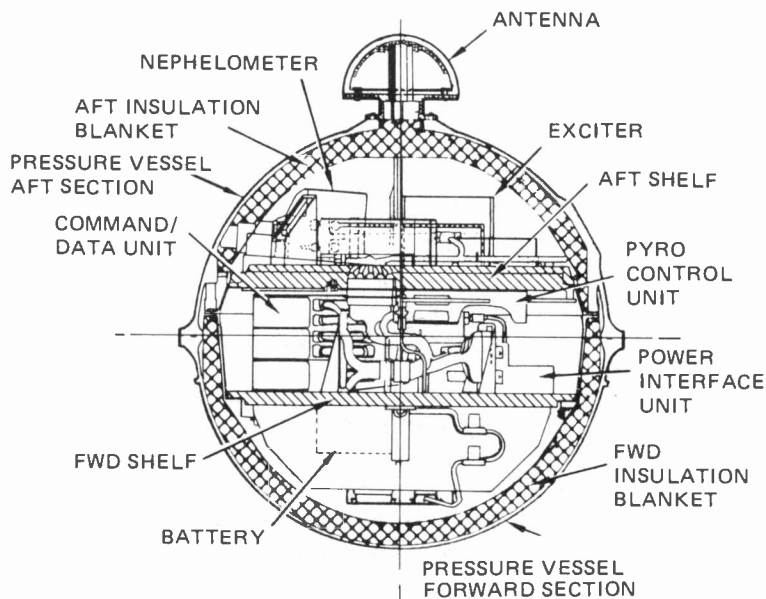
Pressure Vessel

This vessel contains nitrogen at a pressure of between about 0.5 and 2 earth atmospheres, but can withstand an external pressure of about 100 atmospheres. The 73 cm diameter titanium pressure vessel is constructed in three pieces and is about 6 mm in thickness. There are 15 apertures and 7.6 m of sealing are required to prevent gas leaks at the high temperature of the Venusian surface. The thermal insulation ensures that the electronics and instruments inside this vessel remain at a temperature not greater than 50 C even when the external temperature reaches 480 C.

A 19 cell 40 A-hr silver-zinc battery supplies power to the pressure vessel assembly. A total of 15 magnetic latching relays provide on/off control, whilst parallel fuses provide overload protection. Four solid state amplifiers, each rated at 10 W, feed a cross dipole antenna mounted on the rear of the pressure vessel which sends the data back to earth. A data rate of 128 or 256 bits/sec in a convolutionally encoded format is used, the system being capable of providing 72 data channels and 2 minor frame formats in an 8-bit word, 64 word frame. A 3072 bit memory provides storage facilities during the entry communications blackout; this blackout will have a duration of about 10 seconds.

The entire sequence of 128 commands is predetermined and programmed prior to the multiprobe launch. A timer with a 24.27 day capacity and a stability of ± 32 seconds turns on the system prior to entry.

Fig. 7. The interior of a small probe



The seven scientific instruments in the large probe weigh a total of 35 kg and require 106 W for their operation. Three of these instruments require inlets for sampling the atmosphere and four require windows for viewing the atmosphere. All of the windows except one are made of sapphire, the exception being the window for the infra-red instruments which is a 1.3 carat diamond nearly 2 cm in diameter; diamond is the only material able to transmit infra-red in the 10 micron region and to withstand the temperature and pressure at the Venusian surface.

The Small Probes

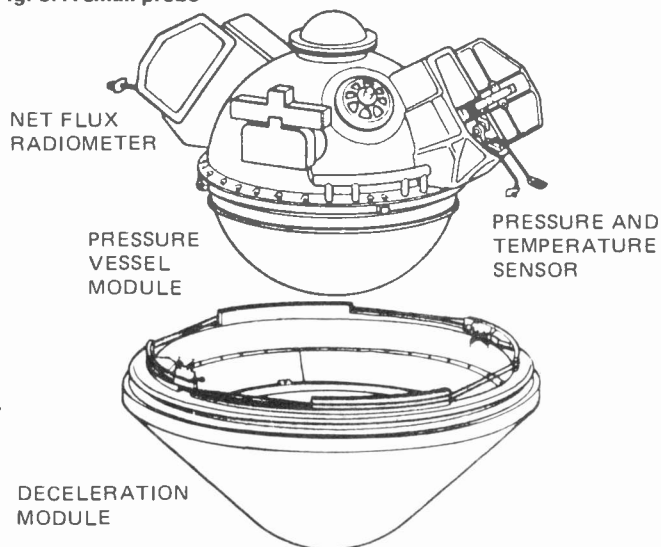
The three identical small probes are designed to measure the characteristics of the Venusian atmosphere simultaneously at three widely different locations. They are designed to withstand the high temperature and pressure at the surface of the planet, but need not necessarily withstand the impact with the surface. During entry into the atmosphere at a speed of about 11.6 km/s, a deceleration as great as 5652 may be encountered. The time of descent to the surface will be about 59 minutes.

Each small probe contains a pressure vessel and a deceleration module. The total weight is some 97 kg. Unlike the large probe, there is no parachute with each small probe and the deceleration module is not detached during descent. The cone of the deceleration module has a diameter of some 76 cm.

The small probe pressure vessels which contain the electronics and the instruments are designed to operate with an internal atmosphere of xenon at between 0.25 and 2 earth atmospheres pressure. These vessels consist of a two piece titanium shell of about 46 cm diameter.

The small probes are each powered by a battery containing 20 silver-zinc cells with an 11 A-hr rating. Each probe employs a single, solid state power amplifier rated at 10 W RF output; this amplifier feeds a crossed dipole antenna mounted on the rear of the pressure shell. A stable oscillator maintains the S-band downlink frequency to 1 part in 10^9 . The data rate used from the small probe to earth is 16 or 64 bits/second, whilst a

Fig. 8. A small probe



3072 bit memory is used for storage during entry blackout and when the bit rate is being changed. A 24.27 day timer turns on the system prior to entry into the Venusian atmosphere.

The 64 bit/second data rate is used initially, but at an altitude of some 30 km above the surface the data rate is reduced to 16 bit/second to allow for the attenuation of the radio frequency signal as it passes through the denser parts of the Venusian atmosphere.

The Orbiter craft. Note the long magnetic probe to measure the magnetic field well away from any interfering field from the craft.

The Orbiter Mission

The main aim of the Orbiter mission is to put 12 scientific instruments in orbit around Venus and to receive information from these instruments. It can be seen that the Orbiter spacecraft has much in common with the multiprobe vehicle, including a rather similar structure. Some of the most noticeable differences are the replacement of the probe structure by a high gain aerial system which can provide communication with the earth at distances of up to 250,000,000 km. A 4.5 m long magnetometer boom is also used in the Orbiter craft.

The size of the Orbiter spacecraft is similar to that of the multiprobe craft. The diameter of the cylinder of solar cells is the same 2.54 m, but the surface area of the cells is greater, being almost 7.2 m². The Orbiter is lighter than the multiprobe unit, being just under 600 kg and only 372 kg in orbit.

The slightly large solar cell area of the Orbiter provides a little more power than in the case of the Multiprobe Bus, this power being about 325 W in Venus orbit. Two 7.5 A-hr nickel cadmium batteries are also incorporated in the Orbiter spacecraft.

A bearing and power transfer assembly (BAPTA) serves an electrical and mechanical interface between the spinning part of the spacecraft and the despun aerial which must always point towards the earth. As in the case of the multiprobe Bus, 32 kg of liquid Hydrazine propellant is carried in two tanks and can drive seven jets, each with a thrust of about 0.5 kg, for the control of the trajectory, attitude and spin rate.

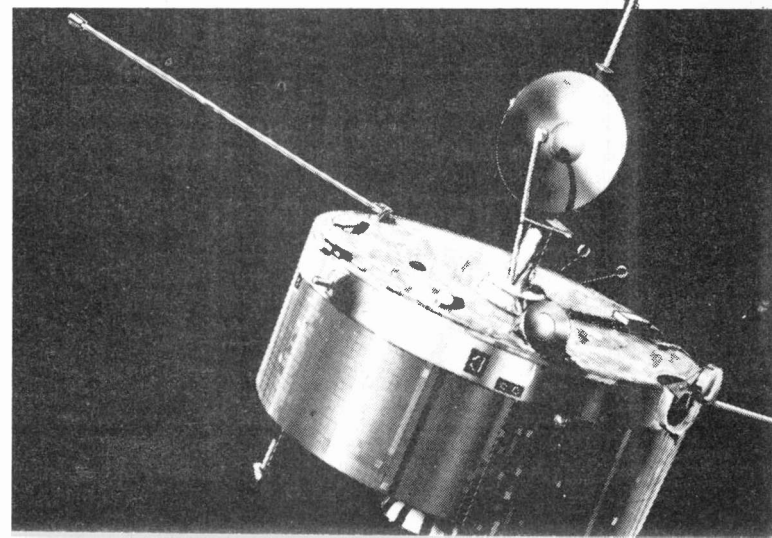
A solid propellant rocket motor, the Thiokol TEM-604, is to be used to place the Orbiter in Venus orbit. It has a velocity change capability of 1060.6 m/s for the maximum design weight.

Conclusion on Cost

A special feature of the Pioneer missions is the relatively low cost for such an ambitious programme. In order to reduce the cost, no experimental prototype craft have been built — only the one multiprobe and the one orbiter will be made, tested and orbited. Economies have also been made by using the same type of components (such as the RF amplifiers) in the Bus, Orbiter and in the probes. Identical command and data handling circuits are used in all of the probes, whilst about 78% of the Bus and Orbiter parts are identical. The cost of developing the probes themselves has been relatively high, since they involve new techniques, whilst special facilities have had to be developed to simulate the hostile Venus atmosphere.

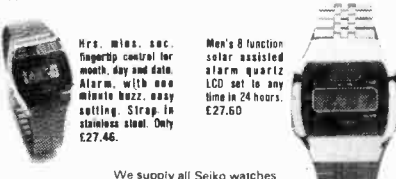
It seems likely that craft similar to the Pioneer type will be useful for relatively economical missions to Mars and for flying through the tails of comets.

ETI



Save on Calculators

TEXAS	
T15040 (print, display, 10 digits, mem., printing calc.)	£70.00
PC100B print cradle 151, 20 T157 key prog	£28.30
T151 (10 mem B+ 2, 32 prog steps)	£28.40
T15B key prog 64 80 T159 mag. card and prog	POA
T159 Mag Cord prog	POA
Software for T159 & 58 (each) (four available)	£24.00
T1 Programmer (Hex to Oct conversions)	£49.95
Little Professor (child's calculator)	£10.80
CASIO	
FX2500	£19.80
FX3100 P+2 LCD sci	£24.30
FX120	£19.80
FX39	£15.60
ST1 Stopwatch + calc.	£24.50
MQS LCD	£34.90
FX48 Mini-calc.	£19.95
ST24 cord mc	£19.80
AD1000 (L.C.D. cal., timer, clock, alarm, 1 year bat.)	
	£21.90
CO81 (L.C.D. clock/cal./alarm, 1000 hrs)	
	£17.90
HEWLETT PACKARD	
H.P.31E at	£38.88
H.P.33E	£69.12
H.P.25C	£105.95
H.P.22 Business/Management Calculator, Low Price	POA
H.P.67	£299.16
H.P.97	£514.62
H.P.29C	£118.90
GDM	
PRO100 29.95 / SR9190R	£28.95
Commodore Pet Computer 2001 / 8K	£695
M55 (Maths) S61 (Stats) N.60 (Navigator)	£49.69
P50 8+2 24 programme steps	£17.40
Sinclair Cambridge Programmable Calculator	£13.44
A.C. Adaptor	£3.00
Programme Library	£4.70
SHARP EL8130 LCD musical calc. - great, no keys	£18.00
Master Chess Challenger (60,000 moves)	£134.95
Chess Challenger 10 (over 3 million moves)	£119.00
Boris Microprocessor chess game	£199.00
Gammon Master II (Computer backgammon), Low price	£149.95
Ataria Microprocessor cassette TV game	£169.00
L.C.D. Penwatch	
Computer Checkers (Draughts 4 levels of play)	£89.95
Cannon P10 print/display desktop calc.	£69.95
Toshiba LC836MN memo calc.	£48.95
Natron (National Electronics NE629 7/M6B 14 function dual time zone alarm chronograph. Night light, stainless steel strap with matching case (gift also available) at	£39.00
S.A.E. for further details	



Mrs. miss, suc. finger's control for month, day and date. Alarm, with one minute buzz, easy setting. Strap in stainless steel. Only £27.46.

Men's 8 function solar assisted alarm quartz LCD set to any time in 24 hours. £27.60

We supply all Seiko watches

We accept gov't/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
 Telephone and Telex orders accepted

BUILD THE TREASURE TRACER MK III



METAL LOCATOR

AS SEEN ON BBC-1 & BBC-2 TV

- Genuine 5 silicon transistor circuit, does not need a transistor radio to operate.
- Incorporates unique varicap tuning for extra stability.
- Search head fitted with Faraday screen to eliminate capacitive effects.
- Loudspeaker or earphone operation (both supplied).
- Britain's best selling metal locator kit. 4,000 already sold.
- Kit can be built in two hours using only soldering iron, screwdriver, pliers and side-cutters.
- Excellent sensitivity and stability.
- Kit absolutely complete including drilled, tinned, fibreglass p.c. board with components sitting printed on.
- Complete after sales service.
- Weighs only 22oz.; handle knocks down to 17" for transport.

Send stamped, self-addressed envelope for literature.

Complete kit with pre-built search coil

£15.95
 Plus £1.20 P&P
 Plus £1.37 VAT (8%)

Built, tested and Guaranteed

£20.95
 Plus £1.20 P&P
 Plus £1.77 VAT (8%)

MINIKITS ELECTRONICS,
 6d Cleveland Road, South Woodford,
 LONDON E18 2AN
 (Mail order only)

Prices are each, net & exclude V.A.T.

Experimenter Series

EXP300 (6 x 2.1 in., 5 x 94 terminals & 2 bus strips)	£5.75
EXP350 (3.5 x 2.1 in., 5 x 46 terminals x 2 bus strips)	£3.16
EXP600 (6 x 2.4 in., 5 x 94 terminals x 2 bus strips)	£6.30
EXP650 (3.6 x 2.4 in., 5 x 46 terminals x 2 bus strips)	£3.60
EXP4B (6 x 4 in., 2 bus strips only)	£2.30

Quick Test Series

QT-59S (6.5 x 6.2 in., 118 terminals)	£7.20
QT-47S (5.3 x 5 in., 94 terminals)	£5.75
QT-35S (4.1 x 3.8 in., 70 terminals)	£4.90
QT-18S (2.4 x 2.1 in., 36 terminals)	£2.75
QT-12S (1.8 x 1.5 in., 24 terminals)	£2.15
QT-8S (1.4 x 1.1 in., 16 terminals)	£1.90
QT-7S (1.3 x 1 in., 14 terminals)	£1.75
QT-59B (6.5 x 6.2 in., 20 terminals)	£1.45
AT-47B (5.3 x 5 in., 16 terminals)	£1.30
QT-35B (4.1 x 3.8 in., 12 terminals)	£1.15

Protoboard Series

PB-6 (630 tie points, 4 binding posts, 4 x 14 DIL capacity)	£9.20
PB-100 (760 tie points, 2 binding posts, 10 x 14 DIL capacity)	£11.80
PB-101 (940 tie points, 1 binding post, 10 x 14 DIL capacity)	£17.20
PB-102 (1240 tie points, 1 binding post, 12 x 14 DIL capacity)	£22.95
PB-103 (2250 tie points, 4 binding posts, 24 x 14 DIL capacity)	£34.45
PB-104 (3060 tie points, 4 binding posts, 32 x 14 DIL capacity)	£45.95
PB-203 (2250 tie points, 4 binding posts, 24 x 14 DIL capacity; built-in regulated 5V d.c. power unit)	£55.15
PB-203A (As PB-203 with 5V and 15V d.c. power supply)	£74.70

Design Mate Instruments

DM-1	£45.95	DM-2	£57.45	DM-3	£57.45
DM-4	£74.70				

IC Test Clips

PC-14 (14-pin)	£2.60	PC-16 (16-pin)	£2.75
PC-24 (24-pin)	£4.90	PC-40 (40-pin)	£7.90

Logic Probes

Hand-held logic probes, TTL/DTL/CMOS compatible, from £18 to £49.00

Logic Monitors for CMOS, HTL, DTL, TTL & RTL

LM-1 Self-power clip-on logic monitor	£28.70
LM-2 As LM-1, with fully isolated power supply	£68.95

Postage, Packing and Insurance per shipment **£1.25**

Please add 8% VAT to overall total

Export orders: credit cards or international money orders, bank drafts and cheques drawn in £ sterling. Please add 10% (Europe) or 1 1/2% (all other countries) to total price.

7400 TTI	74151 .60	74S22 .38	ZTX500 .18
7401 .10	74154 1.00	74S37 .38	ZX063 .20
7402 .12	74156 .60	74S51 .28	ZX054 .57
7403 .12	74157 .54	74S64 .20	ZX056 .57
7404 .10	74160 .80	74S74 .38	ZX3702 .12
7406 .27	74162 .80	74S112 .66	ZX3704 .12
7408 .12	74163 .90	74S124 3.25	ZX3819 .29
7409 .13	74164 .57		
7410 .12	74165 .85	MICRO'S	8A113 .05
7411 .21	74176 .84	74S198 2.40	18914 .05
7412 .21	74180 .86	1702L 3.99	184148 .05
7413 .24	74190 1.04	2708 7.98	184151 .04
74714 .64	74192 .57	2102-1 1.22	184001 .06
7415 .26	74193 .71	2114 10.53	184002 .06
7417 .33	74194 .86	8080A 7.02	184003 .06
7420 .12	74196 .80	8251 7.08	184004 .10
7425 .24	74197 .86		184005 .11
7427 .24	74198 1.41	LINEAR	184005 .11
7430 .12	74LS00 .18	LM300 14 .80	184007 .12
7432 .23	74LS01 .18	LM300 48	184500 .16
7433 .23	74LS02 .18	LM741-8 .21	184504 .21
7437 .23	74LS03 .18	NE555 .29	
7438 .23	74LS04 .19	NE556 .71	ELECTROLYTICS
7440 .16	74LS05 .21	NE566 1.14	UF/V
7441 .90	74LS08 .21	NE566 1.43	47/100 .08
7442 .38	74LS10 .21	NE567 1.62	1/63 .08
7443 .32	74LS11 .21	7805 .80	2.2/63 .08
7445 .67	74LS12 .11	7812 .80	3.3/63 .08
7446 .67	74LS14 1.10	7805 1.39	4.7/63 .08
7447 .59	74LS20 .18	7812 1.39	10/16 .08
7448 .48	74LS21 .21	LM309 .86	10/35 .08
7450 .20	74LS22 .24	LM723 .38	10/63 .09
7453 .30	74LS23 .26		22/25 .08
7454 .16	74LS24 .29	TRANSISTORS	22/25 .10
7455 .20	74LS25 .25	AC128 .23	22/63 .12
7460 .32	74LS26 .54	AC176 .23	33/16 .08
7470 .36	74LS27 .29	BC107 .12	33/35 .11
7472 .32	74LS28 .32	BC108 .12	33/63 .13
7473 .21	74LS29 .33	BC109 .12	47/16 .09
7474 .26	74LS30 .33	BC177 .18	47/35 .15
7475 .29	74LS31 .33	BC178 .18	100/16 .11
7476 .31	74LS32 .33	BC179 .18	100/35 .13
7483 .68	74LS33 .33	BC184 .15	100/63 .24
7485 .84	74LS34 .33	BC187 .32	220/16 .12
7486 .25	74LS35 .33	BC477 .24	220/16 .12
7489 .95	74LS36 .33	BC478 .24	500/16 .18
7490 .38	74LS37 .33	BC479 .24	330/25 .31
7491 .62	74LS38 .33	BC132 .54	470/6/3 .14
7492 .42	74LS39 .33	BC133 .54	470/16 .18
7493 .29	74LS40 .33	BC134 .54	470/35 .30
7495 .51	74LS41 .33	BC135 .54	1000/16 .30
7496 .67	74LS42 .33	BC136 .54	1000/25 .48
74104 .40	74S TTI	OC71 .20	2200/16 .54
74105 .40	74S00 .38	OC72 .36	
74107 .21	74S04 .28	OC280 .45	BURROUGHS 9 Dig.
74109 .45	74S05 .38	TP 2865 .85	7 Sng. Panaplex Display
74121 .29	74S08 .38	TP 3055 .68	Q25- Neon Type with
74122 .40	74S10 .38	11S43 .33	Red Bezel and Socket.
74123 .28	74S11 .38	ZTX300 .17	£2.25
74141 .21	74S11 .38		

All prices INCLUDE V.A.T. add 25p P&P



IBEK SYSTEMS

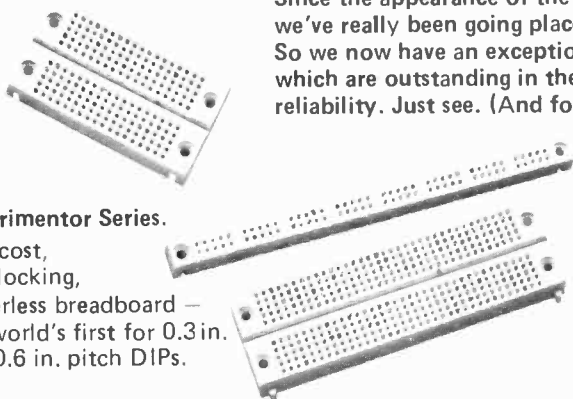
32 DUNSMVILLE DRIVE, COVENTRY, CV2 2HS.

Now, from the breadboard specialists— even better boards!

Since the appearance of the first breadboards back in the '40's, we've really been going places. (The U.K., for one.) So we now have an exceptional range of prototyping products which are outstanding in their simplicity, versatility and reliability. Just see. (And for prices and specs., eyes left!)

1 Experimentor Series.

Low-cost, interlocking, solderless breadboard — the world's first for 0.3 in. and 0.6 in. pitch DIPs.



3 The Protoboard Series.

Solderless breadboards with built-in 10% regulated 5Vd.c. 1A power supply; 2,250 solderless tie points; and capacity for DIPs of 14 to 40 pins.



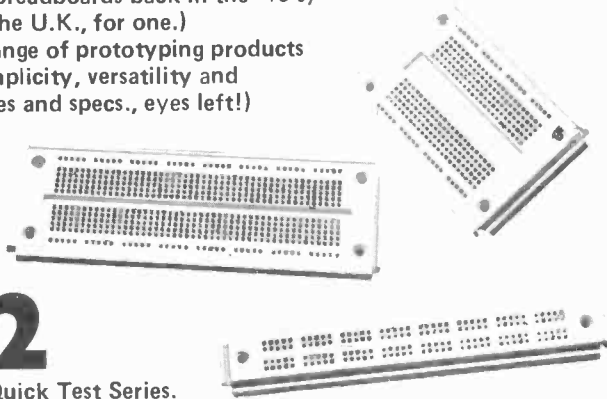
Take a look at our low, low prices and quality specs., and get aboard! (Or if its data you're after, pick up the phone or drop us a line.)

For the best, from the specialists in breadboards.

2

Quick Test Series.

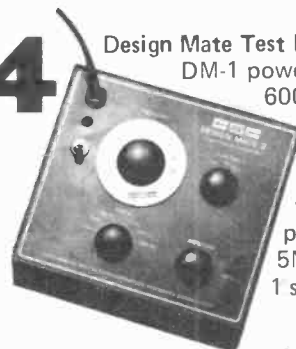
Low-cost, snap-locking solderless circuit boards for fast design with discrete components.



4

Design Mate Test Instruments.

DM-1 power supply, 5V to 15Vd.c. at 600mA; DM-2 function generator for sine, square and triangle wave generation; DM-3 R/C bridge giving 10 ohm to 10 megohm, 10pF to 1.0µF; DM-4 pulse generator with 0.5 Hz to 5MHz frequency and 100ns to 1 sec pulse widths.



5 IC Test Clips.

Ultra-low cost IC clips in 14, 16, 24 and 40 pin versions.

And, much more too: logic monitors, probes, frequency counters and test equipment to ensure the best, fastest results from your design.



Continental Specialties Corporation (U.K.) Ltd., Unit 1, Shire Hill Industrial Estate, Dept. 9H
Saffron Walden, Essex. CB11 3AQ Telephone (0799) 21682 Telex 817477 Reg. in London: 1303780.
VAT No: 224 8074 71. *Trade Mark applied for © CSC (UK) Ltd. 1977 Dealer enquiries welcome.

Please supply _____

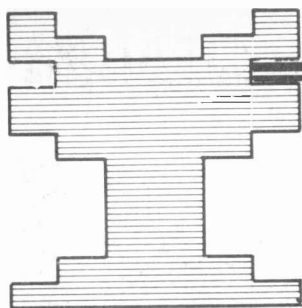
Price _____ Total _____

Name _____ Address _____

My cheque/postal order No _____ for £ _____ is enclosed

My Access/American Express/Barclaycard no. is _____ All I want is data, please.

**We're on Stand B1
at the Breadboard
exhibition.**



TELEVISION

Last month we described the operation of the Tolinka chess recorder — this month we deal with construction.

LAST MONTH WE described the overall principles of the Tolinka Chess Recorder and in this final part of the project we shall describe the circuit from the hardware viewpoint and go on to give constructional details.

First inspect the board on both sides to see if any of the holes have been blocked by tinning. The easy way to clear such holes is to melt the solder and apply the sharp point of a pencil. Wipe the iron frequently on a damp sponge or cloth to avoid solder splashes.

A Small Step

The first step in construction is to make the through board links support the board 4mm approximately away from the bench surface by putting bolts in the corner holes. The side without the IC pads should be uppermost. Each of the small round pads which has a counterpart on the opposite side of the board is a pin-through whereby connection must be made through the board. A piece of wire must be inserted into each of these holes and soldered on both sides of the board.

The board should now be cleaned of flux with a cleaning agent and inspected against a strong light. Look for missed pin-throughs, solder bridges and lifted tracks checking with a continuity meter any suspected opens or shorts. Spend a lot of time at this stage because this is where faults are most likely to exist—it is possible for another observer to find obvious faults on a board which has passed a lengthy examination.

The ICs are inspected next.

Socket It To Me

Use the socket strip provided for any IC with more than 16 pins. The best way of socketing an IC is to push the pins into the socket strip and then trim off the surplus strip. Do not break off the pin carrier part of the strip until you are ready to switch on the power. This will keep the IC pins shorted together during the soldering

and assembly process. If desired socket strip or sockets may be used for the other ICs—and this is a wise precaution.

It is recommended that components be installed in the following sequence—first all discrete parts like resistors, capacitors and diodes; next integrated circuits and last the larger power supply capacitors and voltage regulators. Switches need not be installed until preliminary tests are completed and installation of the PCB behind the front panel has been carried out. The panel then forms a template which aligns the switches correctly.

Remember that the space above the board is limited and solder any bulky components beneath the board: this is certainly necessary for the power supply electrolytics. Leave the output pins of the voltage regulators unsoldered so that supplies may be checked without damage to the circuitry. Note that the power supply components are soldered directly to the tracks on the top of the board and only the wires of the electrolytics pass upwards from the underside of the board through holes. All voltage regulators are 'face down', the main 5 volt supply regulator being bolted to an area of circuit board which acts as a heat sink.

Testing Time

Turn on the mains and test power supply voltages before soldering the regulator output pins down to the supply rails. Remove all ICs from their sockets and break off the pin carriers. Test voltages on supply rails again with the rails connected—do not of course fail to switch off the mains between tests. If all is well then instal the ICs and check the rails again.

Tune the TV set to receive a picture. There will be more than one picture available in the tuning range

and the best one should be found. If the picture has chessmen set up for the start of a game and move status information is correct then the printed circuit board may be installed beneath the lid of the box with the nuts, bolts and spacers provided and the keyboard switches soldered in place. If the device now functions correctly then attention may be turned to the cassette interface.

In an ideal world you could buy audio equipment which had standard sockets using standard signal levels at a standard impedance. This you could connect together with standard leads. The manufacturers of our world do not see things that way, however, and they make equipment with sockets, signal levels and impedances which are different from those of their rivals.

It will therefore be up to you, to decide upon these things as far as your own tape recorder is concerned. You might become involved in designing an attenuator to get things working properly. If you do not know how to do this and do not feel confident after reading the general remarks which follow, perhaps you really ought to be playing at something else.

The Ins and Outs

Outputs vary from millivolt level for a 5 pin DIN socket, but could be only available on a microphone input and earphone output. If inserting a plug into the socket cuts out the internal speaker the cutout switch should be disabled—try bridging it with a 33 ohm resistor. It is essential to hear the data and commentary.

(Input/Output can be the same pin)

It may be that volume and tone controls have an effect on the output signal but this is not usual.

Inputs vary from millivolt level for a dynamic mike to a high level—sometimes marked AUX. The high level input should be used if

CHESS

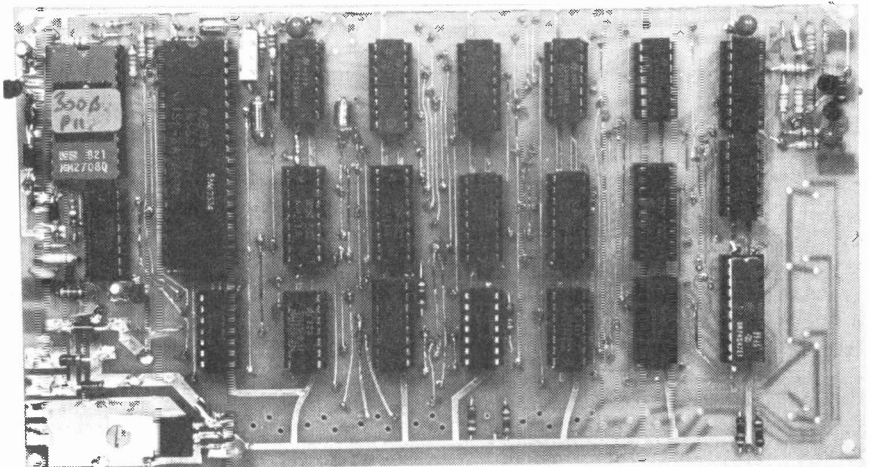
PART 2

available. The signal must be attenuated for a low level input to avoid overloading. Most recorders have Automatic Volume Control and this helps. The output from Tolinka is bursts of 3.9kHz at the data rate, which is 300 baud—or 150Hz maximum. Every high bit generates 12 cycles approximately of the carrier. The main source of interference may be regarded as being the data rate itself and some sort of high pass filter is needed at the input and output to remove it. Attenuation may also be required to match the recorder's input characteristics. A series capacitor followed by a shunt resistor will perform both these functions and in some cases even the shunt resistor is not required—it depends upon the recorder's input impedance.

If an oscilloscope is available the recorder's output may be observed and should consist of clean bursts of 3.9 kHz separated by level blank intervals. If the signal swings up and down with the data the recorder is receiving too much signal and the shunt resistor should be reduced until this effect disappears. This process should not be carried to the point where the output level is reduced.

If in doubt use the following rules of thumb:

- Put a 10k pot between the output and ground, taking the signal from the slider. Reduce the input level until the sound loses volume on playback.
- Take the output from the earphone or headphone socket. This will almost certainly cut out the recorder's internal speaker, but the switch should be easy to find and bridge with a 33 ohm resistor as described earlier. Adjust volume on playback to obtain satisfactory RECALL function. Note setting of both controls and check this setting each time.



Photograph of the circuit board taken during construction. The switches are not fitted until the board is ready to be mounted in the case — Initial testing being done without them in position.

One of the exclamations often heard at a Chess Congress is 'J' Adoube' which is not a Russian four-letter-word but a polite way of informing one's opponent that a piece is not situated in the centre of the square it is supposed to be occupying;—and this fact is bugging the exclamer who intends to adjust it but does not wish to be committed to moving it subsequently according to the rules of the game.

Tolinka has provision for moving

the pieces into the exact centre of their squares. the 'J' ADOUBE' capacitor. This component (C5) loads one of the outputs of a binary counter introducing a propagation delay which is passed down the divider chain. The value mentioned in the parts list is satisfactory for all but the most neurotic. In order that centralization may be optimized provision has also been made to fit a resistor for fine adjustment which will explain two of those redundant holes

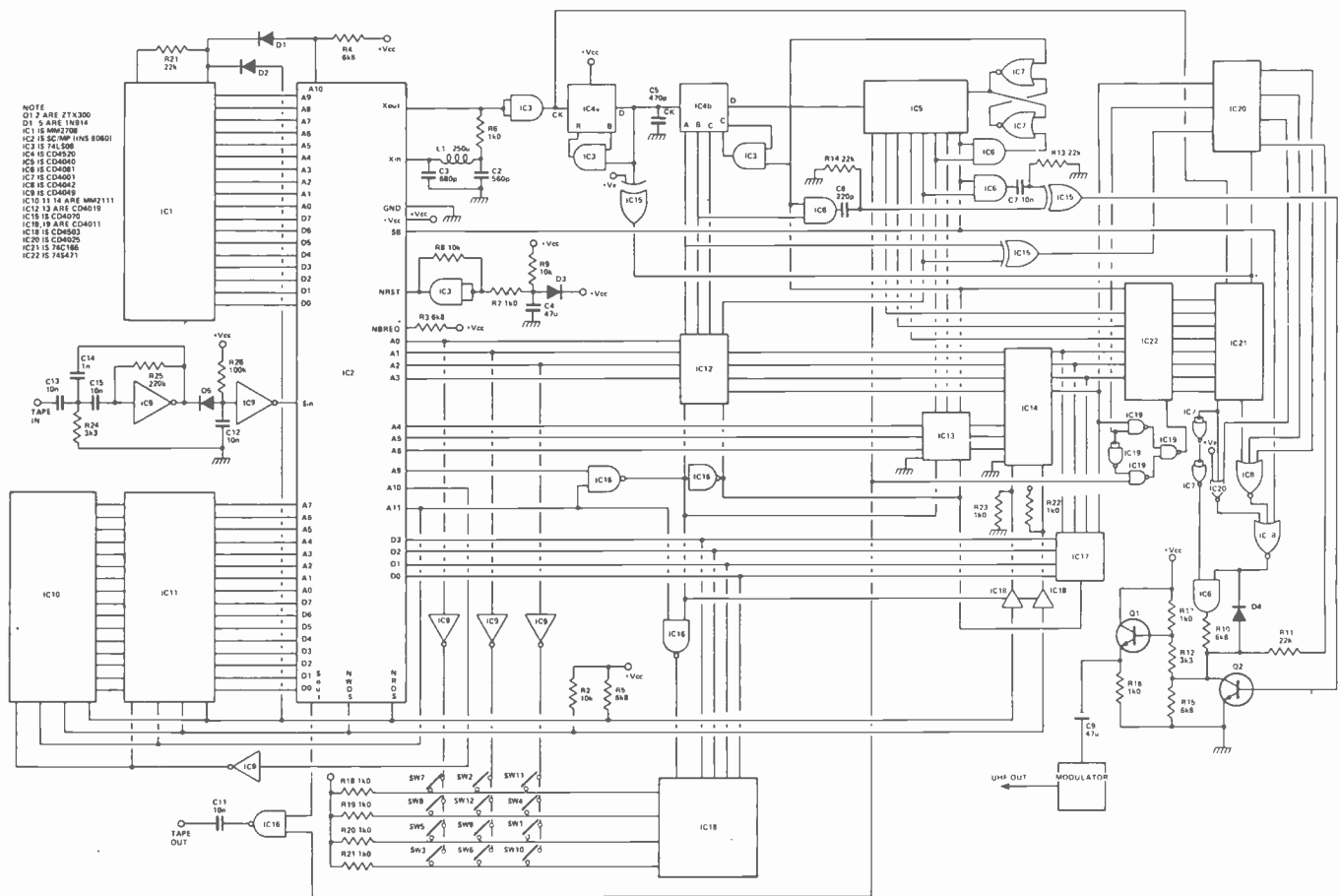
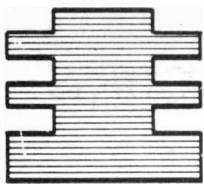


Fig. 1 Main circuit diagram of the Tolinka.

IC2 is National Semiconductor's SC/MP II. Its Program memory is stored in a 2708 type EPROM (1024 bytes). The character generator PROM (IC22) is a 74S471, 256 x 8 in structure. The RAM chips are 2111s, two (IC10 and 11) for game memory and one (IC14) for on-screen information. (There are 8 bits in game memory but only 4 in screen memory.) Top locations in game RAM are used as temporary stores for other information and this restricts the number of moves per player to 62 instead of 64 (four bytes are required to store a move).

Screen RAM is normally addressed by the VDU divider chain's outputs but the MPU must be able to address the screen as well to move the pieces around and change the status information. The address lines are multiplexed through a pair of CMOS And/Or gates (IC12 and 13). The vertical blanking signal is wired to a sense line of the MPU so that the MPU does not access the screen during the VIDEO INTERVAL which would produce annoying flicker.

The three lowest address lines of the MPU are connected to inverter gates (ICXX) which matrix the keyswitches in a three by four arrangement. Pressing any switch connects an inverted address line signal to one of four inputs of a tri-state buffer normally held high by a resistor (R18-21) to Vcc. When the buffer is selected the inverted address line may be read as data and the switch identified with a unique code by a process already described in the Software: How it Works.

Generation of a Video Signal

All frequencies used are derived from a single MASTER CLOCK which is the MPU's own on-chip oscillator. An L/C combination sets the frequency to 1.92 MHz which defines the shortest horizontal change interval on screen at about half a microsecond. The MASTER CLOCK is divided by ten (IC4a) to give the FILE interval. Eight FILES form the visible board but the FILE interval is divided by twelve in a four-stage binary counter. The A, B & C outputs of this counter are the LETTER addresses, the D output being the LINE BLANKING interval. Thus two-thirds of linescan are the chessboard.

During LINE BLANKING a R/C monostable (C18, R14) supplies the LINE SYNC pulse. Further division of the line interval by 32 gives the RANK interval which is taken from the 5th stage of a binary ripple counter (IC5): the 2nd, 3rd, 4th & 5th outputs of this counter being the address lines to the character generator PROM. This PROM supplies the horizontal piece information as eight outputs in parallel and changes this information every other line. The 6th, 7th & 8th outputs of the ripple counter are the FIGURE addresses. The 9th output is the FIELD BLANKING pulse which is 'Anded' with the 7th stage to reset the counter after 320 counts. 256 counts, or lines, are visible as the chessboard. During FIELD BLANKING monostable (C7, R13) supplies the FIELD SYNC pulse.

LINE BLANKING is also connected to the character generator PROM to select Status/Figures presentation instead of chess pieces. The same LINE BLANKING signal also permits the 4th output of the Board RAM, which contains the COLOUR BIT during the Chessboard interval, to address the character generator PROM instead of the 2nd output of the vertical binary ripple counter. (The COLOUR BIT is normally 'Exclusive-Or'd' with the pieces during the Chess board interval to control their colour.) This is because the larger character set of Status/Figures symbols are required than Chesspieces — and loss of vertical resolution (cut by half) is the price which must be paid.

The eight parallel outputs of the character generator PROM are converted to a serial data stream in the Video Shift Register (IC21), driven by the MASTER CLOCK and loaded by the FILE signal.

SQUARE COLOUR is derived from RANK and FILE by Exclusive-Or function. SQUARE COLOUR, LINE BLANKING and COLOUR BIT are aligned with SERIAL VIDEO by a D type Flip Flop clocked by FILE.

LINE SYNC and FIELD SYNC are also passed through an Exclusive OR gate to form MIXED SYNC.

SERIAL VIDEO is combined with COLOUR BIT, LINE BLANKING, FIELD BLANKING, etc. to form two mutually exclusive signals WHITING and BLACKING.

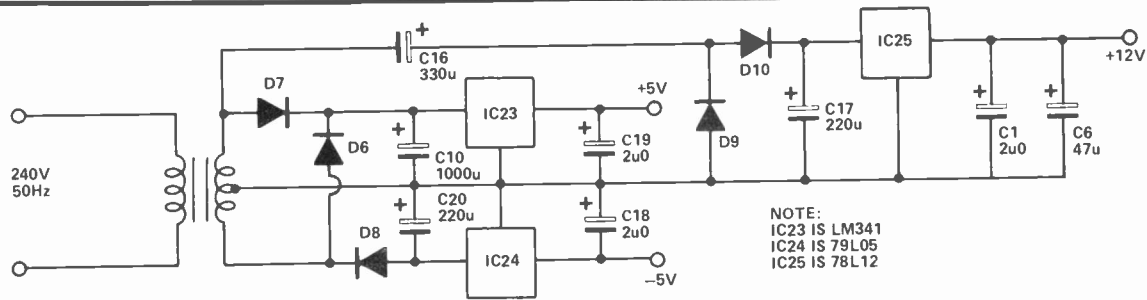
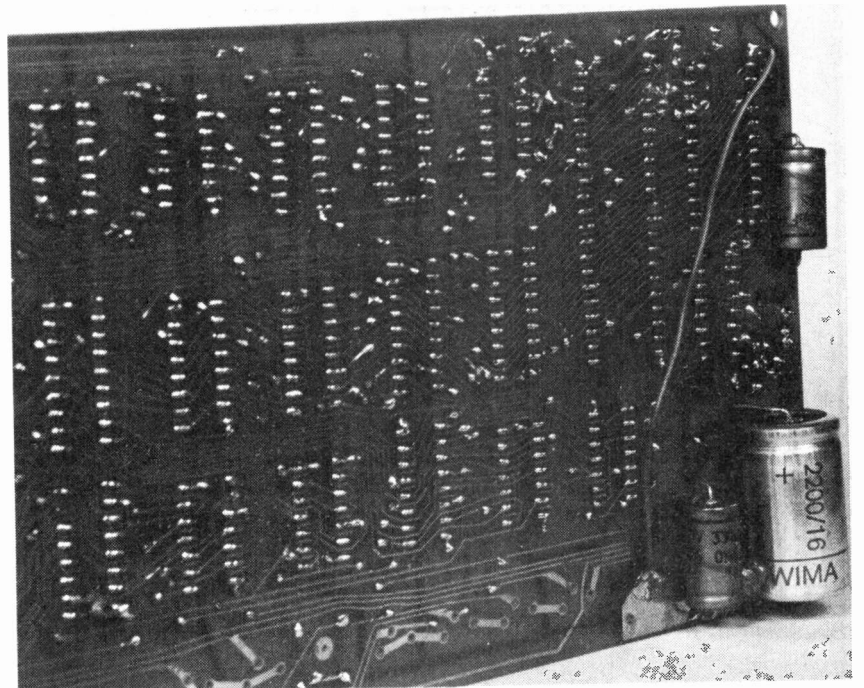


Fig. 2 The Tolinka's power supply is a straightforward design based on three monolithic regulators.

The photograph right shows how the power supply capacitors are mounted beneath the board and the wire link. Note that this photo was taken before the board was complete and not all components are in position.



BUYLINES

A complete kit of parts for this project will be available only from Videotime Products, 56 Queens Road, Basingstoke, Hants, RG21 1REA for the all inclusive price of £109.50.

Individual parts are also to be made available but Videotime will offer help, advice and a repair service only to readers who purchase the complete kit. Note also that software, piece design PCB pattern, etc, are subject to copyright.

HOW IT WORKS

Forming a Video Composite

The video signal is formed by combining SYNC, SQUARE COLOUR, WHITING and BLACKING at a summing point. SYNC is connected to Q2 which clamps the summing point (junction of R10, I2 and I5) to ground when SYNC is high. BLACKING is a negative going signal connected to the summing point through diode D4: when BLACKING is low the summing point is clamped a diode drop above ground. WHITING pulls the summing point up towards the positive rail through resistor R10. SQUARE COLOUR is connected to the summing point through a higher value resistor R1 and supplies two shades of grey when no other signal is present.

The signal is attenuated and passed through an emitter-follower to form a low impedance standard form video signal of approximately 1 volt peak to peak. This signal is used to drive a UHF modulator.

The reason that the SERIAL VIDEO output of IC21 is passed through a couple of spare inverter gates is to equalize propagation delays. Otherwise the black pieces have white edges.

Cassette Interface

The limited bandwidth available in audio cassette recording equipment does not permit serial data to be recorded directly. Some form of modulation is required.

In Tolinka data is recorded as bursts of a single frequency. On playback other frequencies can be filtered out and the demodulation process performed with a diode.

Three CMOS gates are used as the Modem in the final design. Any CMOS inverter will operate as a linear amplifier if a resistor is used between input and output. In this condition it may be regarded as an Op-Amp which has its non-inverting input connected to ground. A limited voltage gain of about 60 is available. The output data comes from the serial output port of the MPU and is combined with a signal of 3.9 KHz from the VDU divider in an AND gate. This supplies bursts of 3.9 KHz at data rate which can be recorded on tape.

The recovered signal is filtered by a CMOS inverter configured as a high pass filter. This rejects low frequencies at data rate and in the speech band. The output of this inverter, which consists of high amplitude bursts of 3.9 KHz, is connected to the cathode of D5. The anode of D5 is taken to the input of another inverter and a low pass filter, consisting of a resistor (R26) to the positive rail and a capacitor (C12) to ground. Gates in the same package have similar transition points — so when there is no input the output remains at ground level. If 3.9 KHz oscillations are present at the input the output is high. The demodulated transmission is fed to the MPU's serial input.

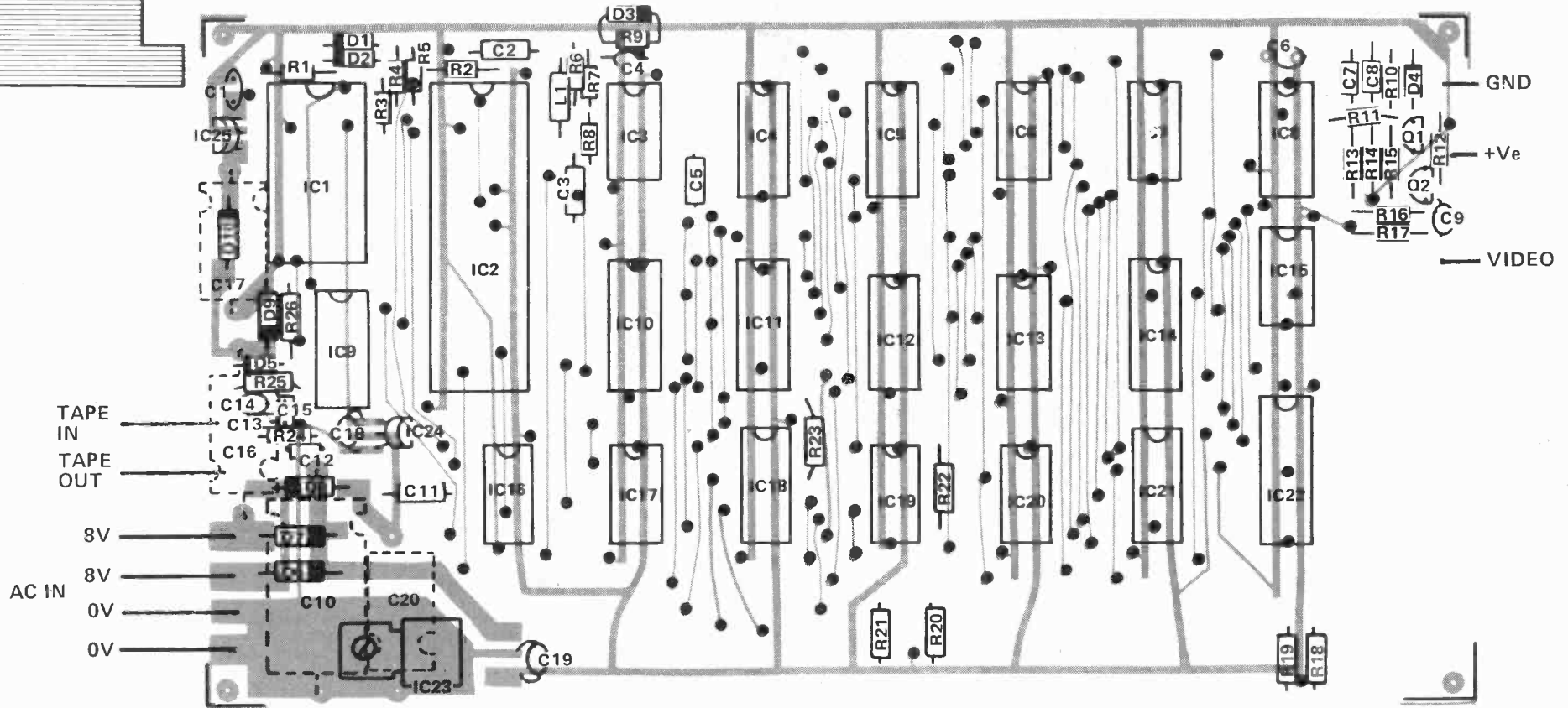
Power-on Reset

The MPU has a Reset input which clears all internal registers and restarts operations with the first instruction after it has been brought low for a specific interval of time. This function occurs when Tolinka is first switched-on and is not required again by the user.

At first sight this circuit seems to be overdesigned. In fact correct initiation of proceedings is vital and reliability suffers if any of the components are omitted. The diode connected across the charging resistor ensures that the capacitor will discharge if the power is interrupted only briefly.

ROM Select Diodes

The ROM occupies the first kilobyte of addressing space and it would seem logical to connect its Chip Select input directly to A10 because no write instructions will be made in this area. Conflict would still take place because the MPU outputs data on the bus at the start of the instruction fetch operation — this data consists of flags and upper address bits and none of it is used by Tolinka. The conflict would be harmless but for the fact that a Video Signal is being produced and processed at the same clock rate as the MPU which produces a faint pattern on screen if the Chip Select diodes are omitted.



PARTS LIST

RESISTORS

R1, 11, 13, 14	22k
R2, 8, 9, 18, 19, 20, 21, 22, 23	10k
R3, 4, 5, 10, 15	6k8
R6, 7, 16, 17	1k0
R25	220k
R26	100k
R12, 14	3k3

CAPACITORS

C1, 18, 19	2u06V3 tantalum
C2	560p polystyrene

C3	680p polystyrene
C4, 6, 9	47u 6V3 tantalum
C5	470p polystyrene
C7, 11, 12, 13, 15	10n ceramic
C8	220p polystyrene
C10	1000u 16V elec- trolytic
C14	1n0 ceramic
C16	330u 16V electrolytic
C17	220u 16V electrolytic

SEMICONDUCTORS

IC1	MM2708
IC2	INS8060
IC3	74LS08

IC4	CD4520
IC5	CD4040
IC6	CD4081
IC7	CD4001
IC8	CD4042
IC9	CD4049
IC10, 11, 14	MM2111
IC12, 13	CD4019
IC15	CD4070
IC16, 19	CD4011
IC17	CD4066
IC18	CD4503
IC20	CD4025
IC21	74C165
IC22	74S471
IC23	LM341-P5

IC24	78L12
IC25	79L05
Q1, 2	ZTX300
D1-5	1N914
D6-10	1N4001

INDUCTOR

L1	250u
----	------

MISCELLANEOUS

PCB, transformer (0-8; 0-8 at 500mA), UHF modulator, switches (Schoeller- 12 off), case to suit, sockets, cable, nuts, bolts etc.



**Just one of
many kits in the
New Hobbies
catalogue**

The new Doram Electronic Hobbies Catalogue is packed full of new exciting merchandise including
MICRO PROCESSOR BASED KITS.

ELECTRONIC KITS FOR ALL THE FAMILY

ELECTRONIC TOOLS AND BOOKS

AUDIO & CAR ACCESSORIES ETC.

Send for your copy now.
(AVAILABLE LATE SEPT)

Overseas customers
(except for N. Ireland)—
60p including despatch by Air
(or all-up post).

Doram Electronics Ltd
PO Box TR8
Wellington Road Estate,
Wellington Bridge,
Leeds LS12 2UF

DORAM

ELECTRONIC HOBBIES CATALOGUE

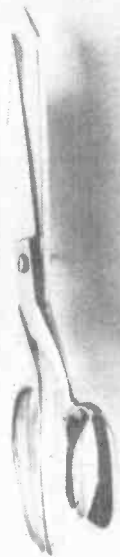
Name.....

Address.....

Please send my FREE Hobbies Catalogue. I enclose 25p. contribution to p. & p.

Doram Electronics Ltd
PO Box TR8
Wellington Road Estate,
Wellington Bridge,
Leeds LS12 2UF

ETI 7





'TOLINKA' CHESS REPORTER — FULL KIT OF PARTS

The original unit used in conjunction with the World Chess Championship at Manila, August '78, by both Chess Champion Viktor Korchnoi and BBC TV news.

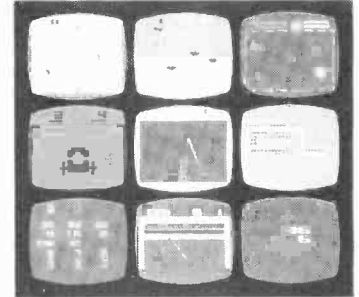
Records every game step, auto en passant, queening and castling. Entire games may be recorded on most domestic cassette recorders. Based on 8060 Mk II Scamp. Full kit including all components — No extras required — **£109.50***



'ATARI' VIDEO COMPUTER — READY BUILT CARTRIDGE SYSTEM (ROM)

Designed and built by Atari (part of Warner Comms.) in the USA this unit is the most advanced centre available.

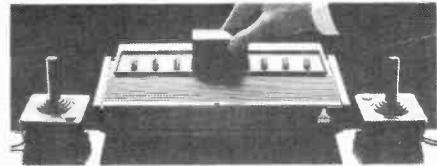
Just look at a few of the cartridges (up to 50 games each) available in full glorious multi-colour and very realistic on TV Sounds.



Examples of some of the many cartridges available. Combat, Air Sea Battles, Space War, Outlaw, Video Olympics, Surround, Black-jack, Breakout, Basic Math.

The Video Computer (based on Signetics 2650) comes complete with 27 Game Combat Cartridge (tanks, bi-planes, bombers, jets), 2 joysticks, 2 rotational controllers, mains adaptor and aerial switching unit. Fully guaranteed for 12 months. **£169.95***

Additional Cartridges (over 21 due by early '79) mostly priced at **£14.95***



Full Colour Brochure available on request

UNBELIEVABLE WATCH BARGAINS



VT01
5 FUNCTION
LCD. Hour, Min, Sec.
Month, Date, S/S strap,
Backlight.



VT07
12 FUNCTION
CHRONOGRAPH
Hour, Min, Sec., DATE,
Month, 1/100th Sec. Time,
1 or 2 Event.

ONLY
£13.95*

VT03
SOLAR ALARM
Hour, Min, Sec, Month,
Date, Day, alarm any time
in 24 hour day.

ONLY
£25.95*



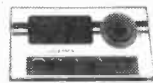
VT04
SOLAR
CHRONOGRAPH
As VT02 but with solar
panel

ONLY
£25.95*



VT05
CHRONOGRAPHY /
ALARM
All the combined features
of alarm & chronograph
watches (photo
represents
case style only)

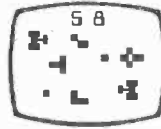
ONLY
£37.95*



VT06
ALARM/STOP WATCH
CLOCK
& Snooze Alarm. Stop
watch.

ONLY
£17.95*

Presentation boxes not included. Please add 65p



BARGAIN TV GAMES KITS AND COMPONENTS



Stand Alone Kits

Kits — full instructions, all PCB components. Mini-kits — instructions, chip, skt, coil, PCB.

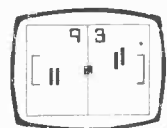
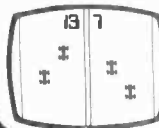
	kits	minikits
B&W Tank Battle (AY-3-8710)	£15.90	£9.75
B&W Stunt Rider (AY-3-8765)	£15.90	£9.95
B&W Road Race (AY-3-8603)	£14.90	£8.50
B&W 10 Game B/B (AY-3-8610)	£13.90	£8.50
NEW B&W Submarine (AY-3-8605)	TBA	TBA
B&W Wipeout (AY-3-8606)	£14.90	£8.50

Astec Modulators & Encoders

UM1263 Sound Osc	£1.95
UM1111 E36 UHF Mod	£1.95
UM1233 UHF (high quality)	£4.95
UM1168 Pal Encoder	£2.50
UM1163 Pal Enc + UHF Mod	£4.95
European Equivalents available	

Accessories

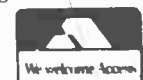
AB Joystick controls 200k lin	£1.95
Crystal 4.4 Mhz	£1.00
Crystal 3.57 Mhz	£1.25
Oscillator coil 100µH	£0.45
Mains adaptor + 150mA 8v reg i/c	£3.50



* Prices include VAT, packing & delivery charges and money back guarantee. Send cheque or P.O. to

VIDEOTIME PRODUCTS 56 Queens Road, Basingstoke, Hants RG21 1REA
Tel: (0256) 56417. Telex: 858747.

(Trade & Export Enquiries welcome)



SWITCH IN LINE SAVES NONE?

Stan Curtis of Mission Electronics, author of our series on super-fi amp design is back with us again to explain the faults inherent in many widely used comparative hi-fi tests. In particular he has a few things to say about switching methods

A SIGNIFICANT RE-APPRAISAL of amplifier design has been seen in the past few years. The revival of serious listening tests (so called "subjective" testing) has shown that laboratory measurements alone are not sufficient to indicate the performance of the amplifier when it is connected to real loudspeakers and pick-up cartridges and fed with a music signal. But it is crucially important that these listening tests be set up with great care. When different amplifiers are compared their gains should be equalised so that their outputs are within 0.1 dB of each other and preferably within 0.05 dB.

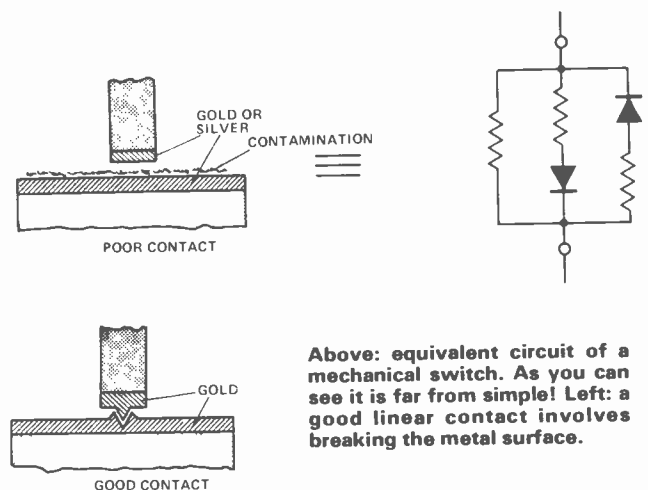
Such level changes could be incorrectly interpreted as differences in amplifier performance. The design of the passive attenuators is important to prevent any significant loading of the circuitry or any unbalancing of impedances which could upset passive filter roll-offs and so alter the frequency response of the system. Even the choice of test signal is important when setting levels. Traditionally a sine wave of 1 Hz or 400 Hz has been used. However, the author prefers to use a noise source fed via a bandwidth limiting filter (to prevent any error by the different frequency responses of the amplifiers) as this more realistically simulates the dynamic conditions.

Care should also be taken in the interconnection of the different amplifiers. All connections should be as short as possible using very high quality and identical (in length and quality) cables. Wherever connections have to be made (other than at the amplifier or loudspeaker) high-quality gold-plated instrumentation connectors should be used in preference, to the rather suspect RCA Phono and DIN Connectors.

Switch Your Contacts

The next problem area is that of switching. Switching the outputs of the different amplifiers to a loudspeaker can be done using high-current, high-conductivity lever of knife switches. Relays can cause problems unless they have very strong springs; good contact design; high-current capability; and are new. The subject of switch contacts is quite complex but can be summed up as follows. A metal to metal contact is rarely a true "short circuit."

An almost invisible layer of oxidation or contamination forms on the contacts. This oxidation increases the contact resistance but more importantly forms a non-linear junction that can in some ways be considered to be a voltage dependent diode-rectifier. The effect on the



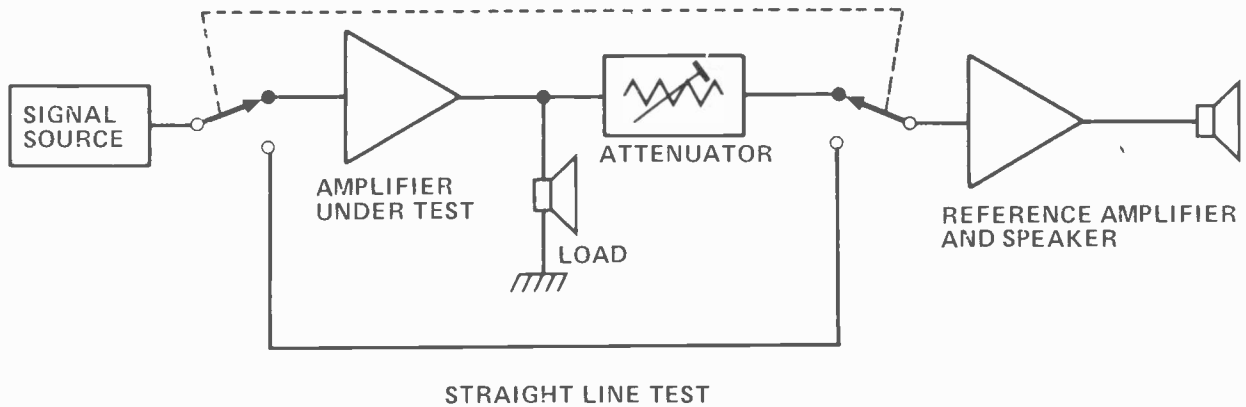
Above: equivalent circuit of a mechanical switch. As you can see it is far from simple! Left: a good linear contact involves breaking the metal surface.

music signal at low levels can be imagined and — more importantly — heard! Even "pure" gold contacts and "self-cleaning" contacts suffer from this problem. A good contact can only be achieved when one contact breaks the surface of, and penetrates, the other contact metal. However, only a limited number of switching actions can occur before the contact material is sufficiently worn or damaged for inconsistent performance. Although this problem is discussed here in relation to testing it has as much significance in the design of the switches used in the amplifier.

When it comes to switching the output of the cartridges the imperfections of the switches have so much effect upon the audible quality of the signal that the listening test ceases to have any real validity.

Test point

The test itself needs further thought. The listening panel should be experienced listeners and yet not be part of a "clique" where views are remarkable for the way they follow the "party line." Testing should be conducted over two or more sessions. Short sessions to perceive the performance of the amplifiers before aural fatigue sets in; and longer sessions with each individual amplifier to judge whether such fatigue is caused by the amplifier and to judge whether the apparent improvement it offered was a "flash in the pan." ▶



STRAIGHT LINE TEST

Fig. 2. The straight wire test. First popularised by Peter Walker of Acoustical Manufacturing (or Quad!) this test method has gained wider acceptance of late. It has its faults however.

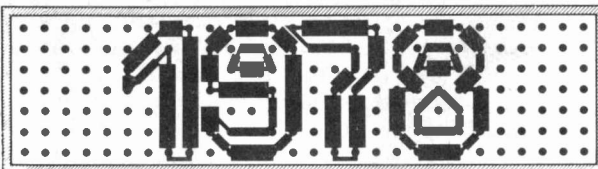
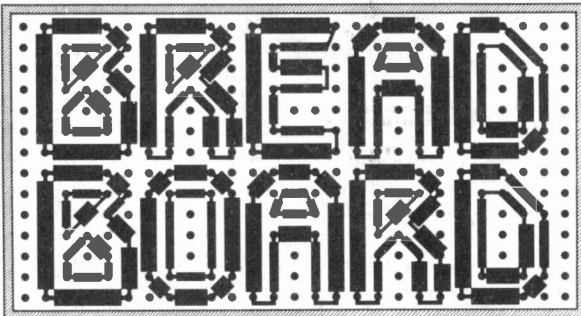
During the initial sessions a number of "check" changes should be made to detect cheating (deliberate or involuntary) i.e. running amplifier No. 3 a second time as amplifier No. 7. Between each piece of music the reference numbers should be changed to minimise the effects of pre-conception. For example; if amplifier No. 3 is disliked for its reproduction of a bass drum, it may then be subconsciously disliked on other pieces of music. Of course the tests should as far as possible, be conducted blind.

A popular "subjective" test in use is the "Straight Wire Test." In this test the amplifier under evaluation is fitted with an attenuator at the output and substituted for a straight wire. The resulting signal is fed to a

"reference" amplifier and loudspeakers of known performance. Such a test is of help in evaluating the dependence of the amplifier on the loading made by different loudspeakers. But otherwise this test must be considered suspect. The "reference" amplifier may be far from perfect and it may well mask subtle changes. The dynamic interactions of two units in series can be quite complex and very difficult to predict in advance.

The foregoing (brief and incomplete) discussion of subjective testing serves only to indicate the difficulties that can be encountered. The reader should only consider seriously those comparative reviews where considerable effort has been expended to eliminate errors due to equipment and human beings.

ETI



The kits & bits show for the home electronics enthusiast

Seymour Hall Seymour Place London W1
21-25 November 1978

Seventy stands packed with the gear that the home electronics constructor needs. From kits for keen youngsters just starting — to components for the dedicated enthusiast intent on building his own computer, it can all be seen and bought on the spot in the Seymour Hall this November. Browse through the range of instrumentation, test gear, components and circuit boards. Kits for making everything from an electric grandfather clock to an electronic organ. Build your own microprocessor, construct your own television games and choose hi-fi audio modules for the ultimate in sound!

Watch the Demonstrations in adjoining halls — electronic projects brought to life by the experts — and a chance for you to try for yourself the latest ideas from manufacturers and journals.

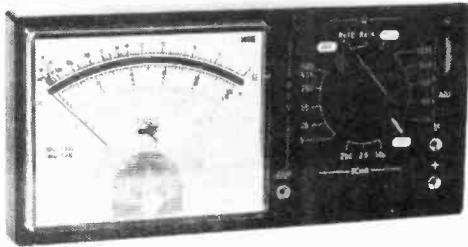
Competitions — Win a microprocessor kit — a frequency counter — a 'starter' kit for the kids — and many other daily prizes throughout the show.

Open 10 a.m. — 7 p.m. daily.
 Entrance £1.00 adults, 70p students.

Organised by Trident Conferences and Exhibitions Limited, Abbey Mead House, 23a Plymouth Road, Tavistock, Devon. PL19 8AU.
 Tel: 0822 4671 Telex: 45412 TRITAV.

DORAM

SEE THE RANGE OF MULTIMETERS IN THE NEW DORAM HOBBIES CATALOGUE.



Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Please send my FREE Hobbies Catalogue (AVAILABLE LATE SEPT)

I enclose 25p contribution to p & p

Name _____

Address _____



Doram Electronics Ltd
PO Box TR8, Leeds LS12 2UF

Overseas customers (except for N. Ireland) - 60p including despatch by Air (or all-up post).

TRANSFORMERS

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

Miniature & Sub Miniature

Volts	Milli-amps	Ref. No.	Price £	P&P
3.0-3	200	238	1.95	55
1A 1A	212	2.60	55	
0.6-0.6	100	13	1.85	40
9.0-9	330 330	235	1.95	40
0.9-0.9	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(OC)	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	Ref. No.	Price £	P&P
12V	24V		
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
8	4	108	6.25 100
10	5	72	6.95 100
12	6	116	7.85 100
16	8	17	9.25 110
20	10	115	12.75 130
30	15	187	16.60 130
60	30	226	22.90 160

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	100
4.0	21	6.85	100
5.0	51	7.75	100
6.0	117	9.50	100
8.00	88	11.35	130
10.0	89	12.00	130

CATALOGUE 30p

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

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

VA (Watts)	Ref. No.	Price £	P&P
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

BAYDIS

54a Mortimer Street
Herne Bay, Kent
Herne Bay G45 8BE

IT'S FREE!

Our monthly Advance Advertising Bargains List gives details of bargains arriving or just arrived - often bargains which sell out before our advertisement can appear. - It's an interesting list and it's free - just send S.A.E. Below are a few of the bargains still available from previous lists.

FM Tuner and decoder, 2 very well made units, nice clear dial, excellent reproduction, £11.20 the pair.

12 Volt Heavy Duty Relay, plug in type has three pairs of 10amp changeover contacts. A transparent dust cover, price £1.08 suitable 11 pin base 45.

Light Dimmer, our timer module with small mods makes an excellent light dimmer. Contains a 4amp 400V SCR so it should be suitable for loads approaching 1KW. Price of module and instructions £2.25.

Flashing Lights, chattering lights, random flashes, strobe effects etc. can easily be achieved using our disco switches. These switches are ex-equipment but guaranteed perfect and supplied suitable for mains working. To get some idea of the loading number each switch is 10amp. For the light pipe or Catherine Wheel effect order the 12 switch model with light pipe data model. Interconnecting the switches to give the fastest speed. 6 switch model £5. 9 switch model £5.75. 12 switch model £6.20.

Reed Switches, standard 60 watt glass type. Normal open contacts glass lengths 2", diameter 3/4". 10 for £1. 100 for £8. 1000 for £70.

Flat Reed Switches, for stacking, greater quantity in confined space. Price 50p.

Crematic Magnets, suitable for operating reed switches, central fixing hole, 10 for £1.

W/ Skaped Fluorescent Tubes for porch light, box signs or where you want light evenly spaced over a confined area approx. 12"x10". 30 watts, made by Philips price £2.24.

Extension Speakers, 6ohm 4.5 watt handling power. We have 5 or 6 different models in stock, cheapest being the Party-time at £3.95 each, again only really a bargain for callers as postage is £1.50 per speaker.

Auto Transformers isolated secondary, for working American tools and equipment, completely enclosed in sheet metal case made for computer so obviously first class 500 watts. With handle, offered at about half price only £15. These may be solid but are fully guaranteed. Similar but 100 watt £29.50.

Car Starter Charger Kit, New version. We supply two 10amp rectifiers, 250V transformers and the start charge switch with instructions, price £9.75. This is probably one of the most useful pieces of equipment you can have in your garage. Sooner or later you or someone will leave something on and you will have a flat battery, this starter will get you away usually in less than 5 minutes.

Resistor Cassette by Vidorol Company, 230/240 V mains operated. Intended for surface mounting has a fixing flange at the bottom. Price £2.16.

12V Drip Proof Relay, Specially designed for going under the bonnet of a car, made by one of our big manufacturers this has a removable semi-hard rubber cover. Contacts look suitable for up to 10amps so this could be the right one if you are thinking of making an anti-theft device. Price £1 + 18p.

High Speed Unisector. As many customers know, we have a very comprehensive stock of unisectors used in automatic telephone exchanges, light flashing device etc. etc. Just arrived, however, is a high speed model made by famous Plessey, this is 2 pole 32 way with make before break wipers, overall size approx. 4"x3"x2 1/2". Price £3.50 + 28p.

Pneumatic Ram, for lifting, thrusting, pulling etc. etc. has 2 1/2" travel, looks large enough to open doors, lift staircase, ventilators etc. Price £7.00.

Solder Gun BARGAIN. The ETP, this is 100watt soldering gun, a very well made tool with lamp to illuminate work, has flexible insulated mains transformer and is built into the shockproof thermoplastic case. Comes complete with spare tips. Mains operated of course. Price £4.50.

Interested in Tape Control? American made tape punches really beautiful units full of sophisticated parts, designed we believe to automatically operate typewriters and they can of course be used to operate other punch tape controlled machines. Reference No. is MCH Class 461-2 reference 205-H156. We believe these are 8 bit tape punches, powered from 115V 50Hz in very good condition with tape £18.00, carriage is £3.20.

MULLARD UNILEX

A mains operated 4+4 stereo system. Rated one of the finest performers in the stereo field they would make a wonderful gift to almost any one in easy to assemble modular form and complete with a pair of Plessey speakers this should sell at about £30 - but due to a special bulk buy and as an incentive for you to buy this month we offer the system complete at only £15 including VAT and postage.

High Voltage Mains transformer. Normal mains primary secondary by our measuring equipment is 8kV approx. at 5mA. We are offering these at a bargain price of £4.50.

MICRO PROCESSOR - VIATRON U.S.A. SYSTEM 21

Just arrived a limited quantity only of these superior V.D.U. M.P.U. Systems.

System 21 consists of a 6250 video monitor 73 key fully coded keyboard with shift and repeat functions, dual digital record replay cassette decks and main M.P.U. housing. Memory P.S.U., refresh and control logic all housed in attractive desk standing console.

Features include:
Full cursor control
hard wired programmes
automatic tape data block search, etc., etc.

Supplied complete with manual and secondhand untested bargain price of £165, personal collection only please.

WHAT COULD YOU BE DOING?

In one year's time, if you understood computer and microprocessor technology? Think it over, then join the "Doing it digitally" course which is starting now.

You will learn mainly by doing, not just reading. It's easy to understand that way.

Pay as you learn - Just £5 deposit and eleven monthly payments of £3. (or £35 cash now). £23 worth of components sent now, more will follow as course requires them.

REMEMBER THIS IS YOUR CHANCE?

Terms, Prices (Except Transformers) include Post & VAT. But orders under £6.00 please add 50p to offset packing. Bulk enquiries - Please phone for Generous Discounts 01-688 1833.

J. BULL (ELECTRICAL) LTD

103 TAMWORTH RD.
CROYDON CR8 1SG

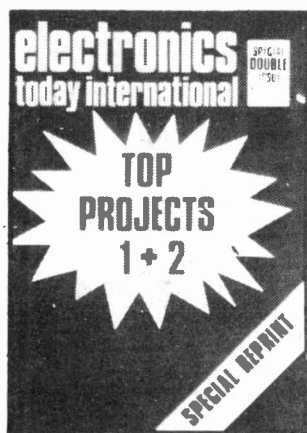
MAINS TRANSFORMERS

All these have 230/240v 50Hz Primary & isolated secondary

VOLTAGE	CURRENT	REF.	PRICE
1v	2 amp	TM1	£1.94
2.4v	5 amp	TM2	£1.62
4v	7 amp	TM32	£2.70
6v	1/2 amp	TM3	85
6.5v	4 amp	TM37	85
6.5v	200mA	TM21	£1.62
6.5v 0-0.5v	100 mA	TM21	£1.62
6.5v 0-6.3v	750 mA	TM7	£2.10
6.3v 0-6.3v	100 mA	TM33	£1.62
6.3v	2 amp	TM4	£1.89
8.5v	1 amp	TM12	£1.62
8.5v + 8.5 sep winding	1/2 amp	TM12	£1.62
9v	1 amp	TM5	£1.62
9v	1 amp 'C' core	TM11	£1.60
9v	3 1/2 amp	TM11	£2.70
9v	5 amp	TM38	£3.24
10v	100 mA	TM15	£4.86
10v	25 amp	TM15	£4.86
10v 0.10v	12 1/2 amp	TM9	£1.05
12v	1/2 amp	TM7	£2.16
12v	1/4 amp	TM10	£1.89
12v-0.12v	50 mA	TM10	£1.62
12v-0.12v	1 amp	TM41	£3.24
15v tapped 9v	2 amp	TM11	£2.70
15v	7 amp	TM11	£4.32
15v-0.15v	3 1/2 amp	TM12	£1.62
15v-0.15v	3 1/2 amp	TM12	£4.32
17v	1/2 amp	TM13	£1.90
18v	1/2 amp	TM14	£1.62
20v	1/2 amp	TM46	£4.32
20v-0.20v	2 1/2 amp	TM15	£4.86
20v	12 1/2 amp	TM15	£4.86
20v-0.20v	6 amp	TM15	£4.86
24v	100 mA	TM21	£1.62
24v	1 1/2 amp	TM16	£2.12
24v	2 amp	TM17	£2.70
24v + 2v 7 amp	2 amp	TM39	£2.97
25v	4 amp	TM40	£3.78
25v	1 1/2 amp	TM18	£2.43
26v	2 amp	TM39	£2.98
30v	8 amp	TM15	£4.86
37v	37 amps	TM34	£31.86
40v tapped @ 30v	5 amp	TM15	£4.86
20v + 18v			
50v-2 amp with 6.3v shrouded		TM22	£4.86
50v	8 amp	TM20	£11.65
60v	2 amp	TM46	£4.32
80v	5 amp	TM24	£7.02
75v-3 amp with 6.3v shrouded		TM23	£8.10
75v	4 1/2 amp	TM24	£7.02
70v tapped 60c & 75v	4 amp	TM24	£7.02
100v	1 amp	TM25	£7.02
100v-0.100v	1/2 amp	TM25	£7.02
120v	4 amp	TM50	£10.50
120v	8 amp	TM51	£8.90
200v	1/2 amp	TM25	£7.02
250v-0.250v with 6.3v 2A	50 mA	TM36	£3.78
250v	180 mA	TM36	£3.78
500v	50 mA	TM36	£3.78

Quantity Prices available. Please, unless you are calling add 25% to your order to cover cost of carriage.

ETI SPECIALS



£2.50 + 25p P&P

1 + 2—Top projects include: Master mixer, 100 W guitar amp., low power laser, printmeter, transistor tester, mixer preamp, logic probe.



£1.00 + 25p P&P

Ni-Cad charger, loudhailer, 'scope calibrator, electronic ignition, car theft alarm, turnindicator canceller, brake

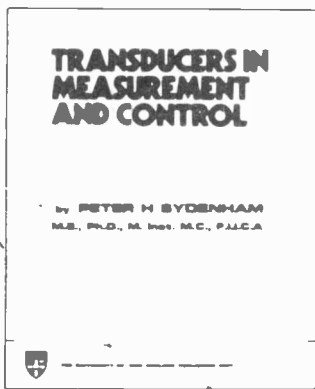
light warning, LM380 circuits, temperature alarm, aerial matcher, UHF TV preamp, metal locator, four-input mixer, IC power supply, rumble filter, IC tester, ignition timing light, 50 W stereo amp. plus many more. . . .

3—This issue was so popular that it is now sold out!
4—Includes Sweet sixteen stereo amp., waa-waa, audio level meter, expander/compressor, car theft alarm, headlight reminder, dual-tracking power supply, audio millivoltmeter, temperature meter, intruder alarm, touch switch, push-button dimmer, exposure meter, photo timer, electronic dice, high-power beacon, electronic one-armed bandit!
5—Twenty-two complete projects, including: 5 W stereo amp., stage mixer, disco mixer, touch organ, audio limiter, infra-red intruder alarm, model train controller, reaction timer, headphone radio, STD timer, double dice, gen-purpose power supply, logic tester, power meter, digital voltmeter, universal timer, breakdown beacon, heart rate monitor, IB metal locator, temperature meter. . . .
6—Just published. Includes Graphic equaliser, 50-100 W amp modules, active crossover, flash trigger, "star and dot" game, burglar alarm, pink noise generator, sweep oscillator, marker generator, audio-visual metronome, LED dice, skeet game, lie detector, disco light show. . . .



75p + 25p P&P

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?



£3.00 + 25p P&P

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.

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.

Please supply me with the following ETI Specials:

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Total cheque/PO enclosed = £ ..

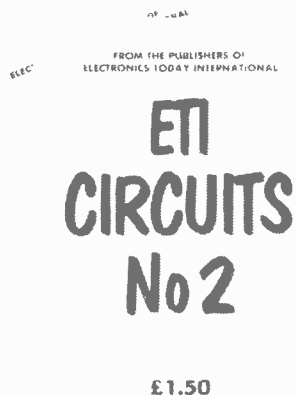
Address:

M

.....

.....

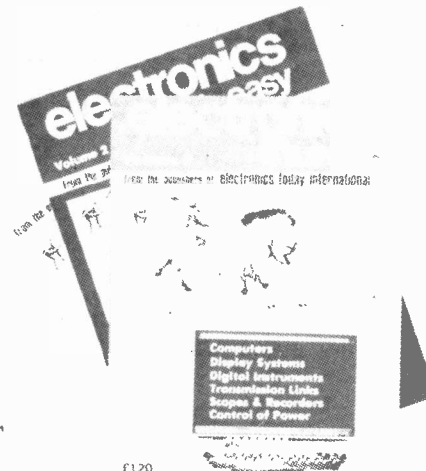
.....



£1.50

Each volume contains over 150 circuits, mainly drawn from the best of our Tech-Tips. The circuits are indexed for rapid selection and an additional section is included which gives transistor specs. and plenty of other useful data. Sales of this publication have been phenomenal — hardly surprising when the circuits cost under 1p each! Each volume costs.

£1.50 + 25p P&P



£1.20

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

ETI MARKET PLACE

Digital Alarm



Size: 105mm wide 115mm deep x 55 mm high.

THIS IS THE THIRD digital alarm clock that we are offering (we regret the earlier versions are no longer available). We have sold thousands and thousands of these and our buying power enables us to offer a first rate branded product at a really excellent price.

The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

Setting up both the time and alarm is simplicity itself as buttons are provided for both fast and slow setting and there's no problem about knocking these accidentally as a 'locking' switch is provided under the clock. A 9-minute 'snooze' switch is located at the top.

£8.95

(Inclusive of VAT and Postage)

An example of this clock can be seen and examined in our reception at our Oxford Street offices.

DIGITAL ALARM

To:
Hanimex Alarm Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque PO for £8.95 (payable to ETI Magazine) for a Hanimex Digital Alarm Clock.

Name

Address

Please allow 14 days for delivery

LCD Watch



New low price!

The enormous numbers involved in ETI offers has enabled us to arrange a real bargain — a full spec LCD watch with adjustable metal bracelet for under half the going rate.

This watch gives continuous display of hours and minutes — press the button once and you'll get the date (American style). After a couple of seconds the display automatically reverts to time but if you press again you'll get a continuous seconds display.

Press another button and you get a back light, enabling you to see the display in the dark. Setting, or resetting is simplicity itself and a 'hold' facility allows you to set the watch spot on. The accuracy is magnificent, as with all the current range of digital watches and battery life is well in excess of a year.

£8.95

(Inclusive of VAT and Postage)

An example of this watch can be seen and examined in our reception at our Oxford Street offices.

LCD WATCH

To:
LCD Watch Offer
ETI Magazine
25-27 Oxford Street
London W1R 1RF

Please find enclosed my cheque/PO for £8.95 (made payable to ETI Magazine) for my LCD Digital Watch.

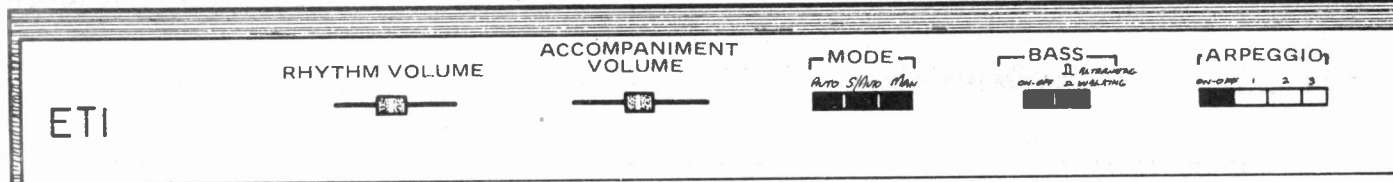
Name

Address

Please allow 14 days for delivery

AUTOCHORD

PART ONE



WHILE NOT QUITE an instrument in its own right the auto chord is certainly more versatile than the common or garden rhythm generator.

The instrument is designed to be added to the lower two octaves of an organ and will provide a variety of accompaniment controlled by the mode selected.

The specification shows that the eight rhythms provided cover most requirements and gives some idea of the extra facilities offered by the auto chord.

The instrument will offer chords — major or minor third, fifth or diminished fifth and sixth of seventh. It will also provide a walking or alternate bass as well as arpeggios.

They say a picture is worth a thousand words, and at this moment we feel that at some time someone must have said much the same about sound. It's difficult to convey all the facilities offered by the auto chord on paper, so if you cannot visit Maplin's shop, where a unit will be on demonstration, you will just have to take our word that the auto chord provides everything that the solo musician could want.

The auto chord is designed to be incorporated within existing organs and is easiest to interface with a DC keyed organ although it is possible to use the auto chord with a direct keyed instrument.

Full constructional details plus a description of the auto chord in use will be presented next month.

SPECIFICATION

8 selectable rhythms Covering waltz, rock to Latin. Latin American rhythms can be combined. Non-Latin American rhythms can be combined.

5 instruments Bass. Snare drum. Low bongo. Claves. Cymbals.

CHORD ACCOMPANIMENT (with keyboard)

Three mode selection

1 **AUTO**
Playing one note produces a chord structured around this note, and will play continuously.

SEMI-AUTO
3 Individual notes or chords played are remembered and played continuously.

MANUAL
Notes or chords played only continue whilst the keys are held operated.

AUTO RESET

Variable bass. Delay-auto-stop and over-ride in all 3 modes. On/off. Walking or alternating in modes 2 and 3. A minimum of three notes. Must be played for bass accompaniment.

Auto: On/off.

Chord accompaniment: On/off.

Two octaves progressive in modes 2 and 3. Selectable maj/min 3rd/7th.

Variable tempo

Harmonic attack

Arpeggio

Chord accompaniment volume

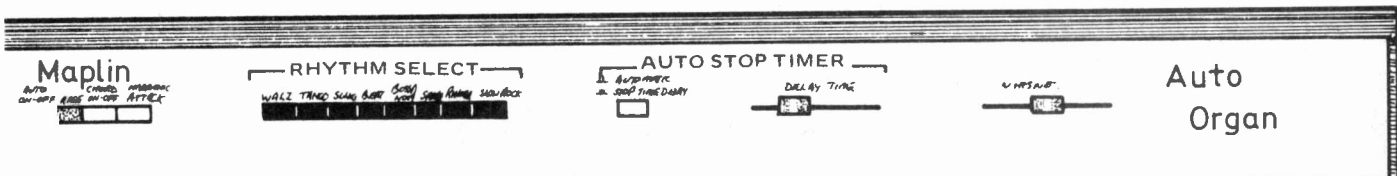
Rhythm volume

Five tones added in short bursts

Three selectable pitches

FRONT PANEL CONTROLS

SW1	Mains on/off	SW18	Auto/semi-auto/ manual
SW2	Auto on/off	S W 1 9	A u t o - s t o p / continuous
SW3 to 10	Rhythm select	SW20	Auto reset
SW11	Chord on/off	SW21	Arpeggio. Off/1/2/3
SW12	Harmonic attack	R13	Tempo
SW13	Major/minor 3rd	R26	Auto-stop time delay
SW14	7th	R131	Auto-accom. volume
SW16	Bass on/off	R140	Rhythm volume
SW17	Bass — walking/ alternating		



RESISTORS

$\frac{1}{2}W$	
R126	47R
R24, 25, 155, 157,	
159, 173, 181, 199,	
216, 221, 234, 231	270R
R104	560R
R80	680R
R72, 88, 101, 115,	
122, 143, 156	2k2
R55, 64, 71, 100	2k7
R154	3k9
R42, 56, 57, 58, 60,	
162, 183, 238	4k7
R87	5k6
R116, 123, 125	6k8
R74, 75, 77, 117,	
118, 124, 127, 131,	
133, 135, 136, 140,	
161, 182, 217, 222,	
232, 235	10k
R15-20	12k
R76, 93	8k2
R28-49, 82, 95, 113,	
158, 172, 208, 250	15k
R1-11, 14, 23, 73,	
90, 168	22k
R106, 163, 170,	
177, 191	27k
R54, 229	33k
R149-153	39k
R166, 167, 198,	
203, 215, 239, 248	47k
R69, 70, 85, 86,	
98, 99, 103	56k
R134, 230, 241	68k
R89, 102	82k
R62, 63, 66, 78, 79,	
92, 120, 128, 132,	
137, 160, 165, 169,	
171, 174, 184, 186,	
187, 200, 201, 204,	
211, 212, 214, 219,	
226, 227, 233, 236,	
237, 240, 243, 245,	
246, 249, 12, 21,	
22, 27, 91,	100k
R50-53, 67, 83,	
96, 189, 195	150k
R185, 188, 242, 244	180k
R129, 138, 209,	
210, 220	220k
R176, 192, 193, 197,	
205, 206, 207, 225	270k
R81, 94, 179	330k
R65, 114, 121, 180,	
223, 224	470k
R105	820k

PARTS LIST

R107, 112, 119,	
175, 178, 218	1M0
R196, 213, 228	2M2
R108	4M7
$\frac{1}{4}W$	
R141	39R
R110	100R
R146, 147	180R
R144	330R
R142, 145	820R
R148	1k5
R194	43k
POTENTIOMETERS	
R111	1k0
R61, 247	47k
R164, 190, 202	100k
R109	470k
R68, 84, 97	1M0
CAPACITORS	
C68, 72, 79, 86, 93,	
94, 95, 101, 103,	
110	10n polyester
C100, 111, 85	22n polyester
C21, 22, 23, 107	33n polyester
C5, 11, 17, 25, 31,	
35, 70, 99, 105, 108	47n polyester
C10, 40, 71	68n polyester
C1, 12, 20, 28, 30,	
47, 69, 76, 104, 109	100n polyester
C75	150n polyester
C9	220n polyester
C13-16	27n polycarbonate
C24	47n polycarbonate
C6, 7, 8	82n polycarbonate
C2, 66, 97, 106	1u0 polycarbonate
C3	1n0 ceramic
C19, 27, 29, 33,	
38, 43	10n ceramic
C4	22p ceramic
C78, 80	220n mylar
C49, 52, 55	100p polystyrene,
C44, 74, 88, 96	330p polystyrene
C73, 89	470p polystyrene
C91, 92	680p polystyrene
C39, 90	1n0 polystyrene
C32	1n5 polystyrene
C45, 87	2n2 polystyrene
C18, 26, 36, 41,	
67, 82, 83, 84	3n3 polystyrene
C102, 77, 81	4n7 polystyrene
C34	6n8 polystyrene
C98	1u5 63 V electrolytic

C48, 50, 51, 53, 54,	
56, 59, 60, 64, 65	10u25 V electrolytic
C37, 42	22u 10 V electrolytic
C58, 63	100u 25 V electrolytic
C61, 62	220u 16 V electrolytic
C57	470u 25 V electrolytic
C46	1000uV 16 V electrolytic

SEMICONDUCTORS

IC1	M254
IC2-5	4011
IC6	M251
IC7	M087
IC8	4069
IC9-11	741
IC12	4016
IC13	4013
Q1-4, 7, 8, 10, 11,	
12, 13, 15, 16	BC548
Q9, 14	BC177
Q5	BFY51
Q6	BFX87
D1-86, 94, 105	1N4148
D87-90	1N4002
D91	12 V 400mW
D92	5V6 400mW
D93	12 V 400mW
LED1	TIL209

SWITCHES

SW1	Mains latchswitch
SW2	2 pole latchswitch
SW3 to 10	8. 2 pole latchswitch interdependent
SW11	2 pole latchswitch
SW12	2 pole latchswitch
SW13	2 pole latchswitch
SW14	2 pole latchswitch
SW16	2 pole latchswitch
SW17	2 pole c/over latch- switch
SW18	4p. 3W rotary
SW19	2 pole latchswitch
SW20	Push (break) sw
SW21	3p. 4W rotary

MISCELLANEOUS

PCBs, 15-0-15 250mA transformer, fuse plus holder, sockets, clip on heat sinks, cable, etc.

Production problems have meant that the circuit diagrams for this project are without the usual component annotations.

HOW IT WORKS

PRE AMPLIFIER

The chord and rhythm outputs are amplified and filtered in ICs 9 and 11 respectively. The outputs from these devices are fed, via level control potentiometers to the input of IC10. This mixes the two signals and provides the final output of the instrument at a level suitable for feeding to a power amplifier.

POWER SUPPLY

The various ICs used in the auto chord require supplies of +12 V, +11 V, -5 V and -11 V. The +12 V line is derived from the rectified AC output of T1 by the series pass element Q5. The voltage at the emitter of Q5 is determined by D91, a zener diode. The +11 V supply is a simple shunt from the 12 V line.

The -5 V line is again a series pass circuit, this time the output voltage being set by D92.

The -11 V rail is simply stabilised by zener diode D93 as the current demanded from this rail is not enough to warrant the use of another series pass transistor.

The LED supply is taken from the negative voltage rail and is current limited by R148.

GENERATOR AND CODER

The rhythm generator section of the instrument is centered on IC1. This is the M254, a device that contains a ROM that will drive the sound generators with a selection of eight rhythms. To select a desired rhythm, the appropriate input must be taken to ground, via SW3-10, will the other inputs are held high by resistors R1-R9.

The M254 requires a clock signal to operate and this is generated by the CMOS oscillator formed by IC2. The frequency of this oscillator, and ultimately, the tempo of the rhythm, is controlled by R13.

The arpeggio, chord and bass accompaniment are generated by IC6, the M251.

The IC is fed with 12 input frequencies from the tone generator, IC7. This is clocked by the output of the CMOS astable based on IC5c and d.

The M251 is used in conjunction with the M254 which is responsible for the selection of the various notes in the arpeggio/chord/bass accompaniment.

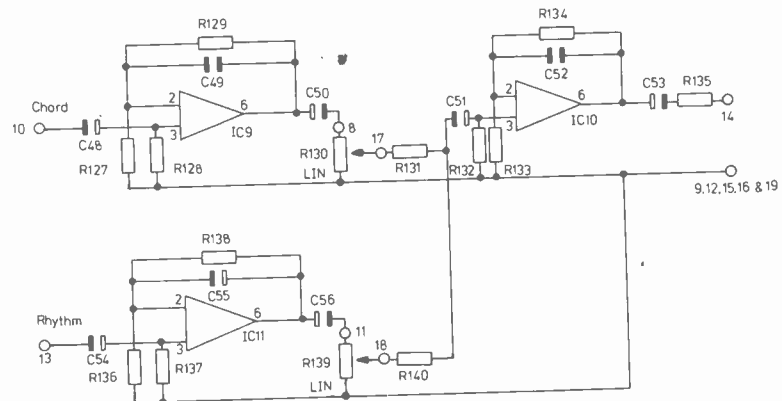
The M251 features a number of different modes of operation, in the automatic mode, when a number of keys in the two available octaves are played, the lowest note will be taken as a reference and memorised.

The memorized key, by means of an internal multiplexer, selects the corresponding tonic and all other notes programmed for arpeggio, chord and bass accompaniment.

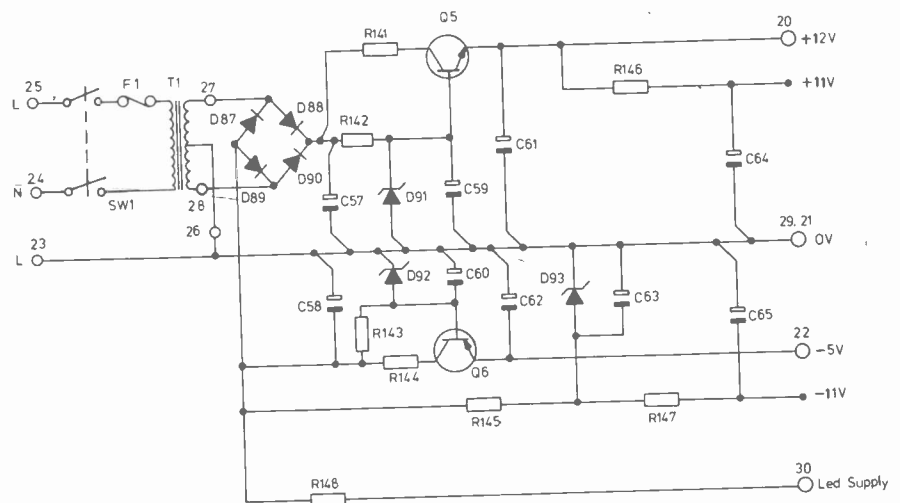
In the semi-automatic mode, the M251 will memorise the lowest four keys played together with the top note played. The circuit will then provide accompaniment until the mode is cancelled by selecting automatic mode briefly and returning to semi-automatic while no keys are played.

The semi-automatic mode can also be selected without memorization of keys.

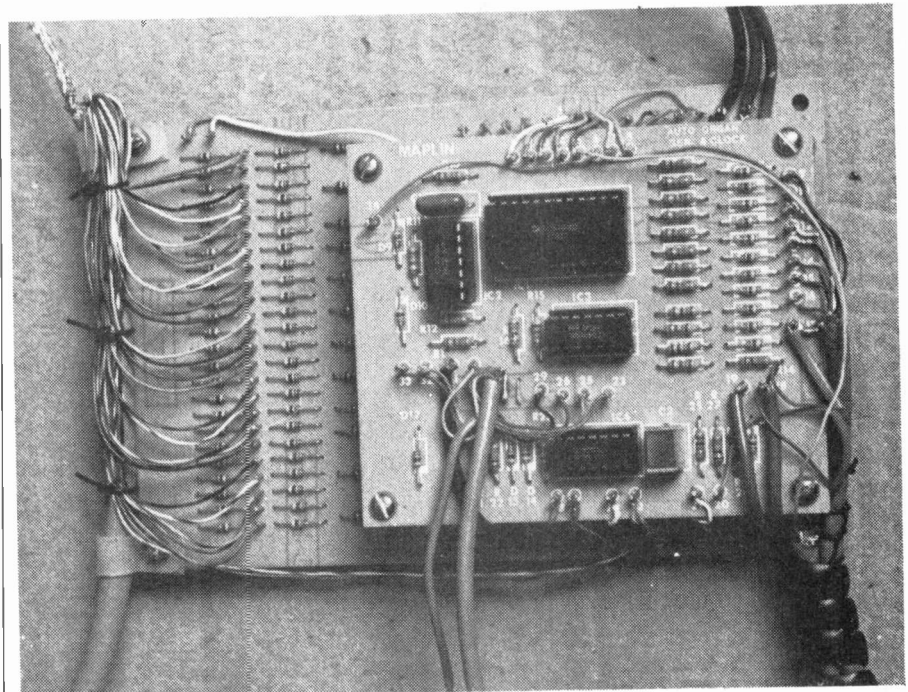
Due to the pin out restrictions of the 40 pin package a system of multiplexing has had to be adopted, this explains some of the complexity in this area of the circuit.

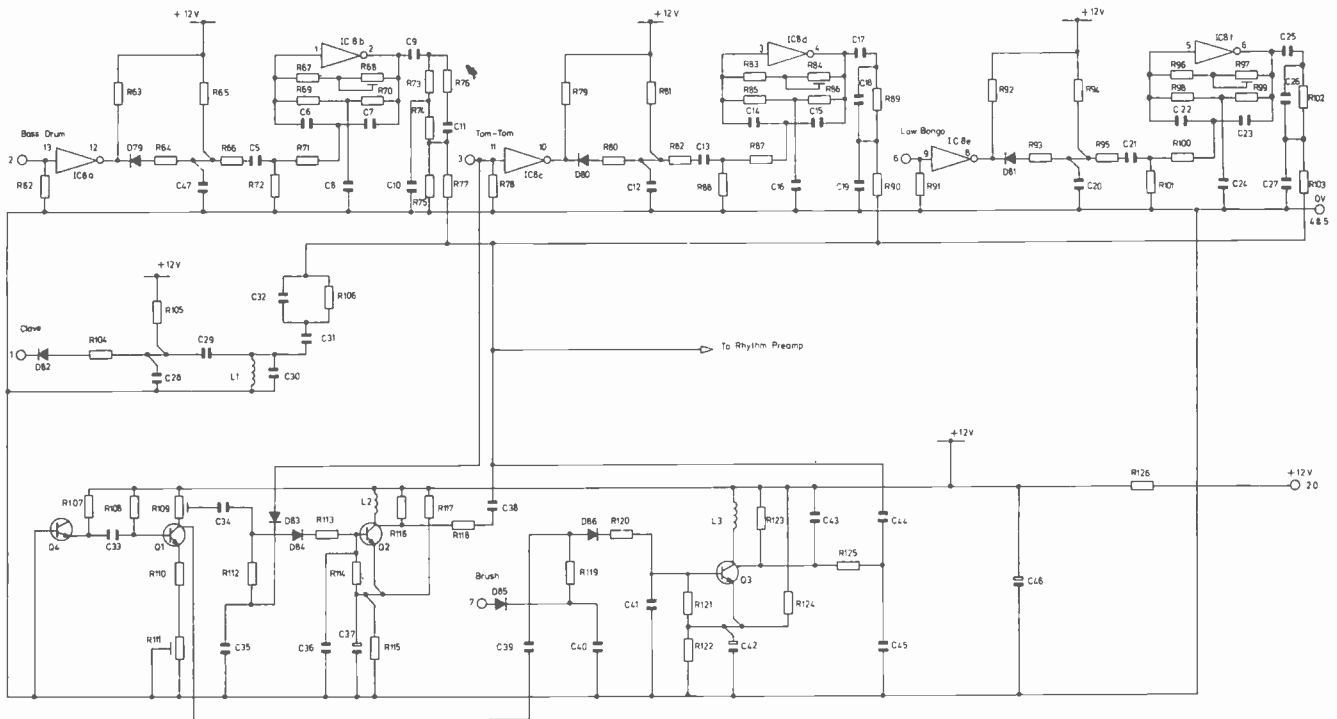


Circuit diagram of the preamplifier



Circuit diagram of the power supply





Circuit diagram of the voice generator

HOW IT WORKS

VOICE GENERATOR

THE bass drum, tom-tom and low bongo sounds are generated by the damped sinusoidal oscillators based upon the six invertors of IC8. Each of the oscillators are the same apart from the values of the timing capacitors which set the characteristic frequency of oscillation.

In each oscillator the variable resistor (R68, R84 and R97) will control the rate at which any oscillations will delay once triggered by the M254 rhythm generator.

The square wave output of the M254 is held low by a resistor, necessary because the M254's outputs are open drain, and fed via a differentiating network to the damped oscillator. A pulse from the output of the M254 will trigger the characteristic instrument sound.

In addition to the output of the damped oscillator based on IC8c and d the tom tom, to give it a more realistic sound, contains a white noise component.

The white noise is produced by the reverse biased zener effect of Q4 and after filtering and buffering, by Q1, with further filtering by Q2, is mixed with the oscillators output to provide a realistic tom-tom sound.

The brush sound consists of filtered white noise, the white noise again being generated by Q4 — the filtering this time being performed by Q3 and associated components.

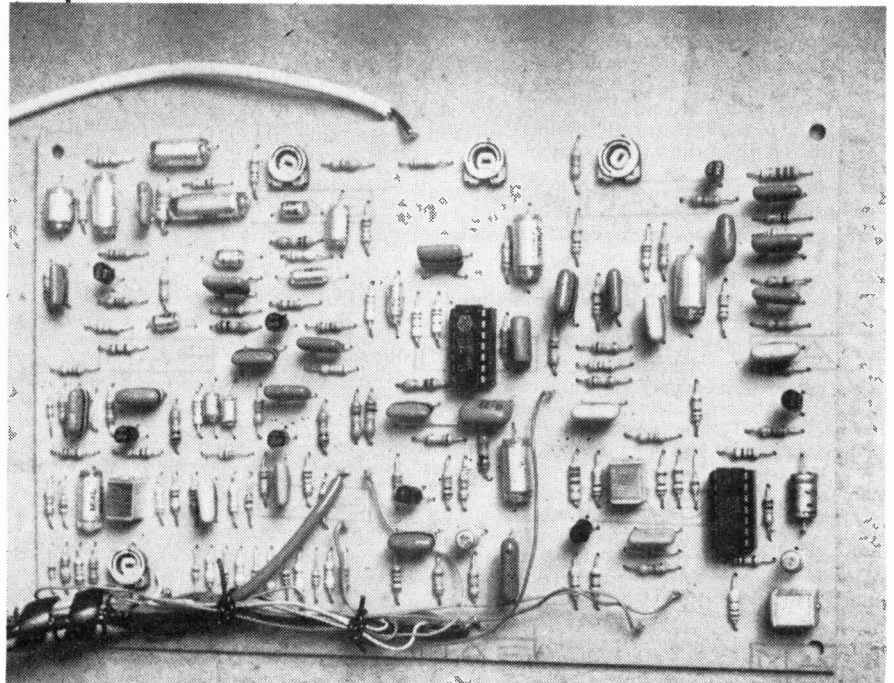
The clave output is generated by the resonant circuit centered around L1 and C30.

The outputs from the various voice generating circuits are summed and fed to the instruments pre-amplifier.

BUYLINES

Maplin Electronics will be supplying a Contact Maplin for details of price. complete kit of parts for the auto Full constructional details for the chord, including screened boards. auto chord will follow next month.

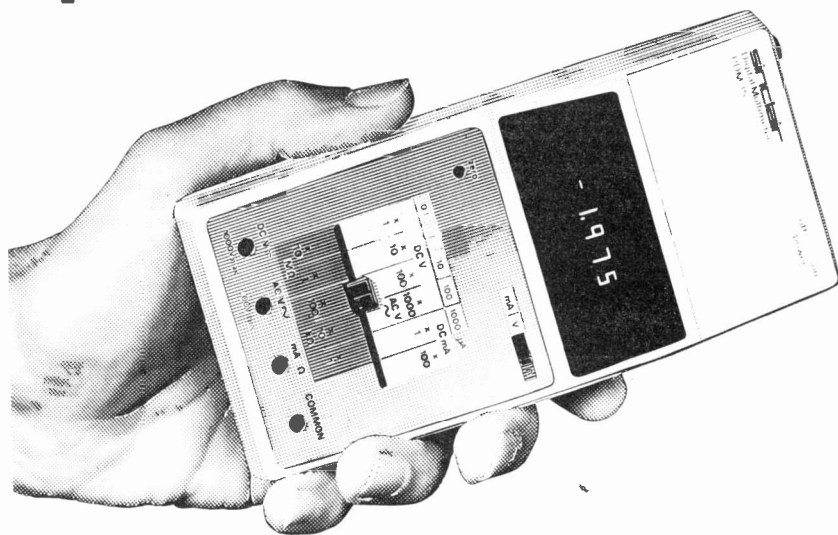
Next month — full constructional details plus the auto stop board.



The Sinclair PDM35.

A personal digital multimeter for only £29.95

(+8% VAT)



Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment.

The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet they're neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

The Sinclair PDM35 gives you all the benefits of an ordinary digital multimeter – quick clear readings, high accuracy and resolution, high input impedance. Yet at £29.95 (+8% VAT), it costs less than you'd expect to pay for an analogue meter!

The Sinclair PDM35 is tailor-made for anyone who needs to make rapid measurements. Development engineers, field service engineers, lab technicians, computer specialists, radio and electronic hobbyists will find it ideal.

With its rugged construction and battery operation, the PDM35 is perfectly suited for hand work in the field, while its angled display and optional AC power facility make it just as useful on the bench.

What you get with a PDM35

3½ digit resolution.

Sharp, bright, easily read LED display, reading to ±1.999.

Automatic polarity selection.

Resolution of 1 mV and 0.1 nA to 0.0001 A.

Direct reading of semiconductor forward voltages at 5 different currents.

Resistance measured up to 20 MΩ.

1% of reading accuracy.

Operation from replaceable battery or AC adaptor.
Industry standard 10 MΩ input impedance.

Compare it with an analogue meter!

The PDM35's 1% of reading compares with 3% of full scale for a comparable analogue meter. That makes it around 5 times more accurate on average.

The PDM35 will resolve 1 mV against around 10 mV for a comparable analogue meter – and resolution on current is over 1000 times greater.

The PDM35's DC input impedance of 10 MΩ is 50 times higher than a 20 kΩ/volt analogue meter on the 10 V range.

The PDM35 gives precise digital readings. So there's no need to interpret ambiguous scales, no parallax errors. There's no need to reverse leads for negative readings. There's no delicate meter movement to damage. And you can resolve current as low as 0.1 nA and measure transistor and diode junctions over 5 decades of current.

Technical specification

DC Volts (4 ranges)

Range: 1 mV to 1000 V.

Accuracy of reading: 1.0% ± 1 count.

Note: 10 MΩ input impedance.

AC Volts (40 Hz-5 kHz)

Range: 1 V to 500 V.

Accuracy of reading: 1.0% ± 2 counts.

DC Current (6 ranges)

Range: 1 nA to 200 mA.

Accuracy of reading: 1.0% ± 1 count.

Note: Max. resolution 0.1 nA.

Resistance (5 ranges)

Range: 1 Ω to 20 MΩ.

Accuracy of reading: 1.5% ± 1 count.

Also provides 5 junction-test ranges.

Dimensions: 6 in x 3 in x 1½ in.

Weight: 6½ oz.

Power supply: 9 V battery or Sinclair AC adaptor.

Sockets: Standard 4 mm for resilient plugs.

Options: AC adaptor for 240 V 50 Hz power. De-luxe padded carrying wallet. 30 kV probe.

The Sinclair credentials

Sinclair have pioneered a whole range of electronic world-firsts – from programmable pocket calculators to miniature TVs. The PDM35 embodies six years' experience in digital multimeter design, in which time Sinclair have become one of the world's largest producers.

Tried, tested, ready to go!

The Sinclair PDM35 comes to you fully built, tested, calibrated and guaranteed. It comes complete with leads and test prods, operating instructions and a carrying wallet. And getting one couldn't be easier. Just fill in the coupon, enclose a cheque/PO for the correct amount (usual 10-day money-back undertaking, of course), and send it to us.

Sinclair Radionics Ltd, London Road, St Ives, Huntingdon, Cambs., PE17 4HJ, England. Regd No: 699483.

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

Please send me _____ qty PDM 35's

at £32.35 (incl. VAT) each.....£.....

_____ (qty) De-Luxe carrying cases

at £3.24 (incl. VAT) each.....£.....

_____ (qty) AC adaptor(s) for 240V

power at £3.24 (incl. VAT) each.....£.....

Post and packing (please add£0.65

I enclose cheque/PO made payable

to Sinclair Radionics Ltd for

(indicate total amount£.....

I understand that if I am not completely satisfied with my PDM 35, I may return it within ten days for full cash refund.



sinclair
World leaders in fingertip electronics

SEIKO 20% OFF!

Analogue and digital from stock or to order.

NEW

**FB 011 ALARM/
CHRONOGRAPH
FH 003 CALCULATOR
WATCH**



RRP £135

£104



RRP £165

£127.50

FB 018 Gold plated (£150) £120

CITIZEN LARGE REDUCTIONS

On most quartz analogue and digital models.

FAIRCHILD TIMEBAND

C6110 Mains digital alarm clock



STILL THE BEST!
Large LED display 24-hour
alarm 9 minute snooze,
concealed controls
3 1/4 x 5 1/4 x 3 1/4 ins.

Black or white

£10.95

FROM CASIO — OF COURSE

NEW

**BEDSIDE
TRAVEL
ALARM
CLOCK**

Okay, genius, so you KNEW Casio would bring one out soon!
You were right to wait.

Provisional spec. LARGE 6 digit LCD display. Night light.
Alarm, Alarm/Timer, Stopwatch.

£19.95

AQ-1000 CALCULATING ALARM CLOCK PLUS 3-WAY STOPWATCH

Hours, minutes, seconds, am/pm, 24
hour Alarm with sign. Stopwatch: Net
times, lap times, 1st & 2nd place times
from 1/10 sec. to 10 hrs. with ST & LAP
signs. Calculator: 4 key memory, %, √ 1
year batteries, ± 20 secs/month.
1/4 x 2 1/2 x 4 1/2 in.
RRP £26.95

Our Price **£21.95**



**CQ-81 CALCULATING ALARM CLOCK. Plus 2 Alarm/
Timers.** 24 hour alarm and alarm/timers, 6 digit LCD clock.
One year battery life. 1 1/2 x 2 1/4 x 5 inches.
(RRP £22.95)

£17.95

FX-8000. 41 sc. funct. 1/100 sec stopwatch 2 x 5
Alarm/Timers (£35.95)

£29.95

MINI CARD CALCULATORS 1/2 x 3 1/2 x 2 1/4 ins. **LC-78.**

Full memory, %, √ K **£16.95**

FX-48 Math. Card. Full SC, with S.D. **£19.95**

ST-24 Card Time. 24 hour stopwatch (or clock), 2

Alarm/Timers, Calc. as LC-78 **£19.95**

ALL Casio scientifics. Lowest prices

ST-1. Four way stopwatch **£24.95**

CARTRIDGE T/V GAMES

OPTIM Coronet 600 **£48.50**

Cartridges from £9.95

FAIRCHILD TIMEBAND Grandstand **£119.95**

Cartridges from £12.50

ATARI Video Computer System **£169.95**

The very best available to date!

Cartridges from £14.95

★ SPECIAL INTRODUCTORY OFFER

FREE extra cartridge worth £14.95 with Atari.

SAVE £££s WITH THE MONITEL

Telephone call charge, calculator and clock. UK model

£28.15, International £38.50. State colour.

WATCH BATTERIES 65p each D.I.Y. KIT 35p (with

battery order).

★ THIS MONTH'S STAR BUY ★



**CASIO 45CS-22B
CHRONOGRAPH**

Hrs, mins, secs.
or Hrs, mins,
date, Day,
date, mth, yr.
Dual time.
12 or 24 hr.

£49.95

Chrono
Net, lap
and 1st & 2nd place
times. 1/100 second
to 6 hrs. with rollover.
Stainless steel, Mineral glass
Water resistant to 100 feet.

TEXAS LCD ANALOGUE

TODAY'S MOST ADVANCED ELECTRONIC WATCH

Hours, minutes, seconds,
Perpetual calendar
Chronograph timing
from 1/10 second to
12 hours
Dual Time
Mineral glass face



£179.95

Stainless steel case, bracelet

10 micron gold plated

£199.95

SOLAR powered watches — so called.
Misrepresentation? We WON'T sell them.

LED display watches — we don't sell them. Send us a
S.A.E. and we will tell you why not.

PH-ALARM and ALARM CHRONO

ALARM (Left)

Hours, mins,
secs or date,
day, am/pm.
Day, date,
month, year

£28.95

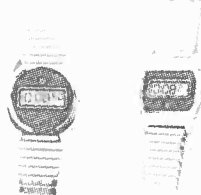
CHRONO

Functions
as above
plus

Chrono. Measuring net, lap and 1st & 2nd place times from
1/100 second to 1 hour, with rollover.

All stainless steel, mineral glass **£39.95**

GBM, 6 DIGIT and ALARM WATCHES



16 x 3 (Left)
6 digits, 6 functions

£13.95

ALARM

18 x 3 (Right)

6 digits

6 functions +

alarm setting

5 minute snooze

£27.50

ANALOGUE

IBICO 700. Cushion shape. Day. Mineral glass face. Water
resistant to 100ft. **£28.95**

LADIES' LCD WATCHES

5 functions, Backlight. Gold or silver finish **Dress Watch.**

PH.L2

Matching

Milanese

bracelet

£14.95

Cocktail

Internal

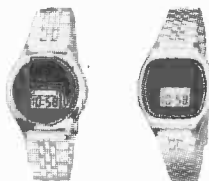
bracelet

(4 other

models)

£18.95

CASIO LADIES' LCD WATCHES



7 + 2 functions

27CL-15B

Round (Left)

(£35.95)

£29.95

27CL-17B

Stopwatch

(£49.95)

£39.95

Send 25p for our illustrated catalogue. Price include VAT and
P&P. Send your cheque, PO or phone your credit card no.
to —

CASIO QUALITY

All CASIO watches have a calendar display, night illumina-
tion, mineral glass and stainless steel cases, water resistant to
100 ft (except sports watches — 66

SPORTS WATCHES

F-100

Left, 9.45 mm

(£29.95)

£24.95

52QS-14B

Right 8 mm

(£44.95)

£34.95



Up to 25 functions. Net, lap and first and second place
times to 1/100th sec. F-100. Resin case, strap 52QS-14B
S/S encased version and bracelet.

4 DIGIT WATCHES (except World Time). Hours, minutes,
ten seconds, seconds by flash, am/pm. Day, date, month,
Stopwatch. Dual time (except 31QR-20B)



31QR-20B Left, 4 digit
(£31.95)

£26.95

51QR-19B. 6 digit
(£35.95)

£29.95

6 DIGIT WATCHES (except Sports and Alarm). Hours,
minutes, seconds, day OR Hours, minutes, date, day, ten
seconds, seconds by flash. Day, date, month, year. Select-
able 12 hour (with am/pm) or 24 hour clock.

54QS-16B

Left, 6 digit

(£44.95)

£34.95

54QS-15B

6 digit

(£49.95)

£39.95



CHRONOGRAPH. 6 digits as above, with stopwatch
measuring net, lap and 1st & 2nd place times from 1/100
sec to 6 hrs. Dual time facility.



45CS-22B

Chronograph

Left, 6 digit (£64.95)

£49.95

29CS-11B

World Time (£74.95)

£59.95

WORLD TIME WATCH. The time in ten capitals plus one
optional time. Instant summertime correction. Hrs, mins, 10
secs, secs by flash. Perpetual calendar, day, date, month.
Running digital seconds display.

ALARM WATCHES

25CR-16B

Round (£64.95)

£49.95

25CS-16B

Square (£74.95)

£59.95



Hours, mins, seconds (or hrs, mins, date) day, am/pm Day,
date, month, year. 24 hr. alarm, on/off indicator.

ULTRA SLIM DRESS WATCHES (Not 24 hour)

53CS-18B

Left, 4 digit (£69.95)

£54.95

49CS-25B

6 digit (£79.95)

£64.95



Not illustrated 53CS-19B, 4 digit, barrel shaped, **£54.95.**
49CS-24B, 6 digit (£74.95) **£59.95.** 53CS-17L: Gold
plated, on strap (£84.95) **£69.95.**

TEMPUS

Dept. ETI, Talk Of The Town
19/21 Fitzroy Street
Cambridge. Tel. 0223 312866

electronics today

international

What to look for in the December issue: On sale Nov 3rd

ETI LIGHT SHOW

HANDS UP all those who've never been to a disco. None? Good — that means you've all seen sound-to-light units in action, although it's more than likely it was a normal three-channel affair. Usually boring, are they not?

Well ETI plans to change that next month; ours has five frequency channels, with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straight sound to light, or have it strobe all lights. At a

speed dependent upon music level (not volume — the unit is independent of that!) or hand over control to an internal digital circuit which produces some superb random effects. If you fancy a five colour manually controlled strobe unit it can do that as well!

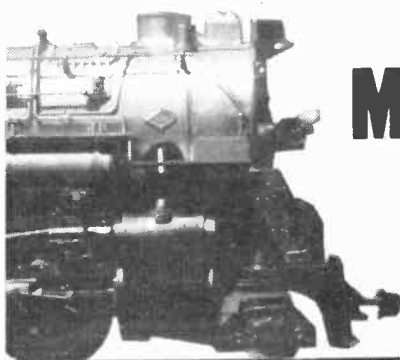
Each channel handles up to 500 W of lighting, and a complete kit of parts will be available from Powertran, who designed this project especially for ETI.

computing today No.2

Win a TRITON Computer



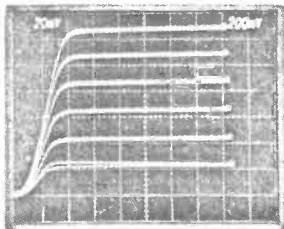
Want to get your hands on a Triton Computer Kit but can't afford it (yet)? In No. 2 of our new supplement Computing Today, we have a free-entry competition for one to be won. If you've read this far you'll probably know what it's worth — but in case you don't it's about £300.



Electronics in Model Railways

An essential part of the education of any young man is his electric train (checking with ETI technical staff shows all eight had one — and five still have). Most of us however remember the controls as crude; today things are changing — sophisticated electronic controls are perfectly suited to model railways and the manufacturers are about to announce some dramatic advances. We take a look at what's happening.

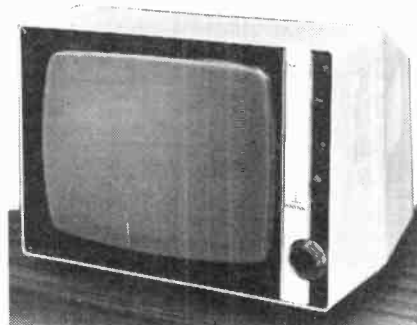
CURVE TRACER



Explaining the shape of Voltage-Current characteristics of diodes, transistors and other non-linear devices is usually dull as it normally involves a tedious plot of static, experimental data.

A more elegant solution is available to anyone with a DC coupled scope capable of taking an external X-input. Next month we carry a project with the additional circuitry necessary to do this yourself.

How It Works



In the November issue we begin a new type of article. The idea came to us when discussions with experts in one area of electronics admitted to almost total ignorance of other areas — especially commercial circuitry. Mass-produced electronics use techniques which are not widely understood elsewhere — we hope to put that right. In the first of this occasional series we have asked Gordon King to dissect a Thorn Monochrome TV; we shall show the complete circuit and explain the function of each stage. It's not done as a beginners series but to give those outside this field the true "Inside Story."

Car Anti-theft System

A simple project to build but sophisticated in its operation. It is a comprehensive system that incorporates several features of large and expensive commercial systems and using state-of-art techniques it is extremely reliable. A kit will be available of the whole project.

INDEX

A complete listing of all we've carried in ETI since our last Index (which was carried in April 1977) and went back to the first ever ETI). As our research shows that 96% of readers never throw away their copies it should be useful to most of you.

Microprocessors by Experiment

Learn about microprocessors — not from some abstract description of a make believe MPU but by hands on experience with an MPU system. The series, based on the MK14 development kit, will take you through the operation of the SC/MP MPU and show you how to use it to do everything from control your heating system to land on the moon.

I/O for 6800

The microprocessor user rapidly arrives at the need to understand and apply input/output circuitry to interface peripheral equipment to the computer system. A standard choice, when using a 6800 microprocessor, is to employ a Peripheral Interface Adapter (PIA). Many engineers now buy ready-built systems then wish to utilise the PIA as straightforward outputs and inputs. When data sheets are consulted they are found to give concise yet complete hardware and software information. The user of a ready-built system needs help in simply getting the PIA to act as outputs and inputs without becoming involved in the intricate details needed by designers of microcomputer boards. This article aims to give this help.

Features mentioned here are in an advanced state of preparation as we go to press but circumstances may affect the final contents of the next issue.

CALCULATORS

SCIENTIFIC

SPECIAL OFFER
TEXAS T159 together with PC100B
(Complete as manufacturer's specifications)
£285.00

- TEXAS/HP Accessories available
*TEXAS T159 (New Card prog 960 prog steps of 100 mem) **£156.50**
- *TEXAS T158 (New Key prog 480 steps or 60 mem) **£60.00**
*TEXAS PC100B (New updated Printing Unit for T158/T159) **£140.00**
- *TEXAS T157 (Key Prog 8 Mem 150 Key Strokes / 50 Prog Steps) **£26.20**
*TEXAS T133 (New — same spec. as T130 but 3 Mem) **£13.95**
*TEXAS T145 (New updated version of the Texas T140) **£19.95**
*TEXAS 42MBA (10 Dig Fin / Stat Prog 12 Mem 32 key strokes) **£42.95**
- *TEXAS T1 PROGRAMMER (Hexadecimal Oct) **£46.50**
*TEXAS T151/iii (New 8 Dig + Exp 10 Mem 32 Prog Steps Stat/Sci) **£26.30**
*TEXAS T125 (new LCD Sci / Stat) **£18.90**

"SLIM-LINE" Chronograph BARGAIN OFFER

You will not believe the luxury of this "slim-line" 12 function Chronograph until you have worn it... until you have enjoyed the compliments it generates.

The "Slim-line" Chronograph gives continuous easy to read LCD display of hours, minutes, seconds, AM/PM. At the touch of a button you have date — month date — day of week — reverting to normal display time at the release of the button.
Press again for immediate stop watch/stop time facility to 1/100 second. The "Slim-line" even has a powerful back light for easy night use. The casing is chrome finished with matching linked bracelet.



We are so certain you will be delighted and satisfied with this "Slim-line" Chronograph that in addition to the One Year Warranty we are offering a 14-day money back guarantee if you are not totally satisfied.

ONLY £27.50 + £1.00 p/p ins. Send cheque/P.O. or order via Barclay/Access credit card today under our Special 14-Day Trial offer.

- *TEXAS T158 with Applied Statistics **£80.00**
*TEXAS T159 with PC100B and Applied Statistics **£305.00**

AUTUMN SALE

TEXAS T159 Calculator (complete as manufacturer's spec. master module, charger, etc.) PLUS statistics modular and extra set of 40 Blank Prog Cards with wallet, etc
ONLY £180

- *CBM S61 (Stat + Sci 6 Mem M & S Div Chi Sq Dis Lin Regr Etc) **£46.00**
*CBM M55 (Adv Math / Sci 6 mem) **£46.00**
*CBM 4190R (Scient Pre-Prog) **£25.50**
*CBM Pro 100 (72 Step Prog) **£29.50**
*HP 19C (Cont Mem Key prog Printer) **£163.00**
*HP 29C (as 19C but no Printer) **£110.00**
*HP35E (8 mem Pro Sci / Stat) **£64.00**
*HP25C (Key Prog Con Mem) **£99.00**
*HP27 (10 Mem Sci / Fin / Stat) **£73.50**
*HP31E (New Sci replaces HP21) **£35.00**
*HP67 (Card Prog 224 Steps 26 Mem) **£277.00**
*HP97 (Fully prog with Printer) **£466.50**
- All HP range avail. inc. new 'E' range
*CASIO FX201P (Sci, 11 mem, 127 step Key prog) Fortran System **£44.50**
*CASIO PRO FX1 (127 Step Card Prog 11 Mem — Fortran System) **£99.00**
- CASIO FX360 (New 10 Dig + Exp 7 Mem 8) (St. Div Lin Regr. Etc.) **£45.00**
CASIO FX5000 EP (Alphanumeric Sci/Stat Desk Printer 10 Dig + Exp 7 Mem etc.) **£185.00**
CASIO AQ 1000 (LCD Cal 3-way Stop Watch / Alarm) **£20.00**
CASIO CQ1 (4 stage alarm / Cal) **£24.50**
CASIO FX3100 (New version of FX3000-LCD Sci/Stat/div. Poles Rec. etc.) **£22.50**
CASIO FX8000 (as above + Stop Watch / Alarm) **£27.75**

LOW PRICED COMPUTING THE COMMODORE PET COMPUTER

with 8K bytes RAM 2001-8
A complete personal computer that operates anywhere by simply plugging into Mains supply. Allows communications directly from BASIC to IEEE — 488 standard devices —

Cassette, Video Display Unit and Keyboard built into PET.
Fully guaranteed Warranty by CBM complete only **£643**

FREE — Mains/Charger included

**GOODS FULLY GUARANTEED
PRICES EXCLUDE VAT (ADD 8%)
BUT INC. P&P CHEQUE WITH ORDER**

Company/hospital and Government orders accepted by phone
Barclaycard/Access accepted by phone

Tel. 01-455 9855

EXPORT ORDERS WELCOMED
Air Freight / Air Post Delivery
Quotations on request. Payments via Letter of Credit / Int Money Order / American Express, etc.

MOUNTAINDENE LTD.

22 Cowper St., London, EC2

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 ½in 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. ET1/9
46 LOWFIELD ROAD
STOCKPORT, CHES.061-480 2179**

SUPER SAVERS ALL FULL SPEC.

7490N—10p, £8—100, 7460N—10p, £8—100, 74190N—15p, £12—100, 74155—35p, 741 (80IL) 17p. Min. order 10 of one type 100 + POA. P/P 20p.

SLIDER POTS PIHER 47K LOG. TRACK 70mm. OVERALL 85mm. SINGLES 20p, £15—100. DOUBLES 50p, £40—100. MIN. ORDER 10, 100 + POA. P/P 20p.

SUPERB STEREO CASSETTE DECKS, BRAND NEW, PIANO KEYS, 6V MOTOR, END OF TAPE STOP, DIGITAL COUNTER, HEADS, PULLEYS, ETC. AS USED IN NATIONAL PANASONIC MUSIC CENTRES VERY HIGH QUALITY. **£8.75p + £2 P/P**

VERO EDGE CONNECTORS 22X 22. TYPE 2245/2-7431 40p, 42X42 ww KEY AT 7 TYPE 1360/2 £1. P/P 20p.

TRIM POTS 50Ω TO 5 20p, 100Ω CERMET 20p, 100Ω PAINTON PCB 20p, 200Ω DITTO 20p, 250Ω DITTO 20p, 500Ω DITTO 20p, 1K DITTO 20p, 2K DITTO 20p, 2K HELITRIM 20p, 5K PCB 20p, 1MEG SKELTERON MIN VERT 12p. P/P 20p.

CANNON "D" TYPE PLUGS / SKTS. 15p-50p. SKT.—50p, 25p-60p, SKT 60p, 25 RIBBON PLUGS 90p, SKTS 90p, 37 PLUG 80p, 50 SKT £1.20, 50—W/WRAP COVERS SKTS £1.30.

COVERS WITH RETAINERS, 15 WAY 60p, 25 WAY 80p, 37 WAY £1, 25 WAY PLASTIC (3M). 50p. ALL ABOVE LIMITED. P/P 20p.

All enquiries s.a.e. please. Cat. s.a.e. 8 x 6 free with goods.

Now distributor for Mutek Products including Ides Micro Systems. In stock, Video Interface board, 16 line, 64 characters, data and control inputs, video output. Ideal for Micro Processor use. With full documentation. **£81**. P/P plus insurance, £1. Brochure available, s.a.e.

POCKET PAGER

Miniature crystal controlled FM RX Single Superhet around 30MHz 450 KHZ IF contains various tone detectors. Ideal for modifications to 27 MHz Radio Control OR 28MHz Amateur Band. Complete, without 2.5v DEAC + circuit of similar type. **£3.95**. P/P 25p.

L. B. ELECTRONICS
43 WESTCOTT, HAYES
MIDDLESEX UB4 8AH

SEMICONDUCTOR OFFERS ALL FULL SPEC.

Common anode 0.3 7 seg displays Toshiba type TLR303 65p. F E Ts similar to 2N3819 18p. Mosfet Sim to 40673 35p. 3N140 Moslets 50p. M203 Dual Matched Pairs Moslets Single Gate per F E T 40p. Intel 1024 bit MOS Rams 95p. Mullard B8113 Triple Varicap Diode 35p. MC13110 Stereo Decoder 1 C.s £1.20. CD4051 CMOS 50p. 741 8-pin D.L. 23p. 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 30p. 7812 12v 1A Plastic V Regs 95p. Min. Nixies ITT 5870S 13 x 6mm Fig Size 85. Nixies ITT GN/9A 13 x 6mm 65p. 0.2 or 0.125 Red LEDs 12p each. M3A3A 3mm LED Displays 50p. 741S (wide bandwidth) 35p. LM380 80p. LM381 90p. 2N414 75p. TIL305 Alpha-numerical Displays, with data, £2.75 ORP61, Mullard, new, boxed 30p. Special Offer SGS TB800 ICs, 10 for £5.00

MICROPHONES. EM506 Condenser Mikes, Uni-directional, F E T Amp. Dual Imped. 50K/600ohms, 30-18KHz, on/off switch. £11.00. Miniature Tie Pin Condenser mke 1K imp. omni-directional, uses hearing aid battery (supplied) £4.95. Grundig Electret Inserts with built-in F E T Preamp £1.50. Crystal Mke Inserts 37mm 45p. Electret Condenser Mikes 1K 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.

MORSE KEYS — Hi-speed Type, all metal, £2.25. Plastic Morse Keys. 95p. Belling Lee L4035 Masthead Amplifiers and 240v AC power unit Group "A" UHF. Only £7.50

CRYSTALS. 300KHz HC64 40p. 0.1 Edge Connectors, 64 way 65p. 32 way 40p.

RELAYS. 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. Min. 24v DC Sealed 2-pole C/O Relay 3 amp contacts. New 55p. 12v DC 4pc o, open type, new 50p each.

MOTORS. 1.5 to 6v DC Model 20p. 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. Crouzet 115v AC 4 R P M Motors, new 95p. 12v DC 5-pole 35p.

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. 225 x 130 x 84mm £1.95

TOOLS. Radio pliers 5in, insulated handles £1.40. Diagonal side cutters, 5in, insulated handles £1.40

MAINSTransFORMERS, all 240v AC primary. Postage shown in brackets per transformer.
6.0-6 100mA, 9.0-9 75mA, 12.0-12 50mA, 75p each (15p)
0.4-6 9 150mA, no mounting bracket, 65p (20p) 12.0-12 100mA, 95p (15p) 12v 500mA, 95p (22p) 12v 2 Amp, £2.25 (45p) 12v 4 Amp, £2.75 (54p) 15.0-15v 1 Amp, £2.10 (45p) 30.0-30v 1 Amp, £2.75 (54p) 0-12-15-20-24-30v tapped at 2 Amp, £4.50 (54p) 20.0-20v 2 Amp, £3.50 (54p) 25v 1.5 Amp, £1.45 (45p) 18v 1.5 Amp rectified, £2.00 (45p) 35v, 2 Amp, 2.5v 2 Amp toroid, £2.95 (54p) 20v 2.5 Amp, £2.20 (54p) 1.1 Xenon/triac pulse transformer, 30p.

SWITCHES — Min. Toggle, SPST 8 x 5 x 7mm 45p. DPDT 8 x 7 x 7mm 60p. DPDT Centre Off 12 x 11 x 9mm 75p. DPDT C/O Siders 20p. R S Single Pole C/O Push Buttons 45p. Roller Micro Switches 15p. Min. Micro Switches 13 x 10 x 4mm 20p. Min. Push to make or push to break Switches 16 x 6mm 15p.

SOLOER SUCKER. Plunger type, eye protection, replaceable nozzle, high suction, £4.95. Reed switches 28mm norm. open, 6p each.

TAPE HEADS — Cassette Stereo £3.00. BSR MN 1330 ¼ Track Dual Impedance Rec / Playback 50p. BSR SRP90 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. All Metal Buzzers, 30mm diam, 6-12 volts high tone, 25p.

U.H.F. TV Transistorised Push Button Tuners (not Varicap) new and boxed, £2.50.

MURATA MA401L. 40kHz Transducers, rec./send £3.25 pair

METERS—Grundig Batt. Level Meter. 1mA 40 x 40mm £1.10. Min. Level Meter 200µa 25 x 15mm 75p. Ferranti 600v AC Meter £3.95.

EOGE METER — Large scale 0-100, new £2.75

POT CORE UNIT. Has 6-pot cores, including 1 FX2243 (45mm) and 2 FX2242 (35mm), 3 20mm Panel Fuseholders 3 203 5IL Power Transistors on heat sink, panel with various transistors and diodes with a 5-amp plastic S.C.R. New £1.75 + 75p P&P

LA1230 adj. core 15mm dia 14mH-18mH, HI Q, 10p each

8 TRACK 12 volt motors new, £1.25

CASSETTE MOTORS 6 volt new, £1.25

SOLENOIDS — 240v AC 45p. 12v DC H Duty 75p. 240v 25lb pull, 2 travel £3.95

12-WAY MOTORIZED CAM UNITS. 50v AC low rev motor driving 12 C/O motor switches, supplied with a capacitor for 240v AC use. Ex equip £1.95 + 35p P&P

13 Amp rubber trailer extension sockets, 38p

8 WAY RUBBER-CABLE, min solid core, 15p metre

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

GAIN CONTROL

PART 2

To conclude his survey of electronic gain control methods, Tim Orr presents us with more circuits which vary from a light bulb compressor to a markspace modulated universal filter unit, and a noise gate/expander.

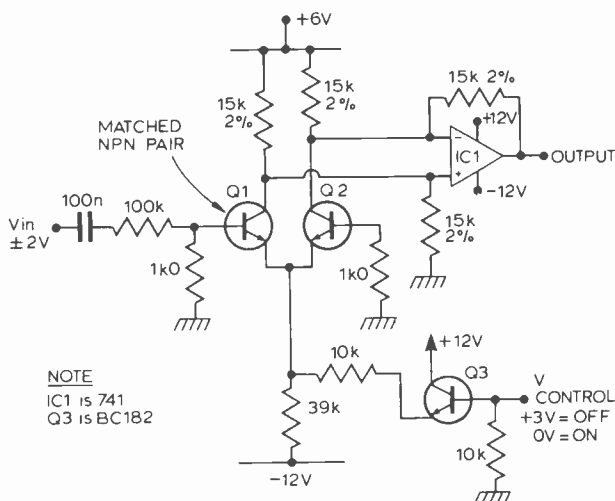
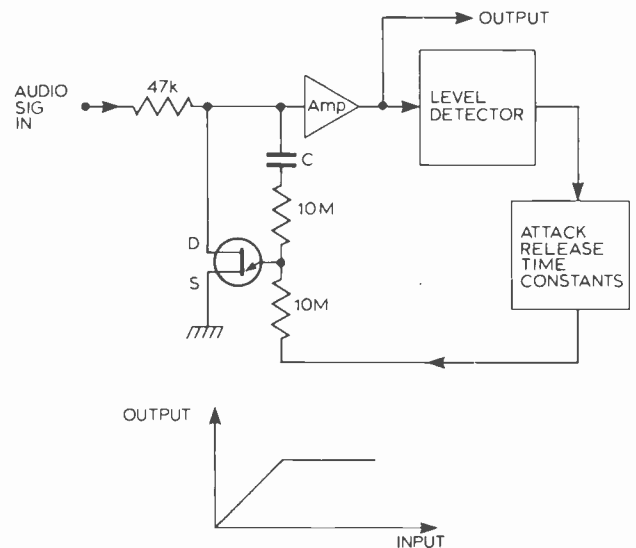
Basic Limiter Circuit

Most professional limiter circuits use a FET as the variable gain element. Relatively low distortion with a reasonable signal to noise ratio can be obtained. A basic limiter circuit is shown this being no different to previous circuits except for the variable gain element.

When a relatively small voltage (20 mV) is applied to the drain source of a FET, it acts like a fairly linear resistor. As the gate source voltage is varied, this resistor (RDS) also varies.

In fact the channel resistance RDS is inversely proportional to gate source voltage V_{GS} . When V_{gs} is 0V, then RDS is at its generally minimum resistance (R_{ON}) which can be as low as 5R, but it is generally more like 100R. When V_{GS} exceeds the pinch off voltage (V_p or $V_{GS\ off}$) the channel resistance goes up to several hundred Megohms. So a junction FET can be used as a voltage controlled resistor, except that R_{ON} and $V_{GS\ (OFF)}$ tend to vary widely from device to device. However with a bit of perseverance suitable devices can be selected and made to work.

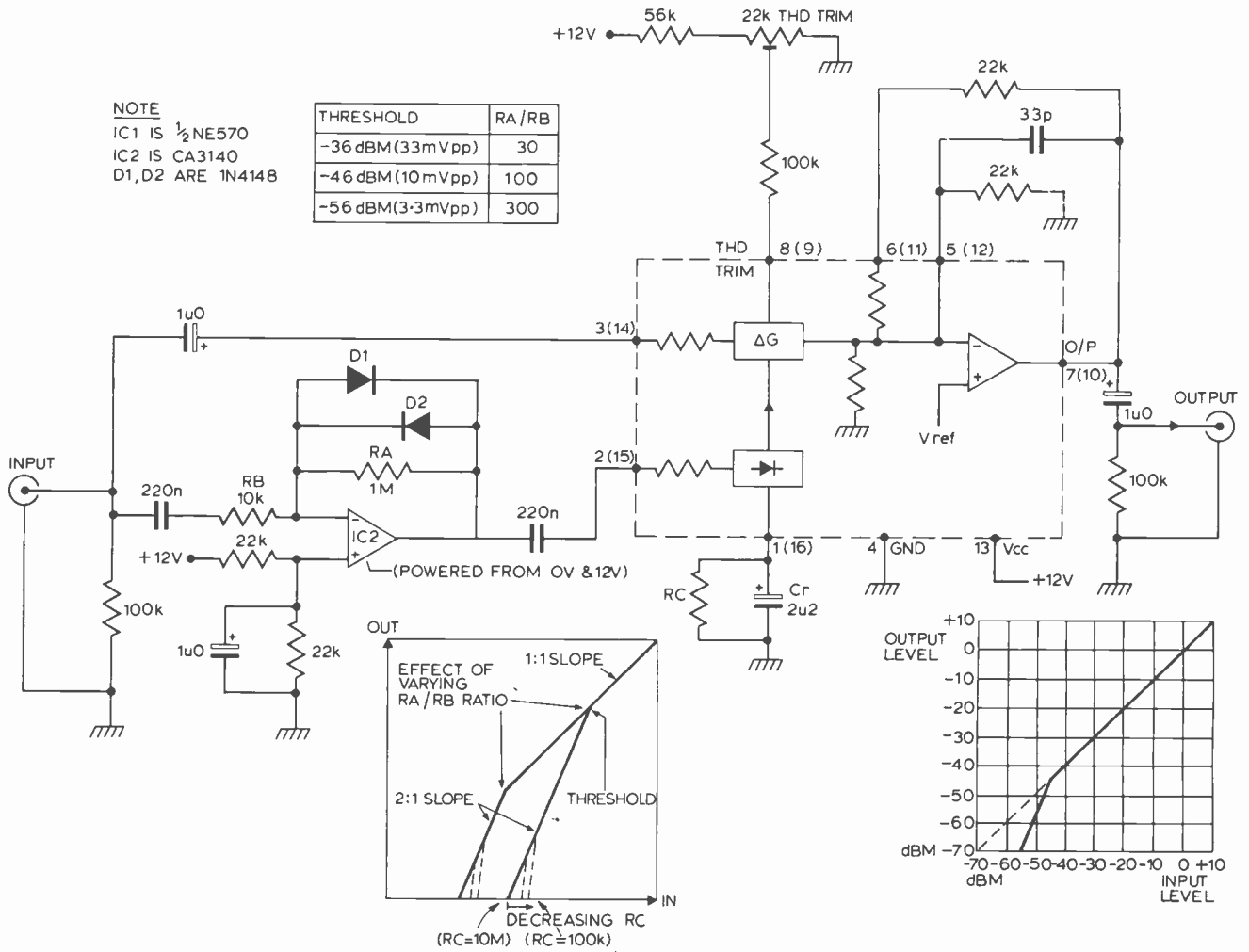
One circuit trick that greatly reduces distortion is shown here. Half of the audio signal at the drain of the FET is presented to the gate. This is superimposed on top of the control voltage and produces a distortion cancelling effect. Distortion levels below 0.1% can be achieved using this technique.



Transistor VCA

A circuit similar in operation to a CA3080 can be constructed with a matched pair of transistors and an op amp. Transistors Q1, 2 form a differential transistor pair which is used to steer whatever current is available between the two collectors, just as in the CA3080. The difference between the collector currents is equal to the product of the input voltage times the current I_{EE} times a constant. This difference is extracted by the differential amplifier IC1. The current I_{EE} is controlled by Q3. As the control voltage goes positive, Q3 robs most of the current flowing down the 39k resistor, and hence I_{EE} and the output of IC1 decrease.

Two Channel Low Level Expander/Noise Gate



It is often required that a rather noisy signal be cleaned up a bit. This is not possible to do continuously, but it is possible to clean up noise in what was initially the gaps. The results of this cleaning up process can quite often be heard when telephone conversations from "foreign correspondents" are broadcast.

By turning down the signal level in the gaps, (by performing a low level expansion) the perceived sound quality improves dramatically.

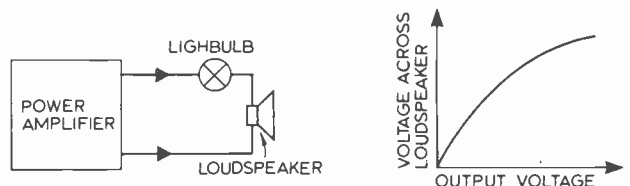
The circuit performs just such an expansion. The input signal passes through the variable gain cell and then appears at the op amp output. The gain of the gain cell is controlled by the signal coming from IC1. This is a high gain amplifier with diode clamping, so that the output swing is limited to about 1V0 ptp. Therefore for input signals of 10 mV pp to 10 V pp, the output of IC1 remains at about 1V0 ptp to 1V2 ptp.

So, for this range of input voltages the gain of the gain cell remains roughly static. Now when the input level drops below 10 mV, the output of IC1 will start to fall and so will the gain of the gain cell. This produces a 2:1 downwards expansion curve, which means that the output then gets quieter at a rate faster than the input. To accentuate this effect, a bleed resistor can be placed in parallel with C.

The resistor robs some of the current that would have otherwise gone to the gain cell and causes the input output curve to roll off much more rapidly at low signal levels. Also, by varying the resistor ratio of RZ/RB , the expansion threshold level can be altered.

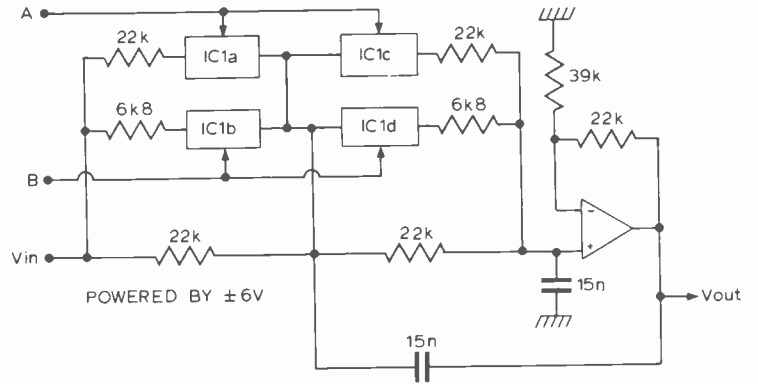
Incredibly Simple Compressor

Not all gain control systems need be complicated or indeed active. One product which I saw advertised was a compressor to help prevent loudspeaker overloads. All it was was a lightbulb in series with the loudspeaker. When the power exceeds a certain level, the lamp will turn on, glow, its resistance increases dramatically and hence a bigger percentage of the power output is dissipated in the lamp. A nice, simple solution, but I think it would require some experimentation to find the right sort of car headlamp bulb!

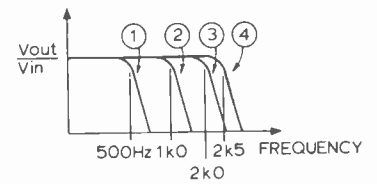


Switched Frequency Low Pass Filter

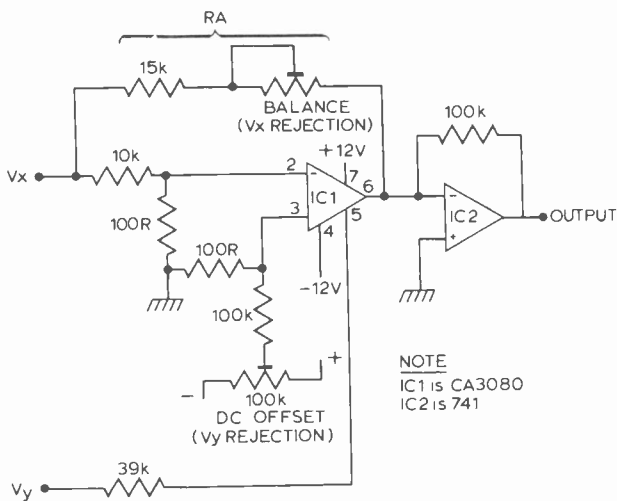
In this example the effective resistance is switched by using 4016 gates. The filter is a lowpass Butterworth and by turning gates A or B ON or OFF the cut off frequency can be altered. This allows the filter control to be physically remote or even to be computer controlled. Mark Space modulation of A and B would enable continuous control over the cut off frequency.



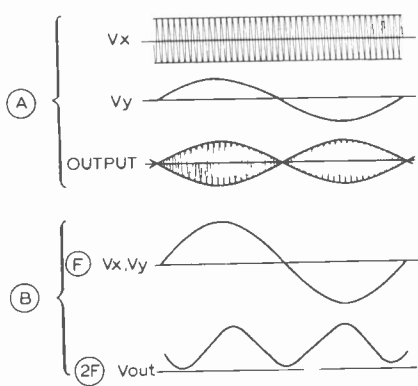
	①	②	③	④
A	OFF	ON	OFF	ON
B	OFF	OFF	ON	ON
Fc	500Hz	1kHz	2kHz	2.5kHz



Four Quadrant Multiplication



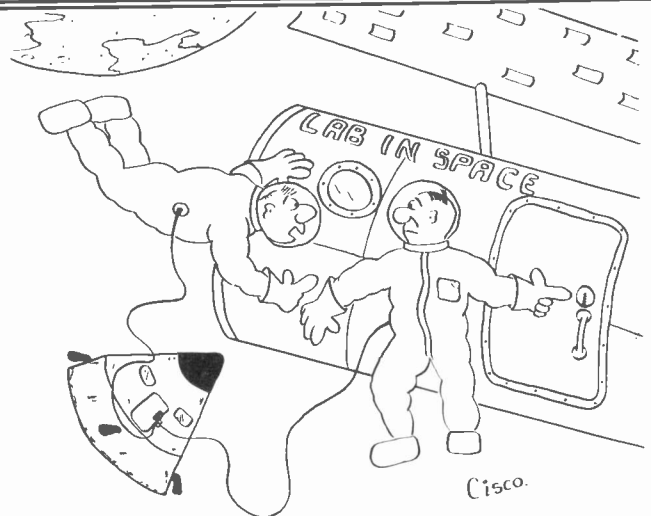
NOTE
IC1 is CA3080
IC2 is 741



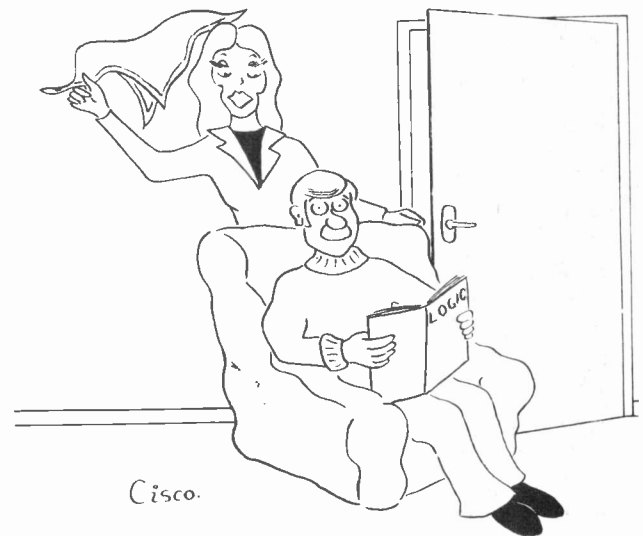
By using a few circuit tricks, the CA3080 can be made to perform 4 quadrant multiplication. In fact the CA3080 performs 2 quadrant multiplication and the trick is to move the axis on the multiplying graph. If we ignore the RA resistor chain then we have a 2 quadrant multiplier circuit similar to that shown previously. Imagine that V_x is a 1kHz sine wave, 1 V_{ptp} and V_y is at 0V. The output of IC2 is a sine wave of fixed amplitude. Now if we connect RA, and adjust the balance control, it will be possible to cancel out the output, because the signal coming from IC1 is out of phase with that from the RA resistor chain. So with V_y set at 0V there is no output for IC2. If V_y goes +ve, the output of IC1 will become greater than the current via the RA chain and the output of IC2 will grow.

If V_y goes -ve the current through the RA chain will exceed that from IC1 and the output of IC2 will grow, the phase being opposite to that when V_y was a sinewave from an oscillator, then this circuit could be used to generate ring modulation effects.

When V_x is set up 0V there may be some V_y breakthrough and this can be minimised by adjusting the V_y rejection preset.

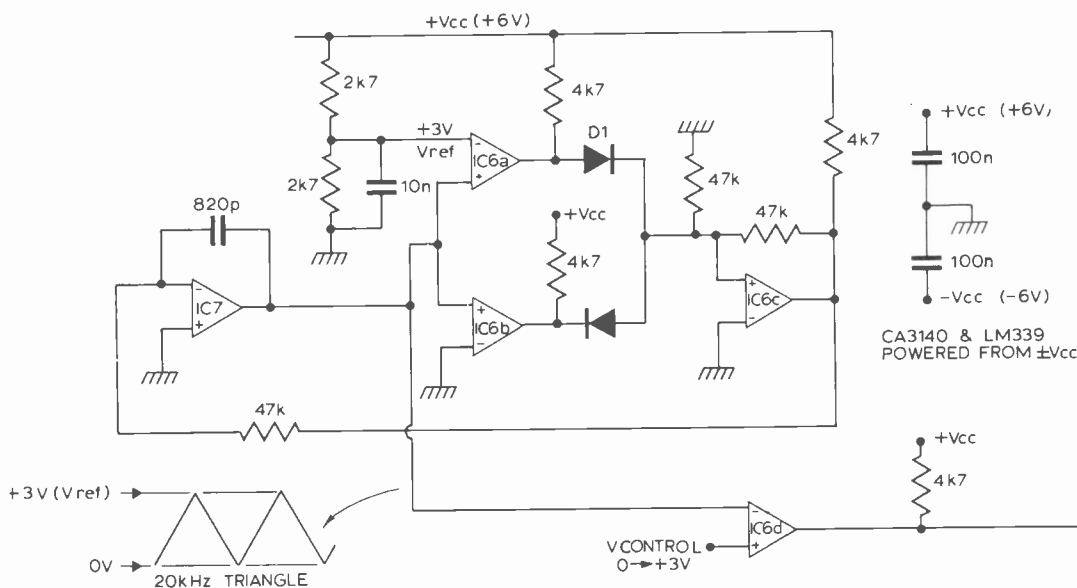
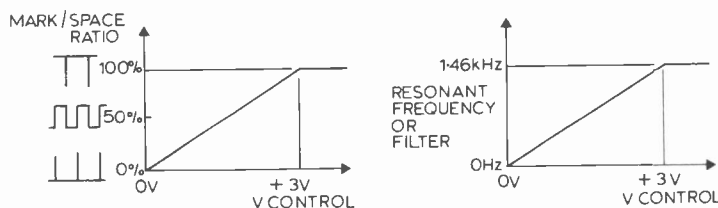
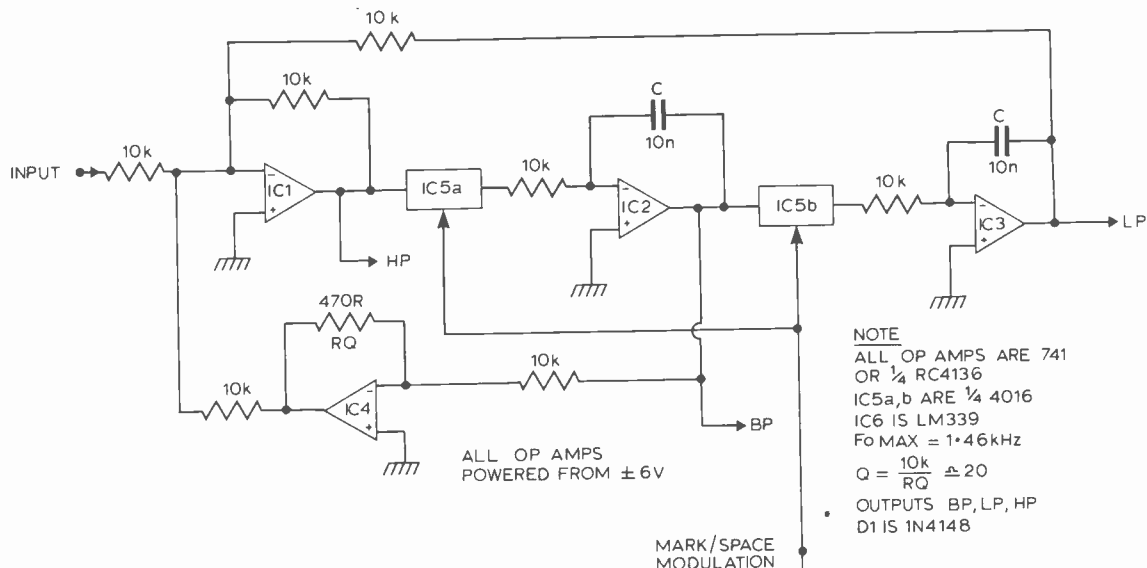


"No. I thought you were supposed to bring the key!"



"Forget about RAMS, ROMS AND PROMS, darling . . . we've got to talk about PRAMS!"

Markspace Modulated Universal Filter



It is possible to change the gain of an amplifier by effectively altering the input resistor. This can be done by markspace modulating a voltage controlled switch in series with the resistor.

When the markspace ratio is low, the switch is OFF most of the time and the effective resistance is large. When the markspace ratio is high the switch is ON most of the time and the effective resistance approaches that of the series resistor.

Having generated a markspace control waveform, it is possible to gang up together literally hundreds of voltage controlled switches. This enables large numbers of variables to be simultaneously changed.

The circuit is a markspace modulated universal filter (IC-6) and the markspace generator itself (IC-11).

IC7-10 forms a triangle square wave oscillator. IC7 is an integrator whose output ramps up and down between 0V and a +3V reference. IC8-10 are all fast comparators. IC8 detects

when the integrator outputs of IC8 & 9 are used to flip over a schmitt trigger IC10, which then drives the integrator. Thus the integrator output ramps up and down between 0V and +3V at a rate of 20 kHz.

It is important that the frequency of the markspace oscillator be relatively high. As a rule of thumb it should be 2 1/2 times the highest frequency components of the signals that you hope to process. The triangle output is fed into IC11's inverting input, the control voltage into the non inverting input. The output of IC11 is the markspace modulation which is used to drive the switches IC5,6. The filter resonant frequency is directly proportional to the mark space ratio that drives these switches.

The number of IC's used is a quad package, and so is the 4016 and so can be the op amps (use RC4136). Thus the whole circuit can be realised with only 4 IC's. Also the mark space oscillator can be used to drive other independent comparators.

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 47k Ω at 1kHz

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

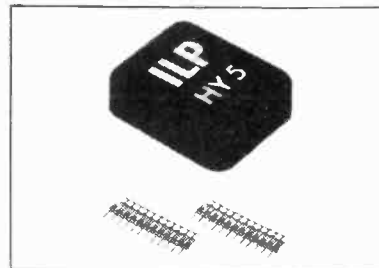
ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz; Bass \pm at 100Hz

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

OVERLOAD: 38dB on Magnetic Pick-up; SUPPLY VOLTAGE \pm 16.50V

Price £6.27 + 78p VAT. P&P free.

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



HY30 15 Watts into 8 Ω

The HY30 is an exciting New kit from I.L.P., it features a virtually indestructible I.C. with short circuit and thermal protection. The kit consists of 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

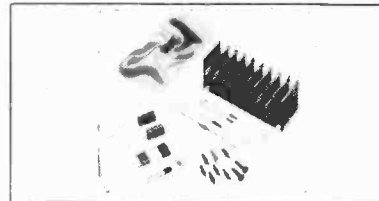
SPECIFICATIONS:

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

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

SUPPLY VOLTAGE: \pm 18V

Price £6.27 + 78p VAT. P&P free.



HY50 25 Watts into 8 Ω

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

FEATURES: Low Distortion — Integral Heatsink — Only five connections — 7 Amp output transistors — No external components.

APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier

SPECIFICATIONS: **INPUT SENSITIVITY:** 500mV

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

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

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

Price £8.18 + £1.02 VAT. P&P free.



HY120 60 Watts into 8 Ω

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

FEATURES: Very low distortion — Integral Heatsink — Load line protection — Thermal protection — Five connections — No external components

APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and organ

SPECIFICATIONS:

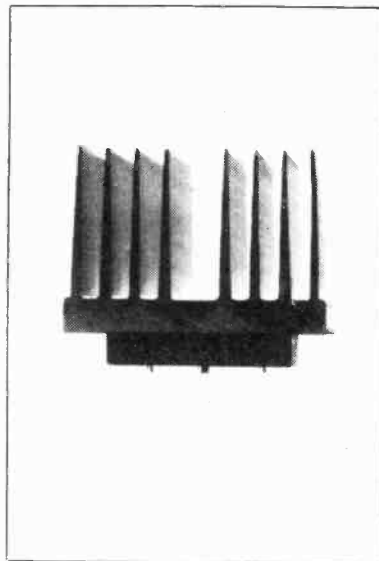
INPUT SENSITIVITY: 500mV

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

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

Size: 114 x 50 x 85mm

Price £19.01 + £1.52 VAT. P&P free.



HY200 120 Watts into 8 Ω

The HY200, now improved to give an output of 120 Watts, has been designed to stand the most rugged conditions, such as disco or group while still retaining 'true Hi-Fi performance'.

FEATURES: Thermal shutdown — Very low distortion — 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 8 Ω ; **LOAD IMPEDANCE:** 4-16 Ω ; **DISTORTION:** 0.05% at 100W at 1kHz

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

SIZE: 114 x 100 x 85mm.

Price £27.99 + £2.24 VAT. P&P free.

HY400 240 Watts into 4 Ω

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

FEATURES: Thermal shutdown — Very low distortion — Load line protection — No external components.

APPLICATIONS: Public address — Disco — Power slave — Industrial

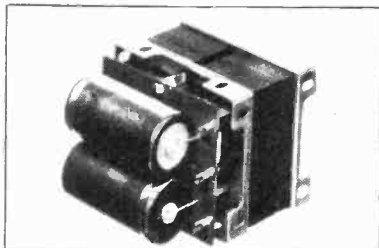
SPECIFICATIONS:

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

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

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

Price £38.61 + £3.09 VAT. P&P free.



POWER SUPPLIES

PSU36 suitable for two HY30's £6.44 + 81p VAT

PSU50 suitable for two HY50's £8.18 + £1.02 VAT

PSU70 suitable for two HY120's £14.58 + £1.17 VAT

PSU90 suitable for one HY200 £15.19 + £1.21 VAT

PSU180 suitable for two HY200's or one HY400 £25.42 + £2.03 VAT

TWO YEARS' GUARANTEE ON ALL OF OUR PRODUCTS

I.L.P. Electronics Ltd.
Crossland House
Nackington, Canterbury
Kent CT4 7AD
Tel. (0227) 64723

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

TRAMPUS

ELECTRONICS LTD.

SEMICONDUCTOR DISTRIBUTORS

ELECTRONIC COMPONENT CENTRE
58-60 GROVE ROAD, WINDSOR, BERKS
SL4 1HS (TRADE AND EXPORT WELCOME)
HOTLINE FOR TELEPHONE CREDIT CARD ORDERS -
WINDSOR 54525



ETI READERS OFFER: OVER £10 DISCOUNT 5% OFF. (THIS MONTH)
QUANTITY DISCOUNT FOR 100 OF ONE TYPE 10% OFF 1 UP PRICE

Cheques or cash orders over £5 Post Free. Other orders add 20p Post & Packing. Credit Card orders £5 min. by post or phone. + Post & Packing 20p. UK add 8% to prices marked*. Add 12 1/2% VAT to all other prices. Free price list send S.A.E.
All devices to makers specifications. Please quote ETI ad as prices may change. E.&O.E. 1978. Callers welcome Tues to Sat (Lunch 1-2).



MICRO POWER SUPPORT

All full spec Grade 1 displays
DL704 CC or DL707 CA 0.3" £1.25*

FN050 CC/161 C 0.6" £1.25*

MAN6A Type/161A 0.6" £1.25*

DL747 CA or DL 750 CC £1.69*

Clock IC AY51224 £3*

Display PCB 6 Digit 0.6" £1*

LEDS. Bright full spec. 0.2" or 0.125" Red 10p*

TIL209 Red & Clip 12p*

0.2" Dia Red & Clip 12p*

Yellow or Green LEDs. 0.2" or 0.125" Dia. All 20p*

1/2 volt Fluorescent Light £5*

Jackson Tuner 370p £1

Trimmer D-8 or 5 to 40p 25p

Coil Former & Sling 0.3" Dia 25p

Type 45 Pots Log & Lin 25p

Relay Mini 3 Pole 12 volt £1*

Coil £1*

RS Type Bleeder 9 to 12v £1.50*

Date PCB Pan 2 mbs 70p*

TUB Ferric CHL 1/4kg £1*

Decon Board Cleaner Pad 50p*

6x4" Nylon/Copper Beard 60p*

Vero Stocked All 10% off I.e. 3"x5"x0.1" Board 56p*

DISCO TRIAC 10A 400v

BR100 Diac 25p*

C1060 4A 400v SCR 55p*

TAG 1/400 1amp 55p*. 1/600 65p*

Switches Mini SPST 55p*

Mini OPDT 69p*. Centre off 89p*

Slide Switch 25p*

Push 'On' 35p*

FULL SPEC PAKS ALL £1

Pak A: 12 x Red LEDs £1*

Pak B: 6 x 741C 8 pin £1*

Pak C: 4x2 N13055. TD 3 £1*

Pak D: 12 x BC109 £1*

Pak E: 13 x BC182 £1*

Pak F: 13 x 2K3704 £1*

Pak G: 7 x BFY 51 £1*

Pak H: 7 x 2N3819 etal £1*

New Pak I: 10 x Metal Trim. Knob 1/4" dia [synthesiser etc.] £1*

Pak J: 6 x 2N3053 £1*

Pak K: 50x1M4148 £1*

Pak L: 50 x 33uf 10 volt electrolytic £1

Pak M: 4 x Pairs Plastic Power Zamp 60 volt. NPN/PNP 80131/2 Type £1

Pak N: 50 x OA81/91 £1

Pak O: 20 x Plastic 109 £1

Pak P: 50 x 220uf 6.3v Volt Electrolytic £1

Pak R: 14 x BC107 £1

Pak S: 14 x BC108 £1

Pak T: Top selling 10 x NPN Plastic Power 60 volt 2 amp 8081 Type £1

TRANSISTORS

Look at our Pak T. Ten Plastic Power £1

Or Pak C: 4 x 2N3055 £1*

Matchline 20p*. Ins Kit 10p*

AC127 17p* BFY50 16p*

AC176 10p* BFY51 16p*

AC187 20p* BFX29 28p*

AD161 40p* BSX20 18p*

AF162 40p* MJ2955 £1*

AF239 42p* MJ340 44p*

BC107 8p* MJ2955 £1*

BC108 8p* MJ3055 80p*

BC109 9p* MPU131 35p*

BC109C 15p* ORP12 55p*

BC147 12p* TIP41A 60p*

BC148 12p* TIP42A 65p*

BC149 12p* TIP2955 60p*

BC157 15p* TIP3055 50p*

BC158 15p* T1543 35p*

BC159 15p* 2N2646 39p*

BC167 10p* 2N2905 22p*

BC168 11p* 2N2926V 10p*

BC169 12p* 2K3053 16p*

BC177 18p* 2N3055 45p*

BC178 16p* 2N3614 £1*

BC179 18p* 2N3702 9p*

BC182 10p* 2N3706 9p*

BC183 10p* 2N3706 9p*

BC184 10p* 2N3819E 18p*

BC212 12p* 2N3820 38p*

BC213 12p* 2N3904 15p*

BC214 12p* 2N3906 15p*

BCY71 20p* 2N4347 50p*

BD131 37p* 2N5457 32p*

BD132 37p* 2N5777 44p*

BD695 69p* TL131 £2*

BD696 69p* TL163 £1*

7400N SERIES TTL

ALL FULL SPEC BRANDED

7400 8p* 7475 44p*

7401 9p* 7476 35p*

7402 10p* 7480 39p*

7403 10p* 7481 £1*

7404 17p* 7482 £1*

7405 9p* 7483 £1*

7406 28p* 7485 £1*

7407 28p* 7486 35p*

7408 12p* 7490 36p*

7409 12p* 7491 75p*

7410 10p* 7492 35p*

7411 22p* 7493 35p*

7412 22p* 7494 75p*

7413 28p* 7495 75p*

7416 28p* 7496 85p*

7417 28p* 74100 £1.15*

7420 10p* 74107 29p*

7423 26p* 74121 27p*

7425 26p*. 74123 59p*

7426 26p* 74141 95p*

7430 10p* 74143 £3.14*

7432 20p* 74145 85p*

7440 14p* 74147 £1.89*

7441 79p* 74152 £2*

7442 87p* 74154 £2*

7445 69p* 74155 80p*

7446 88p* 74156 80p*

7447 82p* 74157 £1*

7448 £1* 74164 £1*

7450 15p* 74174 £1*

7451 15p* 74176 £1*

7453 15p* 74190 £2*

7454 15p* 74192 £2*

7460 15p* 74193 £2*

7470 29p* 74194 £2*

7472 26p* 74196 £1.30*

7473 25p* 74197 £1*

7474 29p* 74198 £2*

CMOS TOP VALUE

4000 15p* 4066 58p*

4001 15p* 4067 £4*

4002 17p* 4069 22p*

4006 £1* 4070 32p*

4007 18p* 4071 21p*

4008 92p* 4072 21p*

4009 58p* 4073 21p*

4010 58p* 4075 23p*

4011 15p* 4076 £1.29*

4012 18p* 4077 40p*

4013 55p* 4078 21p*

4015 93p* 4081 22p*

4016 52p* 4082 21p*

4017 95p* 4089 £1.50*

4018 95p* 4093 85p*

4020 £1* 4507 55p*

4021 £1* 4508 £3*

4022 90p* 4510 £1.35*

4023 26p* 4511 £1.68*

4024 76p* 4512 95p*

4025 15p* 4514 £2.85*

4027 55p* 4516 £1.28*

4028 90p* 4518 £1.05*

4029 £1* 4520 £1.10*

4032 £1* 4521 £2.68*

4034 £2* 4522 £2*

4035 £1.20* 4528 99p*

4038 £1.08* 4534 £7.68*

4040 £1.05* 4541 £1.50*

4041 86p* 4543 £1.75*

4042 81p* 4553 £4.49*

4043 96p* 4556 78p*

4044 95p* 4558 £1.17*

4046 £1.30* 4566 £1.59*

4047 99p* 4569 £3.59*

4049 52p* 4583 £1.10*

4060 £1.15* 4585 £2.05*

4063 £1.10*

OIL SOCKETS

8 pin 12p*

24 Pin 50p

28 Pin 40 Pin £1

Low Profile 14 or 16 Pin 15p



TOP TWOSOME!

555 8 Pin Timer 27p*

741C Full spec DIL 8. Branded Op Amp 19p*

NEW LINEARS Data 10p

TL170 Half effect 69p*

TL071 Lo noise 741 75p*

TL081 Fet Op. 741 69p*

TL083 Fet 747 £1.49*

TL080 Fet 748/308 £1.15*

IC SUPERMARKET

301 Op Amp 30p*

555 Timer (NE555) 27p*

556 Dual 555 70p*

710 Comparator 40p*

723 Regulator 45p*

741C 8 Pin OPA 19p*

741C T099 or OIL 14 39p*

748C Op Amp 33p*

3900 Quad Op Amp 55p*

7805 1 Amp 5 volt 95p*

7805 T03(309K) £1*

7808 or 7812 £1.25*

7815 15 volt plastic 69p*

7900 Negative Series £2.50*

8038 Sig Generator £3.55*

76013 & 76023 £1.35

CA3130 & CA3140 94p*

LM380 1 watt Amp 85p

LM381 Dual Preamp £1.55

LM387 Dual Preamp £1

LM3900 Quad OPA 55p*

MC1460 1461 & 1469 £3*

MC1460 1461 & 1469 £3*

MC935 14433, A/D £5*

NE536 Fet OPA £4*

NE555 Timer 27p*

NE556 Dual 555 70p*

TB8010 7 AF £1

2N414 Radio 65p

Build any Project - Fast and Easy

It's the new deal for project builders from Lektrokit! A complete new range of breadboarding and testing devices. At prices anyone can afford. For any project anyone could want to build - from one-chip simplicity to 1,000-chip complexity.

It's fast and easy project building, too. You simply push components in and pull them out. No soldering, no de-soldering, no chance of heat damage. You can make design changes instantly, keeping full leads on components.

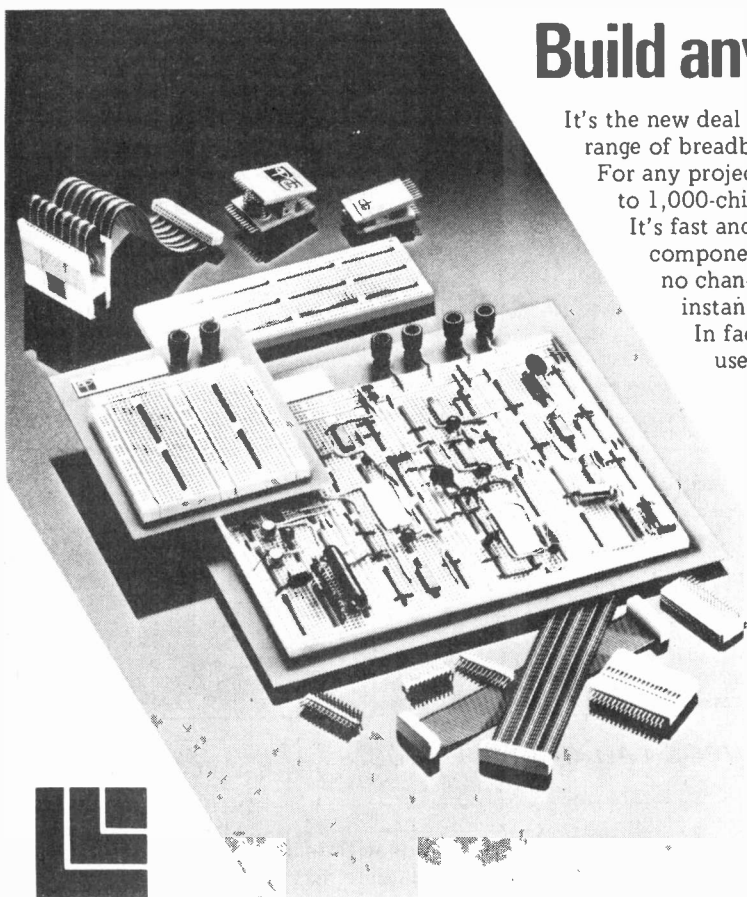
In fact, with Lektrokit, you can build a project as fast as you used to sketch a layout. And a lot more easily.

LEKTROKIT

completes the circuit

See Lektrokit at one of the Lektrokit dealers near you. There's bound to be one - they're springing up everywhere. Send for the name of your nearest - plus FREE full-colour catalogue - to:

Lektrokit Ltd., Dept. ET11 Sutton Industrial Park,
Earley, Reading, Berks RG6 1AZ
Telephone 0734 669 116

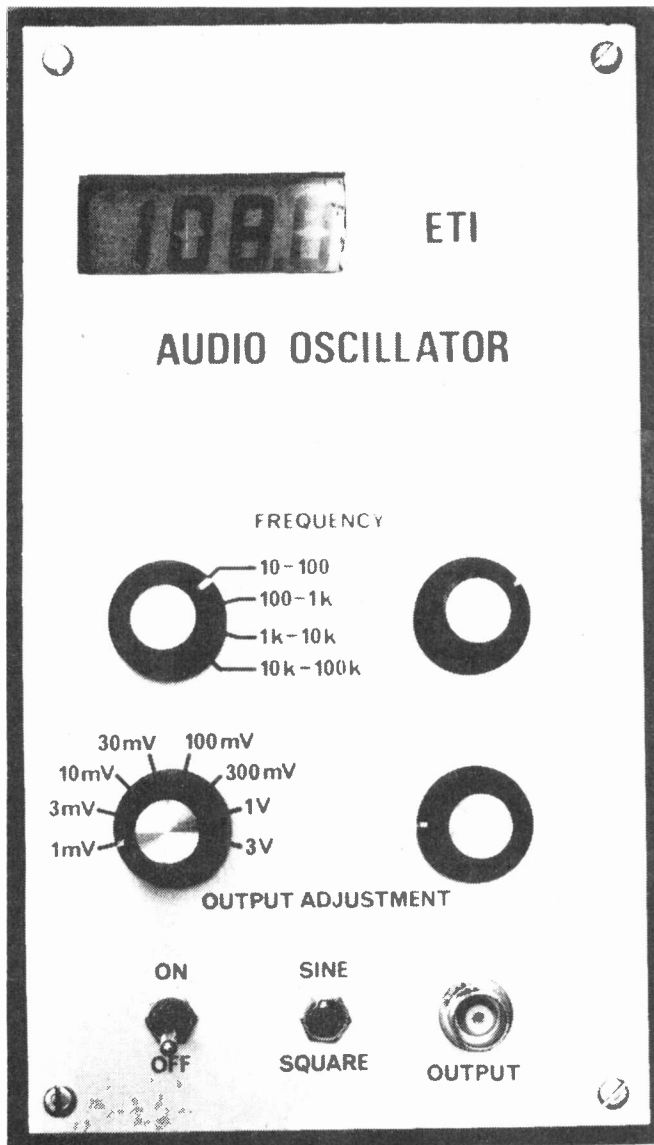


AUDIO OSCILLATOR

WITH LCD DFM OPTION

An audio oscillator combines with a new design in frequency meters that provides accuracy and fast reading rates.

Front view of the audio oscillator. Note that this is an early prototype and the 3V range has been deleted.



THE WEIN BRIDGE oscillator published in our June issue did not provide a performance of adequate standard for many test applications—one would not have expected so from such a simplified design. Since then we have had many requests to provide a high performance oscillator.

This oscillator started life as another wein bridge, started to evolve as a voltage controlled sweep oscillator but when it became too complex reverted to a simple wein bridge.

One major problem with all home made oscillators is that of scaling the frequency dial. This is not just a problem of positioning the knob but since normally available potentiometers have a tolerance of $\pm 20\%$, the scale length will also vary. In commercial units the use of an expensive wire wound potentiometer solves most of the problems giving reasonably accurate scaling.

We then decided to build in a frequency meter and the high power consumption and the poor resolution, especially at low frequencies, of previous designs led us to develop a completely new design.

This uses what is literally an analogue computer to convert a period measurement into frequency with some digital electronics controlling it and displaying the results. We based this on the Intersil ICL7106 IC which, due to its liquid crystal display drive circuitry, allows a low power consumption design. Due to the method of conversion from period to frequency the range is limited from about 50 to 1999 counts and therefore automatic range selection is used. As the oscillator itself has less range than this, this limitation is no problem.

To simplify wiring we initially used CMOS analogue switches to select the range changing capacitors in the oscillator but this unfortunately increased the second harmonic ▶

LCD FREQUENCY METER

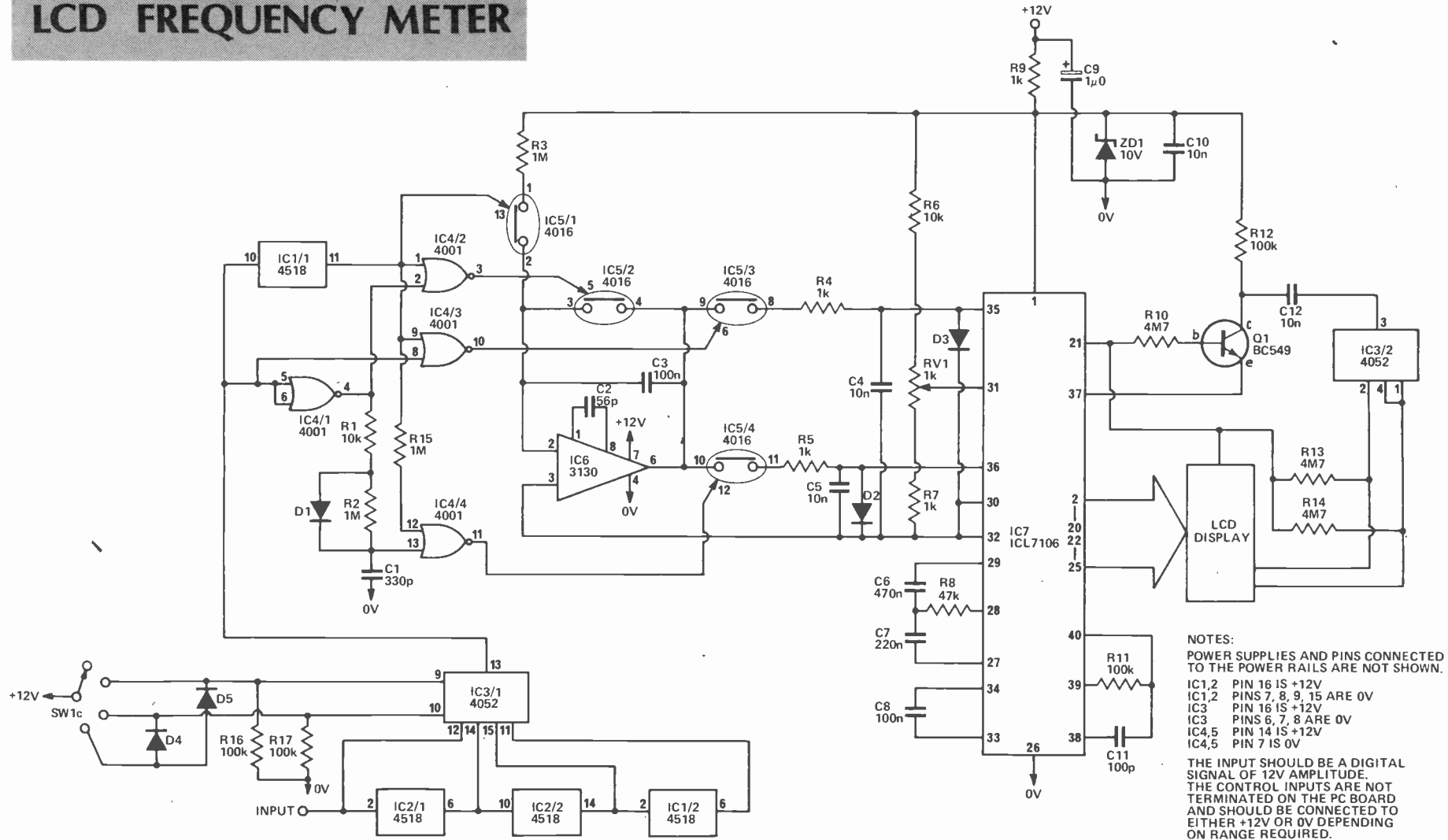
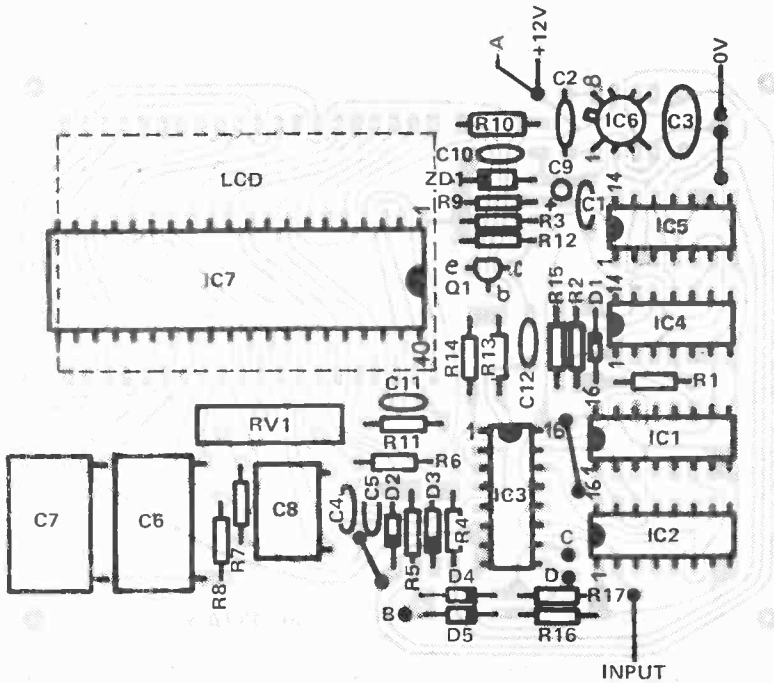
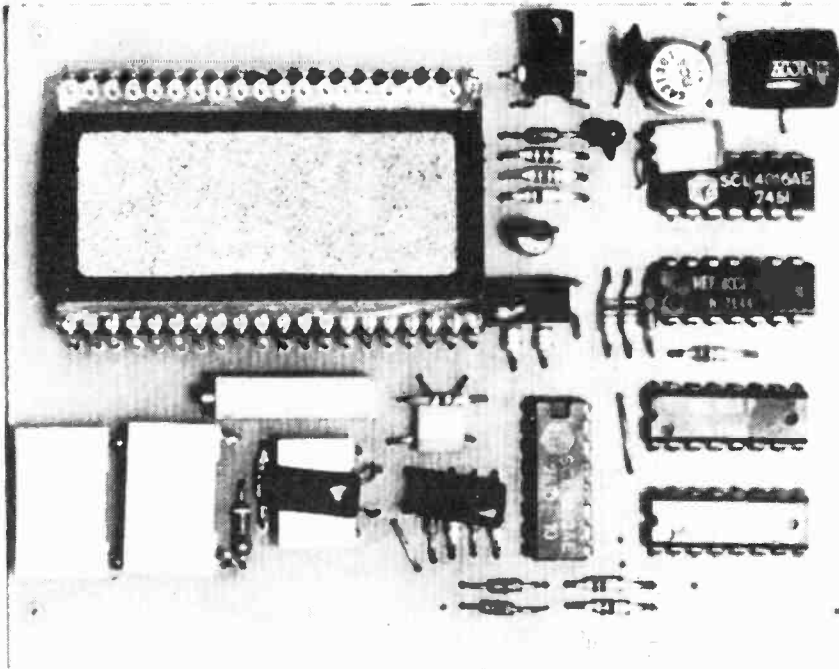


Fig. 1. The circuit diagram of the frequency meter section.

HOW IT WORKS

This section works by generating a voltage proportional to the period of one cycle and using this as the reference voltage for the Intersil voltmeter IC with a fixed voltage on the normal input. This gives the inverse function of normal operation and the display therefore is frequency.

and IC5/2 will turn on. This discharges C3 to zero volts. After a short delay to allow C3 to discharge IC5/4 is turned on transferring that voltage level onto C5. After a total of two cycles the process recommences. The voltage difference between the two capacitors is therefore the voltage change, (pro-



To generate the reference voltage we use an integrator (IC6) which is controlled by IC5. Operation is as follows. Initially C3 is discharged and for one cycle of the input signal IC5/1 turns on. As the IC7 provides a stable voltage between pin 1 and pin 32 of about 2.8V the output of IC6 will fall linearly with time and as IC5/1 is on for exactly one cycle the voltage change will be proportional to that period.

After IC5/1 turns off the output of IC6 will stay fixed. IC5/3 is then turned on and C4 will change to that voltage. After half a cycle IC5/3 will turn off leaving C4 at that voltage

portional to frequency) thus eliminating any offset errors in IC6. The pulses which control IC5 are derived from IC1/1 and IC4.

A reference voltage less than half the input voltage will result in the ICL7106 counting past 2000 (over ranging). The two inputs must also lie within the supply rails (less 1.5V). This limits the range of the instrument from 5 Hz to 200 Hz. For the higher frequency ranges, three decade drivers are provided and the necessary output selected by IC3. The correct decimal point is also selected by the other half of this IC.

PARTS LIST

RESISTORS all 1/4W 5%
 R1, 6 10k
 R2, 3, 15 1M0
 R4, 5, 7, 9 1k
 R8 47k
 R10, 13, 14 4M7
 R11, 12, 16, 17 100k

POTENTIOMETER
 RV1 1k ten turn trim

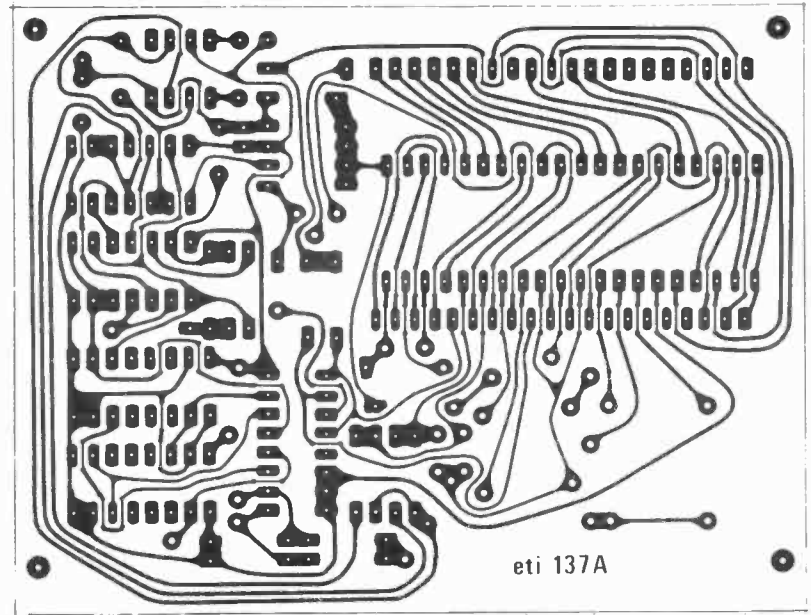
CAPACITORS
 C1 330p ceramic
 C2 56p ceramic
 C3, 8 100n polyester

C4, 5, 10, 12 10n polyester
 C6 470n polyester
 C7 220n polyester
 C9 1u0 35 V tantalum
 C11 100p ceramic

SEMICONDUCTORS

IC1, 2 4518
 IC3 4052
 IC4 4001
 IC5 4016
 IC6 CA3130
 IC7 ICL7106
 Q1 BC549
 D1-D5 1N914
 ZD1 10 V 300mW Zener

Shown on this page are the foil pattern, overlay and photograph of the frequency meter section.



eti 137A

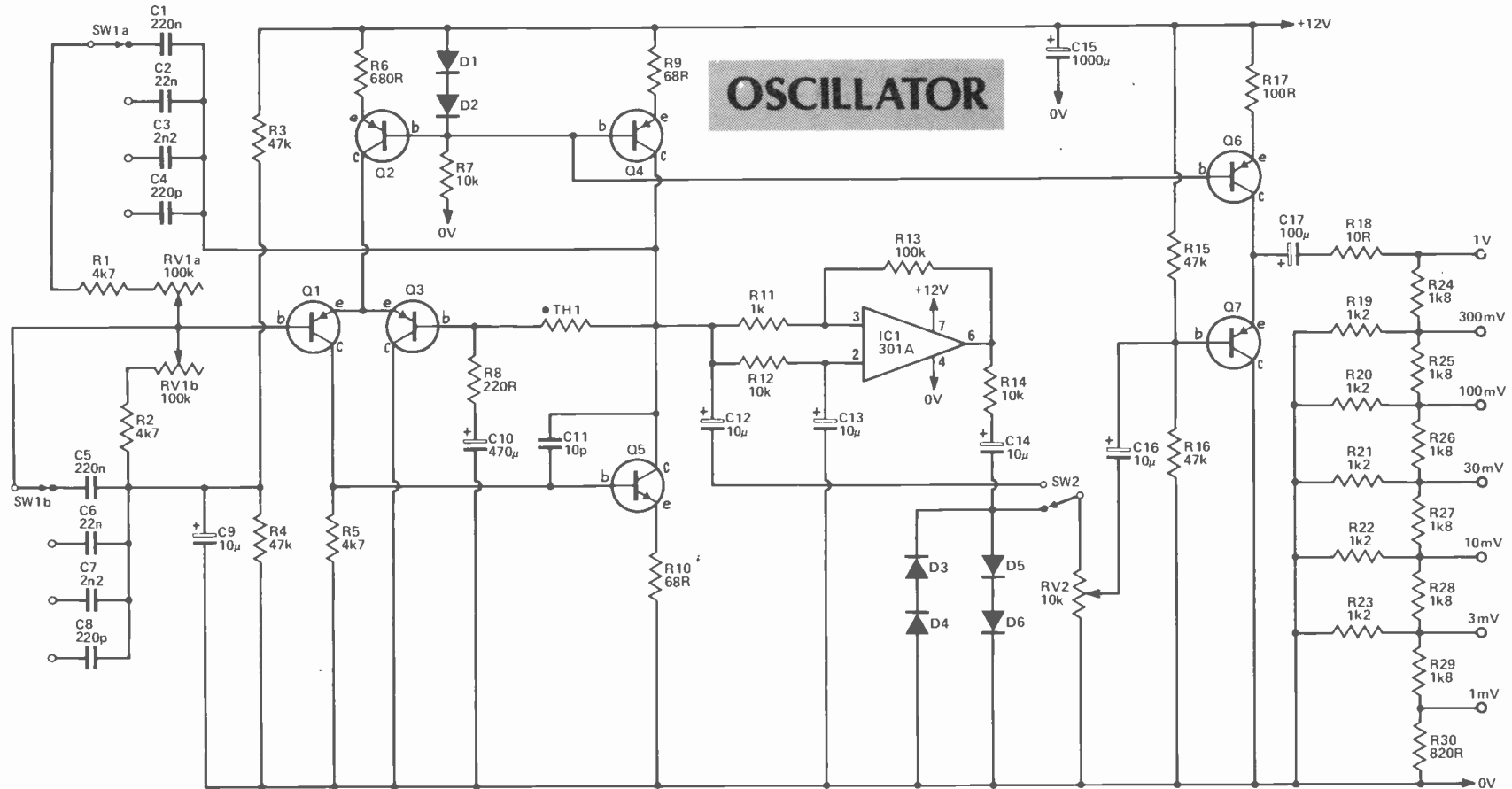


Fig. 2. The circuit diagram of the oscillator section.

PARTS LIST

Oscillator Board

RESISTORS all 1/2W 5%	
R1, 2, 5	4k7
R3, 4, 15, 16	47k
R6	680R
R7, 12, 14	10k
R8	220R
R9, 10	68R
R11	1k
R13	100k
R17	100R
R18	10R
R19-R23	1k2
R24-R29	1k8
R30	820R

CAPACITORS

C1, 5	220n polyester
C2, 6	22n polyester
C3, 7	2n 2 polyester
C4, 8	220p ceramic
C9, 12, 13, 14, 15	10 μ 25 V electrolytic
C10	470 μ 25 V electrolytic
C11	10p ceramic
C15	1000 μ 16 V electrolytic
C17	100 μ 25 V electrolytic

SEMICONDUCTORS

IC1	301A
Q1-Q4	BC559

HOW IT WORKS

The oscillator is of the conventional Wein bridge type with a differential amplifier made up by Q1-Q5. Gain stabilization is provided by the thermistor TH1. This type of circuit oscillates at the frequency where the impedance of the capacitors equals the resistors in the Wein bridge arms. With this feedback network the attenuation does not vary greatly like that of a twin tee but the phase

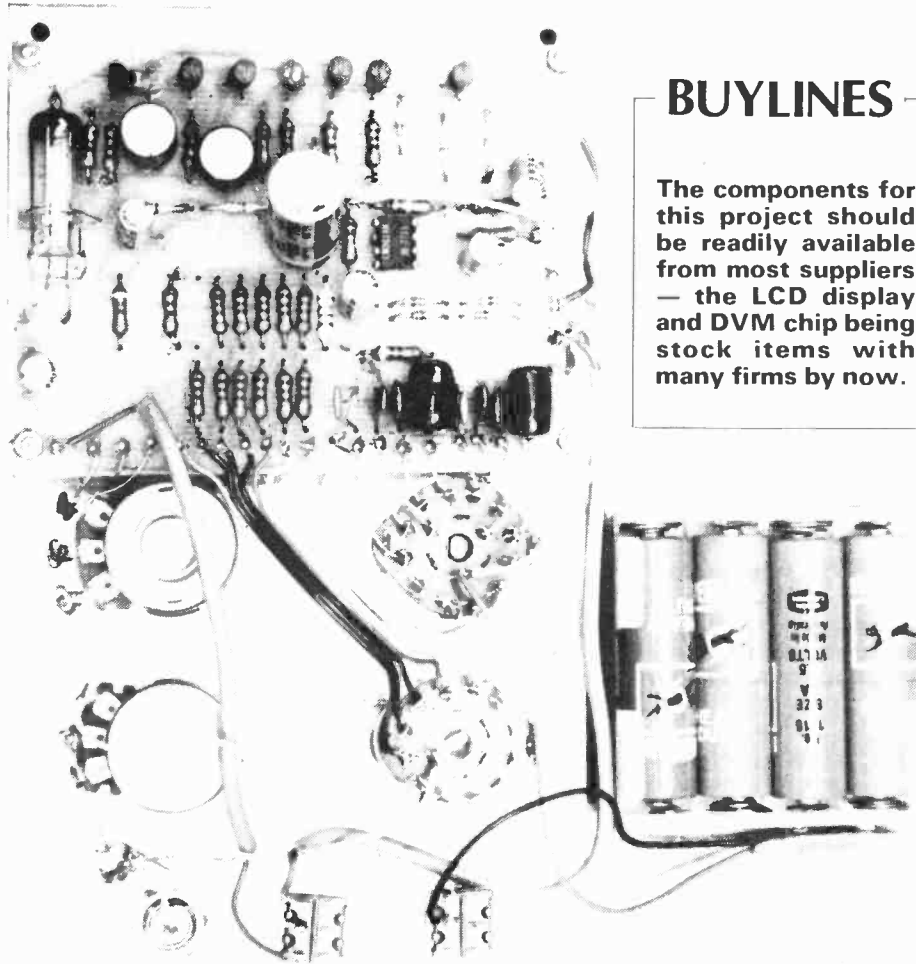
shift does. The result is a sine wave oscillator with low distortion.

For frequency variation a two gang potentiometer is used to give a 20/1 continuous variation with switched capacitors giving four ranges each a decade apart.

The sine wave output is converted to square wave by IC1 with the amplitude stabilized by D3-D6.

	Q5	BC549
	Q6, 7	BC559
	D1-D6	1N914
THERMISTOR		
TH1	type R53	
POTENTIOMETERS		
RV1	100k dual rotary	
RV2	10k lin rotary	
SWITCHES		
SW1	Three pole four way rotary	
SW2	SPDT	
MISCELLANEOUS		
	PCB	

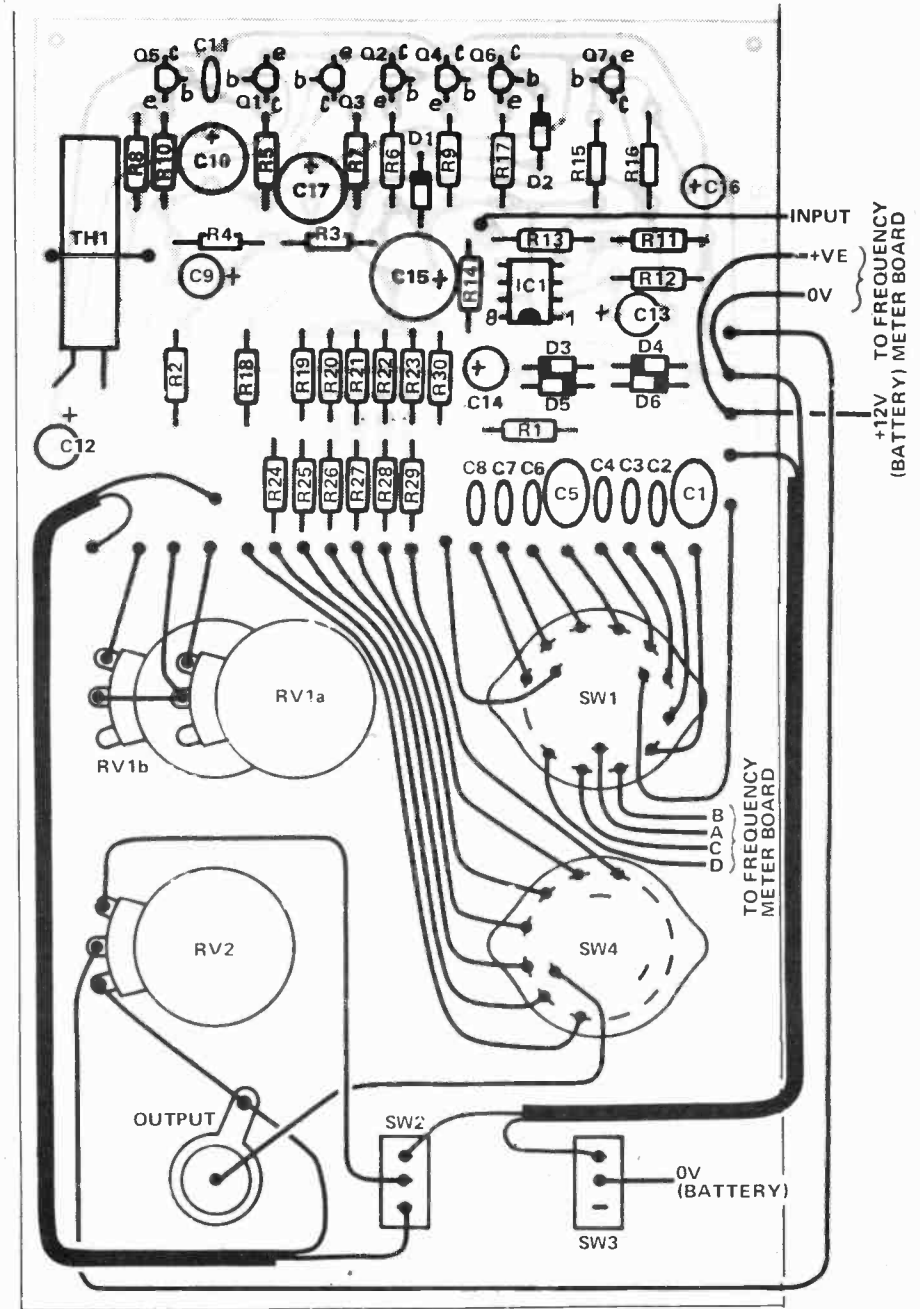
*RV1 — the preferred curve giving best resolution is antilog. If reverse rotation is acceptable log is as good. Otherwise use a linear curve.



BUYLINES

The components for this project should be readily available from most suppliers — the LCD display and DVM chip being stock items with many firms by now.

Fig. 3. Component overlay of the frequency meter board. Insert the LCD such that the +1 digit is on the left.



BUILD-IT-YOURSELF NEW! TEST GEAR KIT

BASIC SERVICING
INSTRUMENTS WITH
EASY STAGE BY STAGE BUILDING
INSTRUCTIONS - IDEAL FOR THE AMATEUR

MULTI RANGE TEST METER

A general purpose meter covering all usual ranges of A.C. and D.C. volts current and resistance measurements

AUDIO SIGNAL GENERATOR

New design covering 10Hz to 10KHz and variable output. Distortion less than 0.01% Ideal for HIFI Testing.

OSCILLOSCOPE

A basic 3" general purpose cathode ray oscilloscope for simple testing and servicing work. Sensitivity 0.3 volts/cm

SEND NOW FOR FREE DETAILS

To LERNAKITS, P.O. Box 156, Jersey.

Name _____

Address _____

NO DISCO SYSTEM IS COMPLETE WITHOUT...

ROPELIGHTS Rope light kits now available from Roger Squire's — 22 feet long, 4 channel, including Tube, Bulbs and Multipin connectors. These ropelights are ex-demonstration stock and will require some bulb replacement — we will supply 20 spare bulbs free with your kit. Additional sets of 20 bulbs cost £4.86 each.

PIEZO HORNS
FANTASTIC SPECIAL OFFER TO READERS OF ELECTRONICS TODAY
Tweeters for your disco, PA system or Hi-Fi. Frequency range 5K-20K. No X over required. They can be used in any PA system up to 100W. Why pay more?
OUR PRICE ONLY £4.99 each (P&P 35p each)

BULGIN OCTAL PLUGS AND SOCKETS
There's always hundreds of Bulgin Octal multiway plugs and sockets in stock at Roger Squire's. Each pin rated 6A. Perfect for your Sound to Light System. P552 SOCKET £0.65 (P&P 35p) P551 PLUG £1.84 (P&P 35p) Carriage on 10 or more nominal £1.00. Also available 6-way multi-core cable 16 Amps per core! ex stock £0.65 per metre. Please phone for carriage quote.

PROJECTORS
SQUIRE MULTIFECT 150 — including rotator and effects wheel. A truly versatile projector which uses a powerful 150W Tungsten bulb, all effects attachments simply slot in ready for use.
A BARGAIN AT £40.50 (P&P £1.00)

SOLAR 250
Utilising a 250W Quartz-Iodine bulb giving brilliant light output this projector is fan-cooled and can be used free standing or ceiling mounted. Dual effect system for stunning versatility. Rotators are extra. Huge choice of special effects and attachments!
NOW ONLY £70.20 (P&P £2.00)
Plus sockets, fuses, plugs etc etc

PLUS MANY DISCO ACCESSORIES
All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES. For example: Fane and H. Disco Speakers 12" and 15" BSR and Garrard decks at discount prices.

Roger Squire's DISCO GEAR

Send Mail Orders to Roger Squire's Mail Orders, Barret Trading Estate, Park Road, Barret, Herts EN5 5SA 01 441 3527 (Hotline) 01 441 1919 (Switchboard) Open Mon-Fri, 9.5-30

Personal callers: ROGER SQUIRE'S DISCO CENTRES
LONDON 176 Junction Road, Tufnell Park, N19 5QQ 01-272 7474
BRISTOL 125 Church Road, Redfield, Bristol BS5 9JR 0272 550550
MANCHESTER 251 Deansgate, Manchester M3 4EN 061-831 7676
Open from 10-5 Tues-Sat 10-8 Weds Closed Mondays

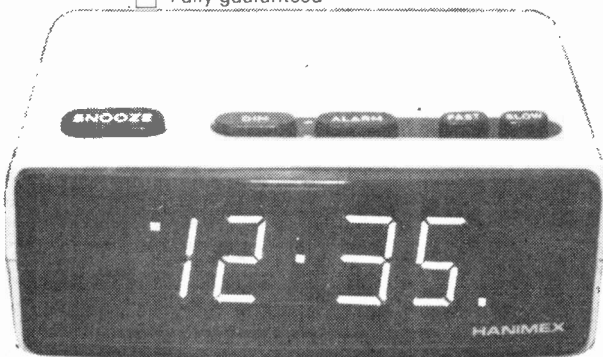
MAINS OPERATED ELECTRONIC DIGITAL ALARM CLOCK

IMMEDIATE DELIVERY
£8.95
INCL V.A.T. POST PAID
THREE FOR £26.00 POST FREE

ETI RECOMMEND THIS MODEL

BARCLAY ACCESS

- Hanimex HC-1100
- Large Bright LED display
- White case with red display on black background
- Adjustable dim/bright control
- Silent operation, all electronic
- Space age technology L.S.I. circuitry
- Alarm and 9 minute snooze repeater
- P.M. indicator
- Seconds Display
- Size 100mm x 130mm x 60mm high
- Fully guaranteed



HENRY'S
RADIO

HENRY'S RADIO
404 Edgware Rd. London W2
PHONE (01)723 1008

THIS MONTH'S SPECIAL OFFER "Motorola Audio Amplifier 1watt I.C."

1 watt plus into 8-16 Ω, 9-16V, 10-400 MV sensitivity. Short circuit proof, no heatsink required. Only 90p with Data and circuits

Sentinel Smoke and Gas Detector. This beautifully made unit uses quality components on fibreglass board, encased in heavy duty, domed diecast box, 3 1/2 diam. x 1 1/2 high. LED indicator, TGS105 plug in sensor, 24v, or 12v by altering 3 resistors, will drive relay or lamp. Ideal for caravans, boats, kitchens, etc., etc. £6.45 with circuit and data.

Miniature Vemtron™ FM4 10.7MHz ceramic filters 50p each, 3 for £1

Crystal earpieces with lead 40p each, 3 for £1

Magnetic earpieces with lead and plug 25p each 5 for £1

Ultrasonic transducers transmitter and receiver, 14mm diam 40 kcs £4.25 per pair

4 aluminium boxes 128 x 44 x 38mm, ideal for signal injectors, etc. £1.00

100 miniature reed switches, ideal for burglar alarms, model railways, etc. £3.30

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**. Rotary type with slow motion drive, aerial socket and leads £2.50

Aluminium **TV coax plus** -10 for £1

Miniature edgewise panel mounting level meters 200µa F.S.D. 90p

300 mixed resistors 1/2 & 1/4 watt £1.50

300 modern mixed caps most types £3.30

100 mixed **electrolytics** £2.20

300 mixed printed circuit components £1.50

300 mixed printed circuit resistors £1.00

100 high-wattage resistors, W.W., etc. £2.20

20 assorted **VDRs** and thermistors £1.20

25 assorted **presets**, skeleton, etc. £1.20

25 assorted **pots** and **presets** £1.50

470 µ F 25v radial, modern type 10 for £1

150 mixed 1- and 2-watt resistors £1.50

100k varicap pots, can be banked side by side, very compact 10 for £1

Maine Neons, long leads 15 for £1

100 mixed modern miniature ceramic and plate caps £1.20

Don't let your environment dehydrate you... BUY OUR "HONEYWELL HUMIDITY CONTROLLER". Membrane actuated, adjustable by 1/4 shaft. Ideal for greenhouses, offices, centrally heated homes, etc. 3.75A contacts at 250V. Build Humidifiers or dehydration alarms with this novel gadget at a fraction of original cost. £1 each, 3 for £2.50.

Semiconductor Bargains

New Super Bargain Diode Pack. Includes zener, power, bridge, varicap, silicon, germanium, marked, unmarked, etc., etc. Excellent value 300 for £2.95.

New Improved Transistor Packs: 100 New and marked transistors including BC 148, BC 154, BF 274, BC 212L, BF 200 and lots of others, only £4.95.

200 transistors as above and including 2N3055, AC128, BD131, BFY50 only £9.95.

ITT 25KV ctv eht triplers for Decca Bradford chassis brand new £2.50, 5 for £10

BD131 3 for £1.00

SN76115N (equivalent MC 1310) 50p

TBA 120A 50p

10 assorted convergence pots £1.00

12 Quil low profile 14 pin i.c. sockets £1.00

BF 200 6 - £1 BF 274 12 - £1

BC 212L 10 - £1 BC 148 12 - £1

BC 154 12 - £1 Varicap diodes 20 for £1 (B.B. types)

Deluxe Fibre Glass Printed Circuit Etching Kits

Includes 150 sq ins copper clad 1/g board, 1lb ferric chloride, 1 dalo etch resist pen, abrasive cleaner, 2 mmp drill bits, etch tray and instructions

Only £5.30

150 sq ins fibre glass board £2.00

Dalo pen 90p

1lb ferric chloride to mil spec £1.25

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

INSIDE ULTRASONICS

Ultrasonic sound at very high frequencies is being used increasingly for medical diagnosis. Dr P. N. T. Wells of Bristol General Hospital reports.

THE IMPORTANCE OF ultrasonic diagnostic methods lies in the fundamental differences between them and other techniques such as radiology and radioisotope scanning. The symptoms of some diseases, and of natural conditions such as pregnancy, are best investigated by ultrasound. It maps out anatomical cross-sections, measures the performance of the heart and the flow of blood, and identifies many kinds of abnormality, including several types of cancer, all without encroaching into the body in any way.

Twenty-five years ago, doctors seeking to investigate the structures of the body had no alternative to X-rays and this often involved injections of substances to give better contrast to obtain information about soft tissues. Nowadays, ultrasonic methods have replaced radiology in helping to solve a number of clinical problems doctors depend on ultrasonic diagnosis, and patients demand this kind of investigation. The procedures are rapid and painless and nothing enters the body other than ultrasound waves. Unlike ionizing radiations, ultrasound at diagnostic exposure levels seems to be harmless.

Basic Principles

Most diagnostic applications of ultrasound depend on the reflection of ultrasonic waves at surfaces between tissue structures which differ in their so-called characteristic impedance. The characteristic impedance of a material is equal to the product of its density and the velocity of ultrasound within it. The densities of soft tissues, about 10^3 kg m^{-3} (kilograms per cubic metre), and the velocities of ultrasound within them, about 1500 m s^{-1} (metres per second), are similar to those for water. When an ultrasonic wave strikes the boundary between tissues that differ in characteristic impedance, a proportion of the energy in the wave is reflected in much the same way that light is reflected when it meets a change in reflectivity at a surface.

The characteristic impedances of soft tissues are similar, so the echoes from their boundaries are very small. For example, only about 0.5 per cent of the

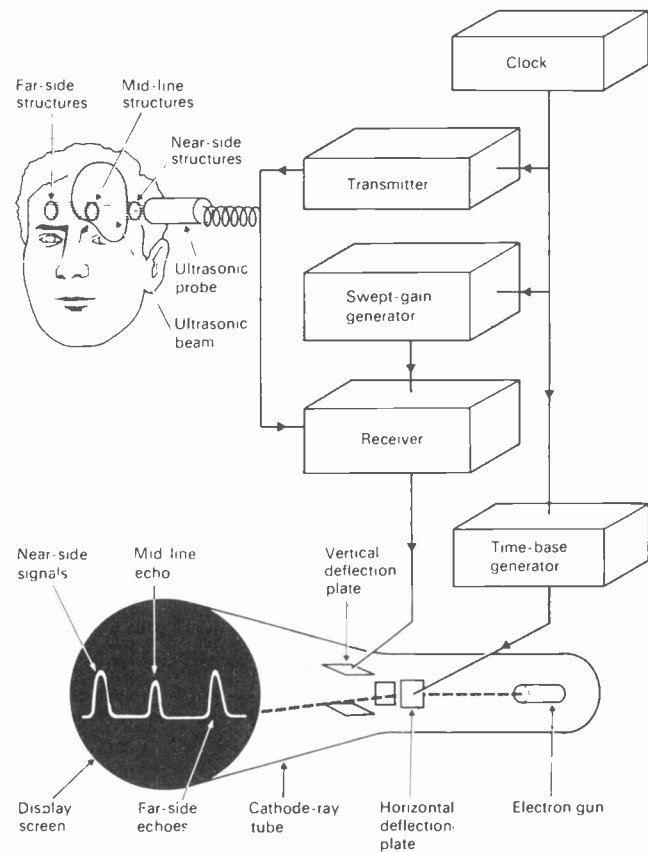


Fig. 1. Basic arrangement of the A-scope system, in use in this instance to show the mid-line structures of the brain in their relative position halfway between the sides of the skull, as indicated by symmetry of the deflections of the cathode-ray tube trace. Asymmetrical spacing of the deflections may mean that disease has brought about a physical change such as a tumour on one side of the brain. The swept-gain generator gradually increases the receiver amplification over each sweep of the time base to compensate for the attenuation of the deeper echoes by intervening tissues.

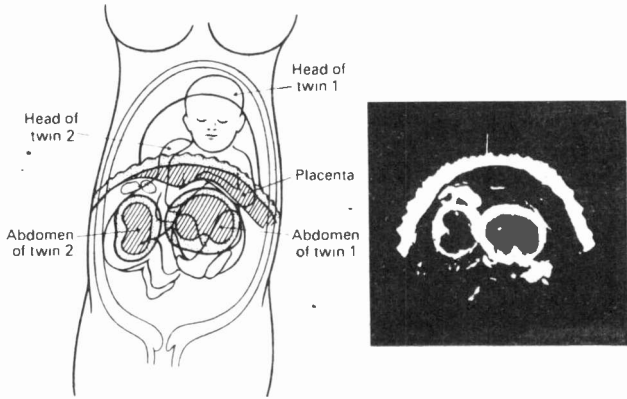


Fig. 4. A two-dimensional scan reveals twins at about 25 weeks of pregnancy. The placenta on the anterior wall of the uterus is clearly defined while the abdomens of the twins, identified in the explanatory diagram, appear in section.

produce spots of light on the display in places where, on an A-scope, there would be deflections of the beam. The positions of the spots of light correspond to echo-producing structures in the patient, and the pattern of their movement can be permanently recorded.

Cross-Sectional Images

The B-scope forms the basis of another display method, the two-dimensional ultrasonic scanner (see Fig. 3). The ultrasonic probe, instead of being held in the hand, is mounted on a scanner. It can be moved to any position in a two-dimensional plane. In this way it is possible to arrange for the beam to pass through structures lying in a chosen plane within the patient, while the position of

the probe and the direction of the beam are measured continuously by 'resolvers' mounted in the scanner. The electrical signals from the resolvers control two time-base generators, driving the vertical and horizontal beam deflection plates of a cathode-ray tube. The direction and position of the ultrasonic beam across the patient controls the position of the cathode-ray beam showing up on the display, related to the positions of the echo-producing surface.

A cross-sectional image of the surfaces can be built up photographically by a camera with an open shutter that records the bright spots on the display while the patient is being scanned. The echo information can also be stored electronically.

Two-dimensional scanners in which the probe is moved in contact with the patient produce individual images in scanning times of about 10 seconds, images can be produced at a much faster rate by moving the probe mechanically. Images in rapid succession allow physiological movements to be studied; their main importance is in cardiological diagnosis. But although these rapid mechanical scanners produce so-called real-time images, they lack flexibility. This difficulty can be overcome by using ultrasonic probes containing many separate transducer elements, operated separately or in groups, which can produce ultrasonic scans made up of parallel lines or lines arranged in a fan shape, at frame rates of tens per second.

As well as making it possible to study rapidly moving structures, real-time scanners can also be used to explore large volumes of anatomy in a short time. A doctor using one can examine a patient in about a quarter of the time it takes with a 'conventional' two-dimensional scanner.

Doppler Effect

The frequency of an ultrasonic wave reflected from a stationary structure is equal to that of the incident wave. If the beam is reflected by a surface which is moving

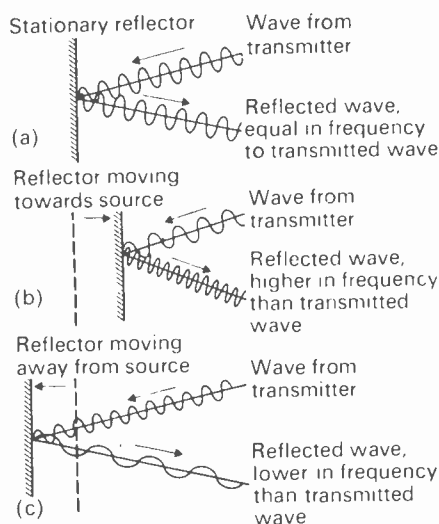


Fig. 5. The Doppler effect occurs when a wave is reflected from a moving surface, giving an upward or downward 'shift' in frequency as in (b) and (c).

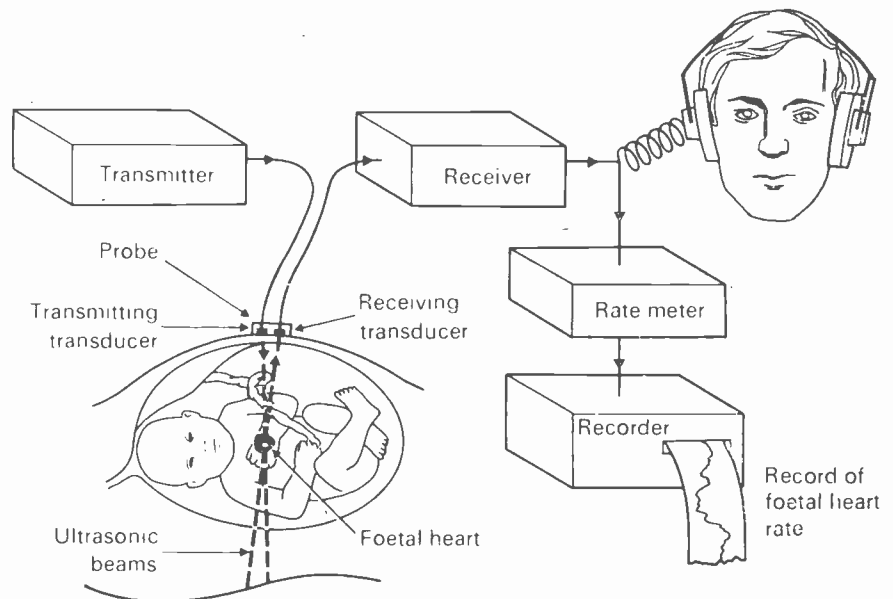


Fig. 6. One use of the Doppler 'shift' is to monitor the foetal heart. The echoes usually fall in the range of audible frequencies.

FEATURE : Ultrasonics

towards the ultrasonic source, the reflected wave is compressed into a shorter space. This means that the wavelength is reduced. It shows as an upward 'shift' in its frequency. Reflection by a surface moving away from the source gives a downward shift. This phenomenon, the well-known Doppler effect, conveniently gives shift frequencies that fall in the audible range when ultrasound is reflected by moving structures in the body such as heart valves or flowing blood. A simple instrument based on this makes it possible to detect the movement of the foetal heart. Similar instruments to measure blood flow allow peripheral arterial disease to be assessed.

Because Doppler shifted signals are received only from structures that move, two-dimensional maps of them can be built up by using a Doppler probe to scan the patient. In this way the distribution vessels close to the surface can be studied. Such information may obviate the need for X-ray angiography, which is a dangerous and expensive procedure.

It can also be combined with other information about structure position obtained by the pulse-echo method, making it possible to map out blood vessels within the body and measure the rate of blood flow at the same time.

The clinical value of ultrasonic techniques has already been proved, but their spread into general, everyday service will depend on the development of instruments that are simple to use. These, paradoxically, may be more complicated than the ones we already have. It will also mean training doctors and technicians to obtain and interpret results. But it is clear that ultrasonic diagnosis is, in many instances, the best and most economical way of getting the information essential to proper care of the patient.

ETI

SINCLAIR PRODUCTS*

Microvision TV £200, PDM35 £27.25, mains adaptor £3.25, case £3.25, 30kv probe £18.95, DM235 £47.50, Rechargeable battery units £7.95, Adaptor/charger £3.70, Case £8.50, 30kv probe £18.95, Cambridge prog calculator £13.15, prog library £2.95, mains adaptor £3.20, Enterprise programmable calculator £20.95.

S-DECS AND T-DECS*

S-Dec £3.39, T-Dec £4.44, µ-DeCA £4.52, µ-DeCB £6.73, 16 dil or 10T05 adaptors with sockets £2.14.

CONTINENTAL SPECIALITIES PRODUCTS*

EXP300 £6.21, EXP350 £3.40, EXP600 £6.80, EXP650 £3.89, EXP48 £2.48, PB6 £9.94, PB100 £12.74, LM1 £30.99, LP1 £33.48, LP2 £19.44.

TV GAMES

Send s.a.e. for free data. New racing car tv games chip AY-3-8603 plus economy kit £20.60, Tank battle chip AY-3-8710 plus economy kit £13.95, stunt motor cycle chip AY-3-8760-1 plus economy kit £12.50, 10 game paddle 2 chip AY-3-8600 plus economy kit £12.50, AY-3-8500 chip plus economy kit £8.95, modified shoot kit £4.96, rifle kit £4.95, colour generator kit £7.50. Attractively cased assembled tv games: Stunt cycle £25.95, tank war game £39.95, 4 game models (tennis, football, squash and pelota) black and white £11.95. Colour £14.50.

MAINS TRANSFORMERS

6-0-6V 100ma 79p, 1½a £2.35, 6.3V 1½a £1.89, 9-0-9V 75ma 79p, 1a £1.99, 2a £2.60, 12-0-12V 50ma 79p, 100ma 90p, 1a £2.49, 1.3V ½a 95p, 15.0-15V ½a £2.70, 30-0-30V 1a £3.59.

JC12, JC20 AND JC40 AMPLIFIERS

A range of integrated circuit audio amplifiers supplied with free data and printed circuits. JC12 6 watts £1.60, JC20 10 watts £2.95, JC40 20 watts £3.95. Send s.a.e. for free data on our range of matching power and preamp kits.

FERRANTI ZN414

IC radio chip £1.05. Extra parts and pcb for radio £3.85, case £1. Send s.a.e. for free data.

PRINTED CIRCUIT MATERIALS

PC etching kits economy £1.70, standard £3.82, 50 sq ins pcb 40p, 1 lb FeCl₃ £1.05, etch resist pens economy 45p, dato 73p, small drill bits 1/32 ins or 1mm 20p each, etching dish 88p, laminate cutter 75p.

BATTERY ELIMINATORS

3-way models with switched output and 4-way type jack 3/4V/6V 100ma £2.51, 6/7½/9V 300ma £2.75, 100ma radio models same size as a PP9 battery with press stud connectors. 9V £2.85, 6V £2.85, 4½V £2.85, 9V+9V £4.60, 6V+6V £4.50, 4½V+4½V £4.50, cassette recorder mains unit 7½V 100ma with 5 pin din plug £2.85, car converters 12V dc input, output 9V 300ma £1.50, output 7½V 300ma £1.50, output 3/4V/6/7½/9/12V 800ma £2.50.

BATTERY ELIMINATOR KITS

Send s.a.e. for free leaflet on range. 100ma radio types with press stud connectors. 4½V £1.80, 6V £1.80, 9V £1.80, 4½+4½V £2.50, 6+6V £2.50, 9+9V £2.50, cassette type 7½V 100ma with din plug £1.80, heavy-duty 13 way types 4½/6/7/8½/11/13/14/17/21/25/28/34/42V 1 Amp £4.85, 2 Amp £7.25, transistor stabilized 8-way types for low hum 3/4V/6/7½/9/12/15/18V 100ma £3.20, 1 Amp £6.40. Variable voltage stabilized models. 2-18V 100ma £3.60, 2-30V 1A £6.95, 2-30V 2A £10.95. Car converters 12V dc input, output 9/7½/6V 1A stabilized £1.95.

BI-PAK AUDIO MODULES

Send s.a.e. for data. S450 tuner £23.51, AL60 £4.86, PA100 £16.71, SP80 £4.47, BMT80 £5.95 MK60 £38.74, Stereo 30 £20.12.

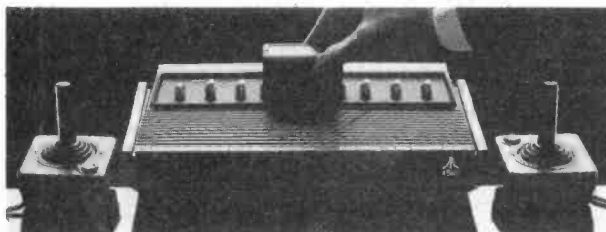
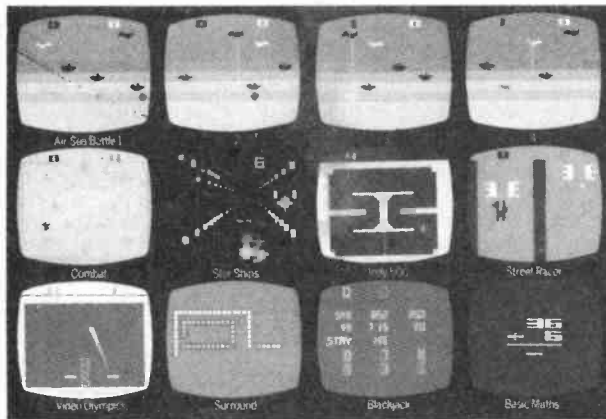
BULK BUY OFFERS

Minimum purchase £3 any mix from this section. 1N4148 1.3p, 1N4002 3.6p, BC212 8p, 741 8d1 15p, NE555 8d1 29p, 723 14d1 43p, AC76023N exact equiv of SN76023N with improved heat sink 79p. Plastic equivs of popular transistors. BC109 4.4p, BCY71 4.7p, BCY72 4.4p, Fuses 20mm x 5mm cartridge 25. 5. 1. 2. 3. 5Amp quickblow type 0.7p, antirupture type 3.4p, Resistors 5% E12 10 ohm to 10M, ¼W 0.9p, 1W 1.9p. Polyester capacitors 250V 0.1, 0.22, 0.33, 0.47mF 2.7p, 0.15mF 1.1p, 0.68mF 1.4p, 0.1mF 1.5p, 0.22mF 3p, 0.33mF 2.5p, 0.47mF 4.8p. Polystyrene capacitors E12 63V 15 to 8200pF 2½p. Ceramic capacitors 50V E12 22pF to 1000pF 1.7p, E6 1500pF to 33000pF 1.7p, 47000pF 2p. Electrolytics 50V, 47, 1, 2mF 5p, 25V 5mF 5p, 10mF 4p, 18V 22mF 5p, 33, 47, 100mF 6p, 220, 330mF 9p, 470mF 11p, 1000mF 12p, 2amers 400mF E24 2V7 to 33V 6.1p. Preset pots sub-miniature 0.1W horiz or vert 100 to 4M7 6.8p. Potentiometers ¼W 4K7 to 2M2 log or lin, single 26p, dual 76p.

SWANLEY ELECTRONICS

DEPT. ETI, 32 Goldsea Road, Swanley, Kent BR8 8EZ

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



Securicor delivery available
— Add £4.00.



Please make cheques and postal orders payable to
DISCOUNT COMPUTING, or phone your order
quoting BARCLAYCARD or ACCESS number.



**Discount
COMPUTING**

14 STATION ROAD · NEW BARNET · HERTS. TEL: 01-441 2922/01-449 6596
CLOSE TO NEW BARNET BR STATION — MOORGATE LINE
OPEN — 10 a.m. to 7 p.m. — Monday to Saturday

THE WORLD'S MOST ADVANCED
MICROPROCESSOR VIDEO GAME
DIRECT FROM THE USA

THE 'ATARI' VIDEO COMPUTER SYSTEM

— READY BUILT CARTRIDGE SYSTEM
EX-STOCK

192
GAMES

Just look at a few of the numerous games
available to you in multi-colour (on colour
TV's) with realistic sound effects.



This Video Computer System (based on Signetics 2550) is
available complete with the 27 game Combat Cartridge,
multi-function joysticks, mains adaptor and aerial switching
unit. Fully guaranteed for ~~£169.95~~ **£149.00**
12 months. (inc. VAT)



At present there are 9 cartridges available — a total of 192
games — plus many more on the way.
Price per cartridge) ~~£14.95~~ **£13.95**
(inc. VAT)

Full colour brochure available on request.

EASY BUILD SPEAKER DIY KITS
Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak simulate enclosures, two EM1 13" x 8" (approx.) woofers, two tweeters and a pair of matching crossovers. Supplied complete with an easy-to-follow circuit diagram, and crossover components.

STEREO PAIR Input 15 watts rms, 30 watts peak, each unit + p & p £5.50 Cabinet size 20" x 11" x 9 1/2" (approx.)

SPEAKERS AVAILABLE WITHOUT CABINETS.
It's the units which we supply with the enclosures illustrated. Size 13" x 8" (approx.) woofer, EM1 2 1/2" approx. £17.00 per tweeter, and matching crossover components. stereo pair Power handling 15 watts rms, 30 watts peak. + p & p £3.40

BUILT AND READY TO PLAY

SPEAKERS Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/2" (approx.) Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" approx.

Duo IIb **£17** PER PAIR p & p £6.50 Duo III **£52** PER PAIR p & p £7.50

EASY TO BUILD WITH SPEAKERS NOT TO SCALE

RECORD PLAYER KIT for the D-I-Y man who requires a stereo unit at a budget price, comprising ready assembled stereo amp module, Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phones socket and record/replay socket including 2 SPHERICAL HI-FI speakers **£19.95** p & p £4.05

AM/FM STEREO TUNER AMPLIFIER CHASSIS COMPLETE.
Ready built. Designed in a slim form for compact, modern installation. Rotary Controls Vol On/Off, Bass, Treble, Balance. Push Buttons for Gram, Tape VHF, MW, LW and 5 button rotary selection switch.

Power Supply Selenium Bridge—35V OC from 210-250V AC, 50Hz input.

Aerial Ferrite 8" x 3/4" built into chassis for LW and MW plus flying lead for FM aerial.

Power Output 5 watts per channel. Sine at 2% THD into 15 Ohm 7 watts speech and music.

Tape Sensitivity Playback 400mV/30K OHM, for max. output. Record 200mV/50K output available from 25KHz. (150mV/100K) deviation FM signal. Frequency Range (Audio) 50Hz to 17 KHz within ± 1dB.

Radio FM sensitivity for 30dB below limiting better than 10 uV. AM sensitivity for 20 dB S/N. MW 350 uV/Metre. LW 1mV/Metre. Size approx. length 16" x height 2 1/4" x depth 4 1/4" **£19.95** P & P £2.50

VALUE FOR PERSONAL SHOPPERS
160 16 VOLT MAINS TRANSFORMER, 2 1/2 amp. **£2.50**

BSR Record auto deck on plinth with stereo cartridge ready wired. **£11.95**

LED 5 function men's digital watch stainless steel finish. **£5.95**

LCD 5 function men's digital watch stainless steel finish. **£7.95**

LCD 8 Function CHRONOGRAPH men's digital watch, stainless steel finish. **£13.95**

125 Watt Power Amp Module **£13.95**

Mains power supply for above unit. **£3.50**

LENTEK Monitor loudspeaker cabinet size approx. 43 1/4" x 15 1/2" x 15 1/4" **£24.95**

100K Multiturn Varicap tuning pots, 6 for **£1.00**

MUSIC CENTRE CABINET with hinged smoke acrylic top, finished in natural teak veneers, size 30 1/4" x 14 1/2" x 7 1/4" approx. **£5.95**

MULLARD Built power supply **£1.50**

DECCA DC 1000 Stereo Cassette P.C.B. complete with switch oscillator coils and tape heads **£2.95**

DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3 1/4" approx. tweeter inc. crossovers **£20.00**

VIDEOMASTER Super Score TV Game with pistol mains operation **£14.95**

VIDEO MASTER Door Tunes (24 different titles) **£12.95**

Micro cassette tape recorder **£13.95**

7" TAPE TRANSPORT Mechanism—a selection of models from **£8.95**

DIGITAL CLOCK RADIO Mains operated. **£10.95**

STEREO RADIO/CASSETTE RECORDER, MW, LW, SW and Stereo VHF. 6 watts output. Battery mains operation. **£75.00**

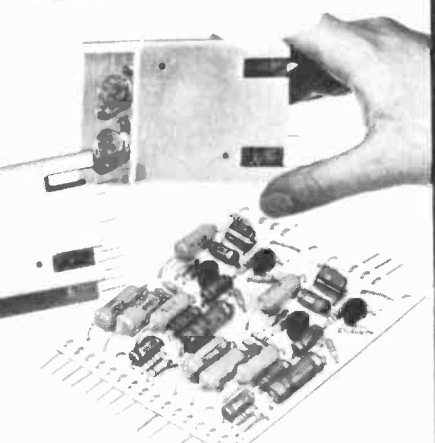
PORTABLE RADIO/CASSETTE RECORDER, AM/FM with clock, LW, MW, SW, VHF mains/battery operation. **£41.95**

Mullard

AUDIO MODULES IN BARGAIN PACKS
CURRENT CATALOGUE

PRICE & AT OVER 25 PER PACK
SEE OUR PRICES

- 1** PACK 1. 2 x LP1173 10w. RMS output power audio amp modules, + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input. **OUR PRICE p+p £1.00 £4.95**
- 2** PACK 2. 2 x LP1173 10w. RMS output power audio amp modules + 1 LP1184/2 Stereo pre amp for magnetic, ceramic and auxiliary inputs. **OUR PRICE p+p £1.00 £7.45**
- 3** PACK 3. 1 x LP1179/2 FM Tuning head with AM gang, 1 x LP1165/1 AM/FM IF module, 2 x LP1173/10w. RMS output power audio amp modules + 1 LP1182/2 Stereo pre amp for ceramic and auxiliary input. **OUR PRICE p+p £1.00 £9.95**



ACCESSORIES
Suitable power supply parts including mains transformer, rectifier, smoothing and output capacitors. **£1.00 p+p**

Recommended set of rotary stereo controls comprising BASS, TREBLE, VOLUME and BALANCE. **p+p 50p 95p**

THIS MONTH'S OFFER
added to our bargain packs
When you buy Pack 3 at £9.95, together with a mains transformer at £1.95 and a set of controls for 95p you receive FREE a Mullard LP1400 Decoder to match. **£12.85**
Listed at £11.90

TRADE ENQUIRIES INVITED



20 x 20 WATT STEREO AMPLIFIER
Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic, magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets, DIN speaker and input sockets, plus fuse. 20 x 20 watts rms. 40 x 40 watts peak. **£29.90** p & p £2.50

30 x 30 WATT AMPLIFIER KIT
For the experienced constructor complete in every detail. Similar facilities as Viscount IV amplifier. 60x60 peak. **£29.00** p & p £2.50

★ SPECIAL OFFER: PACKAGE PRICE WITH 30x30 KIT.
Mk II version operates into 4 to 15 ohms speakers. Specially designed by RT-VC for the experienced constructor, complete in every detail. Same facilities as Viscount IV amplifier. 60x60 peak, supplied with 2 GOODMANS COMPACT 12" Bass woofers with cropped sides. 14,000 Gauss magnet. 30 watts rms handling + 3/4" approx. tweeters and crossovers. **p & p £4.00 £49.00**

NOW AVAILABLE fully built and tested Output 30x30 watts rms. 60x60 peak. **p & p £2.50 £39.00**



50 WATT MONO DISCO AMP
£29.95
P & P £2.50
Size approx. 13 1/4" x 5 1/4" x 6 1/4"

50 watts rms. 100 watts peak output. Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume.

SPECIAL OFFER. The above 50 watt amp plus 4 Goodmans Type 8P. 8" speakers. Package price £45.00 + £4.00 P & P.



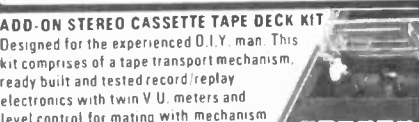
70 & 100 WATT MONO DISCO AMP
Size approx. 14" x 4" x 10 1/2"

Brushed aluminium fascia and rotary controls.

Five vertical slide controls master volume, tape level, mic level, deck level. PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre-fade level control (PFL) lets YOU hear next disc before fading in. VU meter monitors output level.

Output 70 watt 140 watt peak **£57** p & p £4.00

Output 100 watts RMS 200 watts peak. 100 watt **£65**



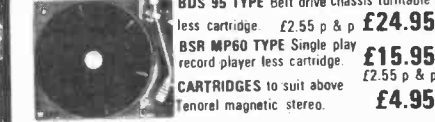
ADD-ON STEREO CASSETTE TAPE DECK KIT
Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control for mating with mechanism.

Specifications: Sensitivity - Mic. 0.85 mV ± 20K OHMS. Din. 40mV ± 400K OHMS. Output - 300mV RMS per channel ± 1KHz from 2K OHMS source. Cross Talk - -30db. Tape Counter - 3 Digit. Resettable. Frequency Response - 40Hz - 8KHz ± 6db.

Deck Motor - 9 Volt DC with electronic speed regulations.

Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject. **£19.95** p & p £2.50

Opt. extras: Mains transformer to suite **£2.50** + **£1** p & p.



BDS 95 TYPE Belt drive chassis turntable less cartridge. **£2.55** p & p **£24.95**

BSR MP60 TYPE Single play record player less cartridge. **£15.95** £2.55 p & p **£4.95**

CARTRIDGES to suit above tenorel magnetic stereo. **£4.95**

BSR automatic record player deck, cueing device and stereo ceramic head. **£2.55** p & p **£9.95**

GARRARD DECK CC10A. Record changer with cue and stereo ceramic cartridge. Size 12" x 8 1/2" approx. **£2.00** p & p **£7.95**

RTVC
323 EDGWARE ROAD, LONDON W2
21E HIGH STREET, ACTON W3 6NG
ALL PRICES INCLUDE VAT AT 12 1/2%
ALL ITEMS SUBJECT TO AVAILABILITY. Price correct at 1.10.78 and subject to change without notice.

Order by giving credit card number ONLY.

PORTABLE DISCO CONSOLE
Here's the big value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simple connects into your existing slave or external amplifier. **£64.00** p & p £6.50

Personal Shoppers EDGWARE ROAD LONDON W2 Tel: 01-723 8432. 9.30am-5.30pm. Half day Thursday. ACTON: Mail Order only. No callers. GOODS NOT DESPATCHED OUTSIDE UK

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

IC TEST CLIPS, clip over IC while still soldered to pcb or in socket. Gold-plated pins, ideal for experimenters or service engineers. 28 pin DIL £1.75, 40 pin DIL £2.00. Or save by buying one of each for £3.50.

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.

SLOW-MOTION MOTORS, 120V 50Hz 1RPM. Size approx. 2 dia. 1 1/2" deep, with 1/2" spindle. 60p each, or 2 for £1.00.

1 1/2V DC MOTORS (ideal for model makers, quite powerful). 50p each.

SUB-MINIATURE ROTARY SWITCHES, 4 x 5-way make contacts. Size approx. 3/4" dia., 1" deep, 3/16" spindle. 50p each.

30pf BEEHIVE TRIMMERS, Brand new, 4 for 50p. Min. 5pf AIR SPACE TRIMMERS, approx. 1/2" square, 3 for 50p.

Min. 5pf COMPRESSION TRIMMERS, 1/2" x 5/16" 4 for 50p.

LARGE ELECTROLYTIC PACKS, Contain range of large electrolytic capacitors, low and high voltage types, over 40 pieces. £3.00 per pack (+ 12 1/2% VAT).

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

A NEW RANGE OF QUALITY BOXES & INSTRUMENT CASES

Aluminium Boxes with Lids

AB10	5 1/4 x 4 1/2	75p
AB13	6 x 4 x 2	£1.00
AB14	7 1/2 x 2 1/2	£1.25
AB15	8 1/2 x 3	£1.50
AB16	10 x 7 x 3	£1.75
AB17	10 x 4 1/2 x 3	£1.50
AB25	6 x 4 x 3	£1.25

Vinyl Coated Instrument Cases

Blue Tops with Plain Lower Sections

Very smart finish

WB1	5 x 2 1/2 x 2 1/2	75p
WB2	6 x 4 1/2 x 1 1/2	£1.35
WB3	8 x 5 x 2	£1.80
WB4	9 x 5 1/2 x 2 1/2	£2.00
WB5	11 x 6 1/2 x 3	£2.25
WB6	11 x 7 1/2 x 3 1/2	£2.50
WB7	12 x 6 x 5 1/2	£2.85
WB853	8 x 5 1/2 x 3 1/2	£2.25

ALL BELOW — ADD 8% VAT

MIXED COMPONENT PACKS, Containing resistors, capacitors, switches, pots, etc. All new, and hundreds of items. £2.00 per pack, while stocks last.

IC AUDIO AMP PCB, Output 2 watts into 3 ohm speaker. 12V DC supply, size approx. 5 1/2" x 1 1/2" x 1 1/2" high, with integral heatsink, complete with circuits. £2.00 each.

NICAD CHARGER CONVERTER PCB, (Low power inverter) Size approx. 4" x 1 1/4" x 1 1/2" high. 12V DC supply. 60V DC output, through pot on pcb, for charging Nicads, etc. (ideal for charging portable batteries from mobile supply). Only needs one BFY50/51/52 or similar transistor, which can be mounted direct on the pcb pins on board, fitted with a star-type heatsink (not supplied). £2.00 each.

THE NEW EAGLE INTERNATIONAL CATALOGUE IS AVAILABLE ON REQUEST containing Audio, In-car, and test equipment, etc.

DECIMAL KEYBOARDS, pressure sensitive type, when pressed contacts go from 0V to approx. 25 ohms. Switches only, no encoders. Size approx. 3 x 3" with large square touch plates. 0.9 + Clear. A. B. Dual Watch, and spare. Few only. £2.00 while stocks last.

TRANSISTORS

BFY51 Transistors, 4 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.
BF152 (UHF amp/mixed), 3 for 50p.
2N3819 Fet, 3 for 60p.
BC148 NPN SILICON, 4 for 50p.
BC158 PNP SILICON, 4 for 50p.
8AY31 Signal Diodes, 10 for 35p.
741CG RCA OP Amps 4 for £1.00.
SCRS400V 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.

VALVES

QVQ03/20A (ex. equipment), £3.00.
QVQ03/10 (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 or 2 for £1.20.

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.
AEI CS10B/R MICROWAVE DIODES, up to X-Band, max. noise figure 8.5dB at 9.375GHz. 80p each.

DIE CAST BOXES

SIZE approx.	£1.25
4.3 x 2.3 x 1.2 (111 x 60 x 30mm)	£1.75
4.8 x 2.3 x 1.5 (121 x 60 x 38mm)	£2.10
4.8 x 3.8 x 1 (121 x 95 x 25mm)	£2.45
4.8 x 3.8 x 2 (121 x 95 x 51mm)	£3.10
6.8 x 4.8 x 2 (171 x 121 x 51mm)	£3.50
6.8 x 3.8 x 3 (121 x 95 x 76mm)	£4.47
6.8 x 4.8 x 4 (171 x 121 x 101mm)	£4.25
8.6 x 5.8 x 2 (222 x 146 x 51mm)	£5.30
10.6 x 6.8 x 2 (273 x 171 x 51mm)	

SPIRALUX Tools for Electronics enthusiasts SAE for list

4MHz XTAL PACKS (10 assorted xtals between 4MHz and 5MHz). Our selection only £1.00 pack.

SOLDER SUCKERS (Plunger Type)

Standard Model, £6.50

Skirted Model, £6.00

Spare Nozzles, 65p each

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. £1.60 each.

WELLER TCP2 temperature controlled soldering iron, and PUZD power unit (replaces Weller TCP1). Iron + PSU £30.00. Spare tips CC7 (standard), or K7 (finer tip) £1.50 each.

Slider Switches, 2 pole make and break (for can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

PLASTIC PROJECT BOXES, with screws on lids (In black ABS) with brass inserts:

Type NB1 approx. 3 x 2 1/2 x 1 1/2 45p each

Type NB2 approx. 3 1/2 x 2 1/2 x 1 1/2 55p

Type NB3 approx. 4 1/2 x 3 1/2 x 1 1/2 65p each

Type NB4 approx. 8 1/2 x 5 1/2 x 3 1/2 £1.50 each

Slider Switches 2 pole make and break (for can be used as 1 pole change-over by linking the two centre pins), 4 for 50p.

OSMOR 10V REED RELAY COILS (1k ohm coil) to fit 1/2" reeds (not supplied), 2 for 50p.

HF CHOKES wound on 1/4" x 1" long ferrites, 4 for 50p.

VHF CHOKES wound on 6-hole tubular ferrites, 5 for 40p.

ALL BELOW — ADD 8% VAT

DUAL T018 HEATSINKS 1 x 1/2 x 1/4 with screw terminals, 3 for 50p.
GLASS BEAD FEEDTHROUGH INSULATORS, solder-in type, overall dia. 5mm, pack of approx. 50 for 50p.
LARGE GLASS BEAD FEEDTHROUGH INSULATORS, as above but 8mm dia. pack of approx. 50 for 70p.
20V RELAYS, PCB mounting type, single pole change-over, 35p each.

10 7MHz SSB XTAL FILTERS (2.4kHz Bandwidth) Low imp. type, Carrier and unwanted sideband rejection min. -40dB (need 10 69835 & 10 70165 xtals for USB/LSB, NOT SUPPLIED). Size approx. 2 x 1 x 1. £10.00 each.

LOW PASS FILTERS (low imp. type), 2.9MHz, small metal encapsulation, size approx. 1 1/2 x 3/4 x 3/4 75p each.

ALL BELOW — ADD 12 1/2 % VAT

CELESTION B x 5 ELLIPTICAL SPEAKERS, 20 ohm, 3 watts rated, £1.50 each + 12 1/2% VAT.

VARCAP TUNERS, Multitune type, ELT1043/05, £5.00.

BSR AUTOCHANGE RECORD PLAYER DECKS with cue device, 33-45-78 rpm, for 7, 10, 12 records. Fitted with SC12M Stereo Ceramic cartridge and stylus. Brand new, £14.00 + 12 1/2% VAT.

GARRARD AUTOCHANGE RECORD PLAYER DECKS, Model 6 300, with cue device, 33-45-78 rpm, for 7, 10, 12 records. Fitted with KS418 Stereo Ceramic cartridge and stylus. Brand new, £16.00 + 12 1/2% VAT.

TV LINE LINEARITY COILS, Special offer 10 for £1.00.

TV SCANS COILS, B/W, to fit 110 degree tubes, £1.00.

TV Plugs (metal type), 4 for 50p.

3-pin Din Plugs, 4 for 50p.

Din 3-pin Line sockets, 15p each.

Din Speaker Sockets, 2-pin, 4 for 30p.

Dubilier Electronics, 500uF 450V, 2 for 50p.

Dubilier Electronics, 100uF 275V, 2 for 50p.

Plessey Electronics, 4700uF 63V, 3 for 50p.

TCC Electronics, 1000uF 30V, 3 for 60p.

Dubilier Electronics, 5000uF 35V, 50p each.

Dubilier Electronics, 5000uF 50V, 60p each.

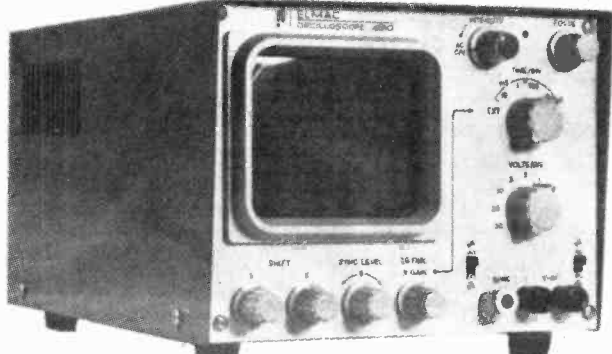
ITT Electronics, 6800uF 25V, high grade, screw terminals, with mounting clips, 50p each.

Resistor PKs, approx 300 pieces 1/2 to 2 watt types, mixed values, our selection, £1.00 each.

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

Buy direct from the importers
and get more scope for your money
KRAMER & CO

4" Oscilloscope for under £100
(as recommended by ETI)



Elmac 4810

SPECIFICATIONS

ELECTRICAL DATA
VERTICAL AXIS (Y): Deflection Sensitivity — 100mV/division. Bandwidth (between 3dB points) — DC — 5MHz. Input Attenuator — (calibrated) — 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50/div. Input Impedance — 1 Meg/40pf in shunt, Input Voltage — Max — 600V P.P.
HORIZONTAL AXIS (X): Deflection Sensitivity — 0.400mV/division. Bandwidth (between 3dB points) — 1Hz-350KHz. Gain Control — Continuous when time bases in EXT position. Input Impedance — 1 Meg, Input Voltage — Max — 600V P.P.
TIME BASE: Sweep Range (calibrated) — 100msec/div to 1µsec/div in 5 steps. FINE Control — Variable between steps — includes time-base calibration position. Blanking — Internal — on all ranges.
SYNCHRONISATION Selection — Internal, external. Synchronisation Level — Continues from positive to negative.
POWER SUPPLY: Input voltage — 115/220V AC ± 10% at 50/60Hz. Power Dissipation — 18W.
CRT DATA — 4in — flat face, single beam — Maximum high voltage — 1.5kV — Fitted with 8x10 division blue filter graticule.
PHYSICAL DATA Dimensions — 15cm (h) x 20.5cm (w) x 28cm (d). Weight — 4.3Kg (approx.). Stand — 2 position flat and inclined. Case — Steel, epoxy enamelled. Front Panel — Aluminium, enamelled epoxy printing.

Cash with order

£99 (+ £7.92 V.A.T. and £2.08 carriage. Total £109)

Oscilloscope Offer, Kramer & Co, 9 October Place, Holders Hill Road, London NW4 1EJ

Tel: 01-203 2473, Telex 888941, Attn: Kramer K7 University, School. Company and Government orders accepted by telex and telephone. Callers by appointment only.

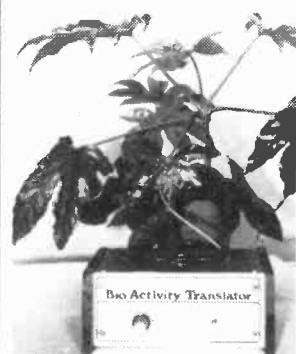
LISTEN TO THE SECRET WORLD OF PLANTS

As featured on Horizon, Nationwide, Radio and Worldwide Press

FIRST TIME IN THE U.K. IN KIT FORM, THE REVOLUTIONARY CONCEPT OF A BIOLOGICAL AMPLIFIER AND SOUND SYNTHESISER IN ONE UNIT, THE AMAZING

Bio Activity Translator

- ★ Experience the unique musical form of plants
- ★ Hear the beautiful patterns of sound — created by their natural response
- ★ Compare house plants reactions to people — with the distinct tunes of those outside
- ★ Easy to operate, internal speaker and batteries



The naturally generated bio electrical potential across a plant leaf is picked up by 2 carbon foam electrodes. When amplified and filtered, a VCO, VCA and other ingenious synthesiser circuits are programmed by the control voltage from the plant to produce tracking sequences of notes. These follow in pitch, rhythm and volume the ever changing signal from the plant.

The Kit includes 6 I.C.'s, 2 transistors, all high quality components, tinned and drilled fibreglass p.c.b., loudspeaker and comprehensive assembly instructions. Also included is a free case, ready punched, with wooden end cheeks and stick-on silk-screened front panel for a really professional finish. Runs on 2 4 1/2-volt batteries (not supplied).

SPECIAL INTRODUCTORY OFFER INCLUDES FREE CASE
KIT £19.90 ASSEMBLED AND TESTED £27.50 Price includes P & P and VAT

Allow 21 days for delivery. Send cheque or postal order to (Mail Order only)

JEREMY LORD SYNTHESISERS (DEPT. ETI)
7 LONDON STILE, LONDON, W.4

audiophile.....

A woeful tale of the pre-amp to make you red in the face this month. Crimsons CPR1 considered by Ron Harris who recovered enough to visit Sony's launching of sixty new models!

MEANWHILE back at the Crimson pre-amp, I shall begin this month by finishing what I began last, and furnishing details of the CPR1 module. To begin with, quoting specs would be largely superfluous in this context, but as I know there are some of you out there high on numbers, try these for size:

SENSITIVITY: 3.4 mV RMS (1kHz) — mag
70 mV RMS 1kHz all others

for 770 mV RMS output

SIGNAL/NOISE: —70dB unweighted 10kHz bandwidth
mag
—86dB unweighted 10kHz bandwidth
others

CROSSTALK: —80dB 20 Hz-20 kHz
THD: .008% any level below clipping

There are pages of figures in the leaflets Crimson issue for free, so if you've at all interested get after one of those. The nice thing about these specs is their completeness — nothing hidden away here in shrouds of triviality. All the parameters are given as test results under very precise conditions. I could find no reason to argue with any of them and as I'm usually mean and nasty about such things Crimson should take that as praise indeed.

Building Up To It

Power requirements are simply 15-0-15 at under 100mA, and mine measured in the region of 40mA per channel while in full flow. Crimson naturally produce a PSU for this, and it is termed not unreasonably REG1.

The pre-amp arrives as an assembled PCB with set of application notes, and as such cannot be considered a kit by any but the most stretched imagination. Not for the beginner this, as a fair bit of experience comes in most handy — although the notes are very good (but poorly produced) and if you're feeling brave by all means get stuck in — I shan't say 'I told you' — not too loud anyway.

After a few minutes fussing around with pen and paper I decided to house pre-amp and PSU in separate boxes — with appropriate nod in direction of Meridian — for reason of neatness and hum foiling. Let me say now that these circuits are good enough to merit such attention.

As there are no tone controls, metalwork is simplified I'm glad to say, and for a basic system should be very easy indeed.

Crimson make out a very good case in their design notes for doing things their way, but nonetheless there are a few things I would like to disagree with.

Firstly they feed straight into the volume control with auxiliary inputs via the selector switch. This presents the equipment driving into the amp with a varying load, and I would personally prefer to see a high impedance buffer in there, with a lower sensitivity, than the 70 mV now prevailing, and a higher input impedance. A small point perhaps, but under music conditions a constant load is to be preferred I feel.

Secondly the magnetic input is 'fairly' standard although better than most. I would differ from Crimson philosophy enough to prefer the idea of buffering the cartridge input at a constant value, say $47k\parallel 200p$ with unity gain in the first stage, picking up equalisation over two further stages both run at lower gain than usual. This configuration results in a cleaner sound with better transient performance providing the capacitance of each stage is carefully designed for.

I'm offering up these ideas for perusal, not criticising Crimson in particular, its just that the Crimson approach encourages you to drag out your personal theories and give 'em a good airing. I'd be very interested to hear from any of you out there with your ideas on how audio design should be done — we'll print the best we get.

Back To Wires

Anyway to return to the point the CPR1 auditioned very well indeed. Mind you our first sample gave me a hard time for a while. It kept doing things it couldn't do and doing them when I least expected it. After a few bottles of Vallium and several hair pulling sessions with Crimson we discovered I'd been given a non-production board. A quick GPO job and we're back in business. Sanity is saved.

I still don't know what the odd sample was up to — and don't intend to find out any further that way lies madness. I suspect Crimson save that board to assassinate reviewers in the most fiendish way possible. Who'd believe it was murder?

The production model has never given the slightest problem and has behaved impeccably throughout. I compliment Crimson on the attentive way they panicked along with me over the rogue PCB, several poor unsuspecting boards now on soak test because of my nervous breakdown.

Inputting Pickups

To use this input, you add a passive network to the input to optimise loading for the particular device in use. Crimson themselves recommend adding several networks and switches to increase flexibility. I don't. Switches at this signal level are a menace — if you don't believe me, see Stan Curtis's article elsewhere in this

issue. Leave out the switches and hardware for your choice of pickup — how often do you change anyway?

With the switches added a thickening of detail occurs, and transients don't transient nearly as well.

Other inputs are straightforward, although perhaps a little low on input impedance. Noise and hum were commendably low on all inputs, and the separate boxes earn their worth on first power-up. The ten second switch-on blank period to eliminate 'clunks' is a great idea, although on both my samples the delay was so long I almost had time to go make a cup of tea before power came through.

It can be most detrimental to confidence to be left standing there, soldering iron still smoking, poised over the completed unit hand on power switch counting off seconds wondering why the b... hell it hasn't come on yet. Smiles fade rapidly like that.

Listen In

On magnetic input the Crimson CPR1 produced a very nice sound indeed, of very high quality with good detail and fair extension into the bass registers. On a quick A-B with a very highly priced integrated amp the CPR1 surprised me by showing itself clearly superior! OK wiseguy — wheel out the heavies.

Now my personal idol amongst pre-amps is the Lecson AC1 which I feel has never been approached for quality of reproduction, at any price. As such it makes an excellent reference against which to judge lesser machines. However not everyone agrees, and a champion of the Naim offered up his favourite to give the Crimson a run.

You can see from the opposition how seriously the CPR1 managed to get itself taken. Against the Lecson it was frankly outclassed. The AC1 had better depth, and better bass control. Treble came out smoother from the Lecson showing up the Crimson as slightly hard in this register. Mind you the Lecson costs nearly ten times as much and the Crimson gave a very good account of itself.

Comparing it with the Naim unit nearly lost me a friend. I preferred the CPR1! There was not much in it mind you, and Crimson can be justly proud to have produced a home build design capable of this level of performance.

grumbles

A few niggles. The balance control is very limited in operation. More so than is even trendy, never mind useful, and a little extra swing would do no harm. I'm not at all happy about those auxiliary inputs really, but they seemed to cause no problems so I'll shut up about them.

In order to obtain the level of performance the design can offer very careful construction is required. All cables screened. All as short as possible. Good soldering. Good earthing. Isolated PSU and sound routing of cables carrying HT — away from anywhere at signal level. Leave the on-off switch on the PSU box so that mains need not even enter the case.

Also the subjective quality, although of a very high quality, is a little hard, and judged against the best designs around slightly lacking in detail. Still none of this detracts from the fact that here we have a DIY amplifier that can compete with the very best commercial units, and make mincemeat of many far higher priced designs. Highly recommended.

Outlook: Warm and Sony

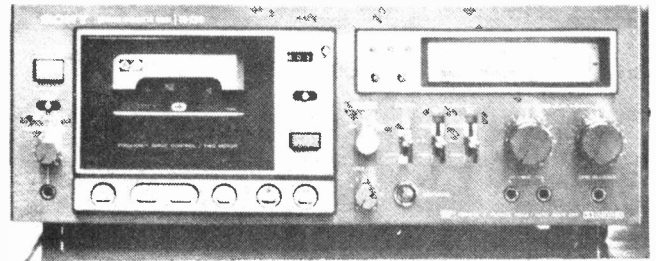
Sony have gone berserk. Only gone and scrapped practically their entire hi-fi range they have and launched no less than 60 new models if you please. Its enough to give leaflet collectors a heart attack. There is some very clever gadgetry in amongst the flock, and scattered here before you are some of the gems.

The TA-E88 looks very, very interesting indeed, representing as it does the state-of-the-art for Japanese pre-amp design. I'm at present still on my knees to Sony (and my trousers are wearing out fast) to get a closer look so hopefully more details on that one later (Please Mr Sony? ... Sir?).

The G1 and G7 speakers came as a surprise too, they're better than any oriental offering previously to assail my ear drums, and are capable of giving any competitor a good run for its cones.

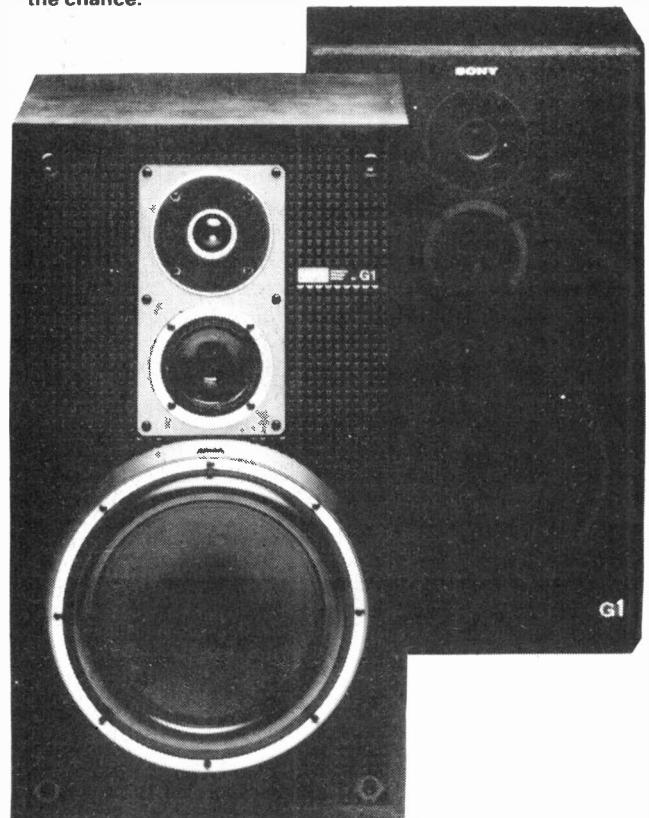
They have divided up the dealers too, creating a new super-fi franchise. This basically means that only the best dealers can sell the best of the range, although the division looks to be a bit unsure in places.

ETI

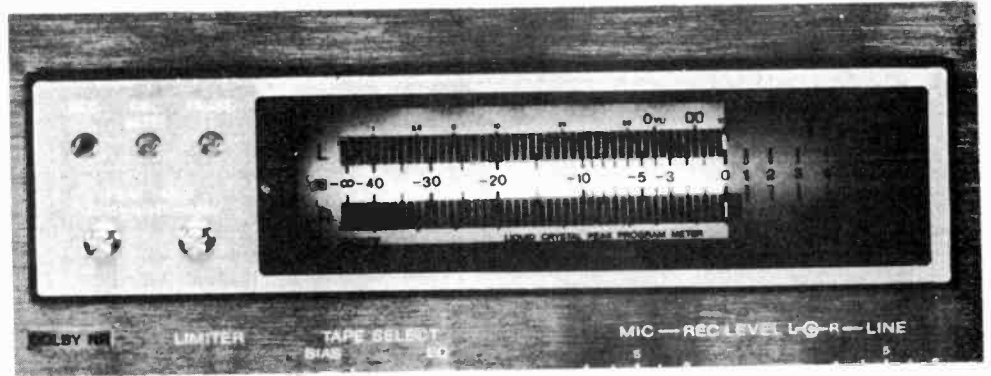
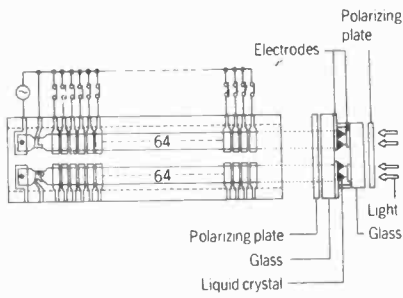


And here we have the TC K8B the new £469 cassette deck released as part of the super-fi Sony range. It incorporates that magnificent LCD display (details on the right) and on the short listen so far gave an excellent audio account of itself.

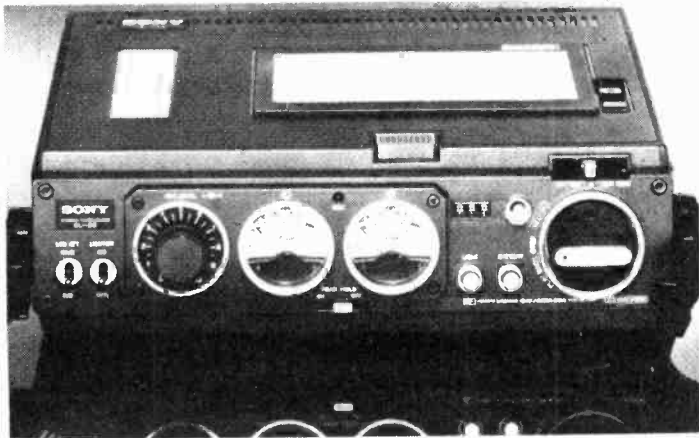
Below: the G1 speakers. Very good indeed for the price (circa £190 the pair) and deserving of none of the usual anti-Japanese speaker bias. Give them a listen if you get the chance.



LCD Peak Programme Meter

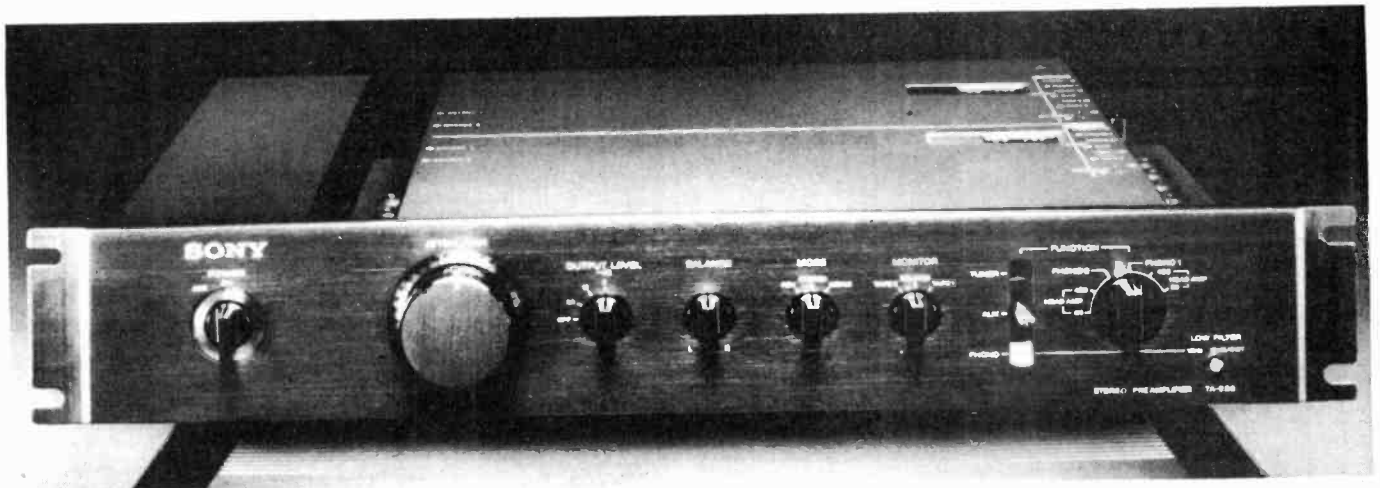


Above: the LCD level meter as used in the TCK8B in close-up. This uses 64 segments to indicate signal level, and has red settable stops to hold peak values. The colours are nice too!



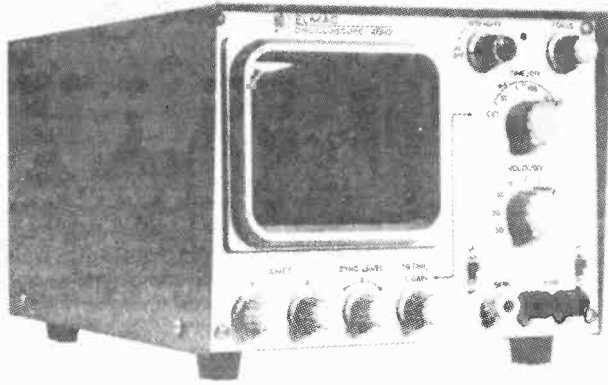
This is a nice touch. A portable Elcaset machine. Gives really nice reproduction and is quite easy to cart around. All the controls are mounted so as to be accessible when in mid-carry. The format would seem to be ideal for this usage. All the quality of a reel-to-reel and no fiddling about while rapidly unspooling tape in a gale! Priced sensibly at £459 and called the EL D8 for the wandering rich amongst you.

Not that I'm obsessed with cassette decks or anything, but here's another one. The TC K6B this time. It's main little gimmick is the MPU program selector. That little LED display in the centre can be stepped to read the number of the track you wish to hear. The machine will promptly go and find it and play it for you. Again LCD level meters, although not as good as the TC K8Bs obviously less segments. Below: The incredible TAEB8. The unit has two COMPLETELY separate channels inside its box. Selectable phono load on one input, and one straight in for people who don't like switches in line (Like me) at this low level. Moving coil pre-pre amp is standard of course. Price £699 (What did you expect?)



AS RECOMMENDED
BY ELECTRONICS TODAY
INTERNATIONAL JULY 1978

4" Oscilloscope



ALTERNATIVE MODEL
3" OSCILLOSCOPE
otherwise specification as 4" model

£85.50 FROM STOCK
Add VAT £7.34
Carriage £1.50

FROM STOCK
£99
Add VAT £7.92
Carriage £2.08
Appointed
London Stockist

SPECIFICATIONS

ELECTRICAL DATA

VERTICAL AXIS (Y)

Deflection Sensitivity
Bandwidth (between 3 dB points)
Input Attenuator — (calibrated)

Input Impedance

Input Voltage — Max

HORIZONTAL AXIS (X)

Deflection Sensitivity
Bandwidth (between 3dB points)

Gain Control

Input Impedance

Input Voltage — Max

TIME BASE

Sweep Range (calibrated)

FINE Control

Blanking

SYNCHRONIZATION

Selection

Synchronization Level

POWER SUPPLY

— 115/220V AC ± 10% at

50/60Hz

Power Dissipation

CRT DATA

PHYSICAL DATA

Dimensions

Weight

Stand

Case

Front Panel

— 100m V/division

— DC — 5MHz

— 9 step 0.1, 0.2, 0.5, 1, 2, 5,

10.20 50V/div

— 1 Meg/40 pf in shunt

— 600V P.P

— 0-400mV/division

1Hz-350KHz

— Continuous, when time

base in EXT position

— 1 Meg

600V P.P

— 100msec/div to 1µ sec /

div in 5 steps

— Variable between steps —

includes timebase calibration

position

— Internal — on all ranges

— Internal, external

— Continues from positive to

negative

Input Voltage

— 18W

— 4in. — flat face, single

beam

— Maximum high voltage —

1.5kV

— Fitted with 8x10 division

blue filter graticule

— 14cm (h) x 20.5cm (w) x

28cm (d)

— 4.3Kg (approx)

— 2 position, flat and in-

clined

— Steel, epoxy enamelled

— Aluminium, enamelled

epoxy printing

Also available from 248 Tottenham Court Road
London W1
301 Edware Road, London W2

HENRY'S RADIO All mail to: Henry's Radio 404 Edgware Rd, London W2
LONDON W2: 404 6 Edgware Road. Tel. 01 723 1008

Greenbank Electronics

CMOS

These cut prices for Amateur Users and Export. Note: industrial users — quantity prices available.

Mostly Motorola, RCA			
4000	15p	4050	48p
4001	17p	5051	72p
4002	17p	5052	72p
4006	£1.05	4055	72p
4007	19p	4054	£1.10
4008	87p	4055	£1.28
4009	50p	4056	£1.34
4010	50p	4057	£25.70
4011	18p	4059	£4.80
4012	18p	4060	£1.15
4013	42p	4061	£15.67
4014	86p	4062T	£10.00
4015	89p	4063	£1.09
4016	45p	4064	N/S
4017	89p	4065	N/S
4018	89p	4066	57p
4019	48p	4067	£3.80
4020	89p	4068	22p
4021	91p	4069	20p
4022	86p	4070	23p
4023	20p	4071	21p
4024	66p	4072	21p
4025	19p	4073	21p
4026	£1.80	4075	23p
4027	45p	4076	85p
4028	81p	4077	23p
4029	99p	4078	21p
4030	58p	4081	20p
4031	£2.05	4082	21p
4032	£1.00	4083	74p
4033	£1.45	4086	73p
4034	£1.96	4089	£1.50
4035	£1.11	4093	63p
4036	£2.45	4094	£1.90
4037	£1.00	4095	£1.05
4038	£1.08	4096	£1.05
4039	£2.45	4097	£2.45
4040	£1.05	4098	£1.10
4041	80p	4099	£1.45
4042	75p	40061	N/S
4043	94p	40100	£2.50
4044	90p	40101	£1.61
4045	£1.45	40102	£2.12
4046	£1.28	40103	£2.12
4047	87p	40104	£1.09
4048	58p	40105	£1.06
4049	48p	40106	71p

(National etc.) 74C00 Series

74C00	24p	74C85	£1.29
74C02	24p	74C86	64p
74C04	24p	74C89	£4.38
74C08	24p	74C90	85p
74C10	24p	74C93	85p
74C14	£1.41	74C95	£1.04
74C22	24p	74C107	£1.22
74C24	24p	74C110	£4.12
74C32	24p	74C151	£2.46
74C42	92p	74C154	£3.67
74C48	£1.38	74C157	£2.20
74C73	54p	74C160	£1.10
74C74	56p	74C161	£1.10
74C76	54p	74C162	£1.10
74C83	£1.29	74C163	£1.10
74C905	£7.26	74C164	£1.04
74C906	54p	74C165	£1.04
74C907	54p	74C173	90p
74C908	96p	74C174	£1.51
74C909	£1.63	74C175	90p
74C910	£6.78	74C192	£1.10
74C911	78p	74C193	£1.10
74C912	£7.13	74C194	£1.04
74C913	£1.13	74C200	£6.78
74C914	£1.41	74C221	£1.36
74C915	£1.10	74C901	54p
74C916	£1.06	74C920	£11.83
74C917	£4.84	74C921	£11.83
74C918	£4.84	74C922	£3.66
74C919	£4.84	74C923	£3.73
74C920	£11.83		

QUARTZ

32.768 KHz	£3.23
100.0 KHz	£3.62
100.0 KHz	£3.92
200.0 KHz	£3.92
262.144 KHz	£3.92
307.2 KHz	£3.92
312.5 KHz	£3.92
453.0 KHz	£3.92
1.000 MHz	£3.62
1.008 MHz	£3.92
1.8432 MHz	£3.62
2.000 MHz	£3.62
2.09132 MHz	£3.23
2.4576 MHz	£3.62
2.56250 MHz	£3.62
3.000 MHz	£3.62
3.2768 MHz	£3.23
3.579545 MHz	£1.95
4.000 MHz	£2.90
4.032 MHz	£3.23
4.096 MHz	£3.23
4.194304 MHz	£3.23
4.433619 MHz	£1.25
4.608 MHz	£3.23
4.800 MHz	£3.23
4.915 MHz	£3.23
5.000 MHz	£3.23
5.120 MHz	£3.23
5.185 MHz	£3.23
6.000 MHz	£3.23
6.144 MHz	£3.23
6.400 MHz	£3.23
6.55360 MHz	£3.23
7.000 MHz	£3.23
7.168 MHz	£3.23
7.680 MHz	£3.23
7.85424 MHz	£3.23
8.000 MHz	£3.23
8.38608 MHz	£3.23
9.800 MHz	£3.23
10.000 MHz	£3.23
10.700 MHz	£3.23
14.31818 MHz	£3.23
16.000 MHz	£3.23
18.432 MHz	£3.23
20.000 MHz	£3.23
22.1184 MHz	£3.23
27.648 MHz	£3.23
38.6666 MHz	£3.23
48.000 MHz	£3.23
100.000 MHz	£3.23
116.000 MHz	£3.23

SC/MP KITS

DON'T WORK!
You've already got a commercial micro-computer kit, and you know that, due to incomplete address decoding and various hardware limitations, it is hardly any more use than a log!

You're now ready to put SC/MP to WORK. You need a separate circuit board for the SC/MP chip, your own or your existing kit's programme in ROM, some RAM working space, and Input/Output ports.

You need: a "SC/MP PROTO BOARD!"
Price £5.95
(The board is double sided, with a gold plated edge connector and has numerous features. Further details on request.)

MPU CHIPS

COSMAC 1802	£15.95
SC/MP II (4MHz)	£7.95
8080	£7.95
14500 'ICU'	£5.56
8800	£9.50
FB	£9.30
Z80 (2 1/2 MHz)	£16.50
Z80A (4 MHz)	£19.95

DATA

Note: In this section all data books are subject to 0% VAT. For postage see 'Terms' at foot of page.

c650 page COSMOS Databook (RCA) £4.95
c200 page McMOS Databook (Motorola) £3.50
"MC 14500B ICU Handbook" (Motorola) £1.50
"Understanding Microprocessors" (Motorola) £2.75
"A Guide to KIRBUG" (Kermitron) £1.00
"A Guide to SC/MP Programming" (Kermitron) £3.50
16-page data for INS 8154 (ISP-8A/650) (National) 50p
20-page data for SC/MP II (National) 50p

MICROPROCESSORS

COMPUTER KITS

Check stock before ordering	
MK 14	£39.95
NASCOM 1	£197.50

ROM CHARACTER GENERATORS

MCM 6571/6576	£6.71
MK 5202	£15.20
RD-32513	£5.50
OM 8678 CAB/DM 8678 BWF	£14.27

NEW! VDU-from-TV CHIP

Thompson-CSE TV-CRT controller (16 line by 64 characters)
SF.F96364 £11.75
(The ideal companion to NIBL firmware to turn your TV into a Personal Computer.)

ROM SOFTWARE ("FIRMWARE")

MC 6830-7 (Mk-Bug)	£13.70
S204 (N.S. Kit-Bug)	£14.95

FANCY A NIBL?

Add this superior version of TINY BASIC to SC/MP II, and make your computer INTERLUCE! Available in two forms, both 4k x 8 bit (ISP-8F/352 (2 x 2316A ROMS) £46.90 (Prices include booklet)

STATIC RAMS

6810 (128 x 8)	£3.10
2101 (256 x 4)	£2.25
2102 (1k x 1)	£1.20
2111 (256 x 4)	£1.75
2112 (256 x 4)	£2.25
2104 (4k)	£15.95
2114 (1k x 4)	£11.95

EPROM (not erasable)

MC 2708P	£5.78
----------	-------

SPECIAL: Z80 DATA PACK

£13.95
A set of the following Z80 data manuals and all the related data we can find of interest to the Z80 user:
c80-page Z80-CPU Technical Manual
c10-page Z80-CPU Product Specification
c25-page Z80-P10 Technical Manual
c200-page Z80 Programming Manual
c25-page Z80 Micro Reference Manual

'VERDBOARD'

Still stocked, please see last month's issue for prices.

SOLDERCON PINS

100/1000	50p/£3.50
----------	-----------

DIL SOCKETS

8/14/16 pin	10p/12p/13p
24/28/40 pin	30p/40p/50p

TIMER ICs

NE555/556	29p/49p
-----------	---------

OP-AMPS

(All Microchips)

CA 3130E	84p
CA 3140E	35p
UA 741 (Texas)	22p
6x741 (Texas)	£1.00

LED DISPLAYS

DL-704E/707E	85p
DL-727E/728E	£2.00
DL-747E/750E	£1.80
FND 500/500	£1.20

LIQUID CRYSTAL DISPLAY

4 x 0.5" Digits 40 pin DIL	£8.95
----------------------------	-------

CLOCK CHIPS

AY-51224A	£2.60
MK 50253	£5.50
MK 50362/50366	£6.50
MC 14440 (LCO)	£11.58

SIX DECADE COUNTERS

MK 50395/6/7	£8.75
MK 50398/9	£6.20

VIDEO

(Add

electronics today
MAY 1978 INTERNATIONAL
45p
ROBOTS
to reality?
TV-TALK
MULTIPLE OFFERS INSIDE

KEY:

- 1: The bit of chocolate you thought you'd leave for later.
- 2: Coffee stains (instant).
- 3: A useful-sized bit of stiff paper to stop the window from rattling.
- 4: Rough calculations for your new combined egg timer/laser cannon project.
- 5: ETI makes a fair soldering iron stand.
- 6: The dog insisted on carrying your copy to you along with your slippers.

WHAT A BIND!

Half our orders for binders are repeats: we think that says a lot for their quality. At £3.00 all inc. you get a great deal of peace of mind too!

ETI Binders
25-27 Oxford Street,
London W1R 1RF.

SINTEL

THE SINTEL SIX DIGIT MAINS CLOCK KIT

with BLEEP ALARM and TOUCH SWITCH SNOOZE

- HIGH BRIGHTNESS DISPLAY
- AUTOMATIC INTENSITY CONTROL
- DEEP RED DISPLAY FILTER
- SLIM WHITE CASE 205mm x 40mm x 140mm
- BATTERY BACKUP
- CRYSTAL CONTROL FOR IMPROVED ACCURACY



Order as **ACK + BBK + YTK** £34.50
The ACK is also available without battery backup and crystal control. Order as **ACK** £28.80
The kit is supplied complete with the exception of a mains plug, cable and battery

DATABOOKS

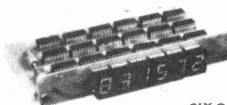
BEST OF BYTE Volume 1 380 pages illustrating Basic	£11.95
Intel Memory Design Handbook	£2.45
Intel 8080 Microcomputer Systems User's Manual	£5.20
Intel 8085 Microcomputer Systems User's Manual	£6.50
Motorola Booklet From the Computer to the Microprocessor	£1.80
Motorola CMOS Databook (Vol 5 Series B)	£3.50
Motorola M6800 Microprocessor Applications Manual	£12.95
Motorola M6800 Programming Manual	£5.35
National SC/MP Intronik 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-P10 Technical Manual	£3.30
DATASHEETS at 75p each on IM6100, 6800 SC/MP, CDP 1802, 2650, TMS5501, TMS8080, 9131, Z800P, Intel 8085. Also free data on some components	

Some Popular Memories available from SINTEL

(See ETI DATA SHEET SPECIAL July 1978)

2102 450 nsec 1K STATIC RAM	£1.85
2102 650 nsec STATIC RAM	£1.85
2708 1K x 8 bit UNERASABLE ROM	£8.80
6508 600 nsec 1K STATIC RAM	£8.05

ASSEMBLED LATCHED COUNTER MODULES



SIX DIGIT TTL COUNTER MODULE

Our range of Industrial Latched Counter Module Kits is now available ready-built. These counters use both CMOS and TTL ICs and will save you considerable design, purchasing, building and de-bugging time. Each module uses a set of red LED displays and features a single in-line plug and socket. Instructions are provided. For full details please send for Catalogue.

	TTL				CMOS			
	Part No.	Built	Part No.	Kit	Part No.	Built	Part No.	Kit
2 digit	401-484	£13.22	926-412	£10.52	995-568	£13.02	548-478	£10.42
4 digit	715-484	£23.38	857-412	£17.98	512-568	£22.63	869-470	£18.11
6 digit	293-484	£33.76	721-412	£25.66	393-568	£32.31	191-478	£25.85

NEW PRICES AND SOME NEW CMOS ADDITIONS

If you need your CMOS by return - buy it from SINTEL

CD4000	0.15	CD4027	0.44	CD4051	0.82	CD4086	0.64	CD40182	1.40
CD4001	0.17	CD4028	0.77	CD4052	0.82	CD4089	1.39	CD40192	1.40
CD4002	0.17	CD4029	1.03	CD4053	0.82	CD4093	0.80	CD40193	1.40
CD4006	1.04	CD4030	0.50	CD4054	1.04	CD4094	1.69	CD40194	1.19
CD4007	0.18	CD4031	2.00	CD4055	1.18	CD4095	0.94	CD40257	1.48
CD4008	0.87	CD4032	0.89	CD4056	1.18	CD4096	0.94	CD40502	0.81
CD4009	0.50	CD4033	1.25	CD4059	4.29	CD4097	3.35	CD4510	1.01
CD4010	0.50	CD4034	1.71	CD4060	1.00	CD4098	0.98	CD4511	1.25
CD4011	0.18	CD4035	1.08	CD4063	0.98	CD4099	1.65	CD4514	2.47
CD4012	0.20	CD4036	2.86	CD4066	0.55	CD40100	2.50	CD4515	2.82
CD4013	0.43	CD4037	0.85	CD4067	3.35	CD40101	1.61	CD4516	1.01
CD4014	0.83	CD4038	0.96	CD4068	0.20	CD40102	2.13	CD4518	0.97
CD4015	0.83	CD4039	2.78	CD4069	0.20	CD40103	2.13	CD4520	1.04
CD4016	0.48	CD4040	0.97	CD4070	0.46	CD40104	1.10	CD4527	1.43
CD4017	0.79	CD4041	0.75	CD4071	0.20	CD40105	1.06	CD4532	1.21
CD4018	0.83	CD4042	0.69	CD4072	0.20	CD40106	0.62	CD4555	0.78
CD4019	0.50	CD4043	0.88	CD4073	0.20	CD40107	0.69	CD4556	0.78
CD4020	1.11	CD4044	0.84	CD4075	0.20	CD40108	5.38	MC14528	0.93
CD4021	0.80	CD4045	1.26	CD4076	1.17	CD40109	1.03	MC14553	4.43
CD4022	0.82	CD4046	1.20	CD4077	0.39	CD40160	1.19	IM6508	8.05
CD4023	0.18	CD4047	0.89	CD4078	0.20	CD40161	1.19		
CD4024	0.70	CD4048	0.50	CD4081	0.20	CD40162	1.19		
CD4025	0.20	CD4049	0.50	CD4082	0.20	CD40163	1.19		
CD4026	1.55	CD4050	0.43	CD4085	0.64	CD40181	3.40		

For our full range of components send for Free Catalogue

Our Offices are at 209 Cowley Road, Oxford, but please do not use this as a postal address
PRICES VALID UNTIL 31st AUGUST 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.



TOPS THE PACK!

COMPONENTS - Now over 1,000 types in stock.
KITS - See the new range of low-cost 'ELEKITS'.
MODULES - New ready-built functions.
SERVICE - 1st Class same day despatch.
QUALITY - All guaranteed products.
PRICES - Many reductions!
MAGAZINE PROJECTS - Trouble-free!

LOOK

Our 2nd edition illustrated catalogue is now available. The much increased range shows many welcome price reductions.

INTRODUCING FABULOUS ELEKITS

The new range of easy build kits complete with simple to follow instructions. Battery powered (not supplied). With case.

- ✳ BURGALAR ALARM ✳ ROULETTE
- ✳ BICYCLE SOUND FLASHER
- ✳ WATER LEVEL ALARM ✳ SIREN
- ✳ BLINKER ✳ TIME SWITCH

Easy build introduction to electronics. Many hours of enjoyment. **NOW AVAILABLE!**

Many others in preparation - included in full ACE catalogue - send S.A.E. for free brochure of kit range.

Mini ORGAN
only **£7.95**

MORSE TRAINER
only **£4.95**

PRICES Inc.VAT

I enclose 30p*, please send catalogue.

Name _____
 Address _____

* Refundable with future orders over £5.00.

CHROMASONIC electronics

56 FORTIS GREEN ROAD, MUSWELL HILL, N10 3HN
 TELEPHONE: 01-883 3705

OUR LATEST CATALOGUE

CONTAINS FREE
45 pence WORTH OF VOUCHERS

40p
INC P.&P.

CONTAINS MICROPROCESSORS +BOARDS, MEMORIES, TTL, CMOS, ICs, PASSIVES, ETC., ETC.

SUPERSAVERS

ALL FULL SPEC DEVICES

TEXAS	TIMER	RED LED
741	555	TIL209
5 for	4 for	10 for
£1.00	£1.00	£1.00

(INC CLIP)

VAT INCLUSIVE PRICE + 25p P. & P.

A4 IC BOOKLET

SUPPLIED FREE WITH ORDERS OF ANY ICs WORTH £5.00 OR MORE, CONTAINS CIRCUITS, PIN CONNECTIONS AND DATA (35p + SAE IF SOLD ALONE).

ALL PRICES INCLUDE VAT

FOR SERVICE QUALITY & VALUE

ALL PRICES INCLUDE VAT

RF POWER METER

(ETI project 139 - October '78)
 Most components in stock including 12.7mm toroid - F14 @ 16p, F25 @ 28p. PCB £1.00.

TELETEXT DECODERS

From Catronics - the Number One company for Teletext Decoders for CEEFAX and ORACLE. We now offer a wide range starting at below £145.00.
 KITS - Based on 'Wireless World' design:
 Basic upper case only - £144.50
 Standard decoder - £157.25
 De-luxe with ALL new facilities - £194.40
 KITS - Based on 'Television' magazine design:
 Complete kit (as published) - £220

2 METER POWER AMP

(ETI project 710 - September '76)

This is a simple-to-build, easily-aligned Class C PA suitable for CW and FM amplification at 2 metres from a nominal 13.5V (-ve earth) supply (7 amps at full power). T/R 'switching' is performed by diodes and ¼ wave lines. A power input of 10 watts is required for the nominal 40 watts output power.
Complete with cabinet - £19.50 + 65p p&p.

TIFAX MODULE

special offer including mounting board and interface circuitry plus full application information - **£129.35.**

LOW COST V.D.U.

(ETI project 560 - Aug/Sept/Oct '76)

All components available for this popular low cost V.D.U. project. Complete kit at **Special Price £64.00 + £1.00 p&p.**
 Separate components - **PCB set £7.20; 2112-2, £4.50; 2513, £8.50; 555, 47p.**
All prices INCLUDE VAT but please add minimum of 34p for post and packing.
Send SAE for FREE PRICE LIST or 45p + large (A4) 18 ½p SAE for copy of our Data-Catalogue.

7400 SERIES TTL

All new, full specification, full Guarantees Mostly National and Texas products

7400 14p	7421 31p	7483 78p	74145 £1.24	74177 84p
7402 14p	7427 29p	7485 £1.12	74150 £1.07	74180 82p
7403 14p	7428 38p	7486 33p	74153 69p	74188 £3.40
7404 15p	7430 18p	7490 38p	74157 72p	74192 £1.38
7406 40p	7432 27p	7492 52p	74161 99p	74193 £1.38
7408 18p	7440 18p	7493 39p	74164 £1.12	74195 £1.03
7410 16p	7442 73p	7496 97p	74165 £1.12	74196 £1.00
7411 22p	7447 75p	74107 35p	74166 £1.60	74221 £1.76
7412 24p	7473 35p	74121 29p	74170 £2.48	74H00 35p
7414 78p	7474 29p	74123 79p	74174 94p	74H04 44p
7420 17p	7475 46p	74126 81p	74175 94p	74H10 39p

10% DISCOUNT on TTL orders over £20

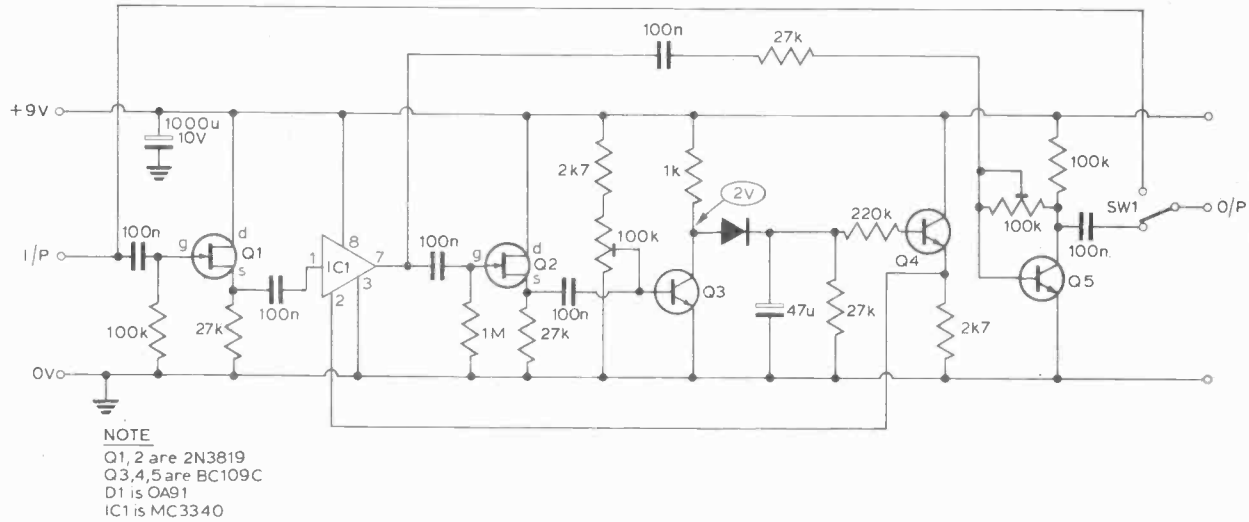
CATRONICS LTD. (Dept. 851), COMMUNICATIONS HOUSE, 20 WALLINGTON SQUARE, WALLINGTON, SURREY SM6 8RG
 Telephone: 01-669 6700 Open 9 am to 6 pm Mon.-Fri., 9 am to 1 pm Sat. Closed for lunch 12.45 to 1.45 pm

90

ELECTRONICS TODAY INTERNATIONAL - NOVEMBER 1978

Guitar Sustain Unit

S. D. Maistre



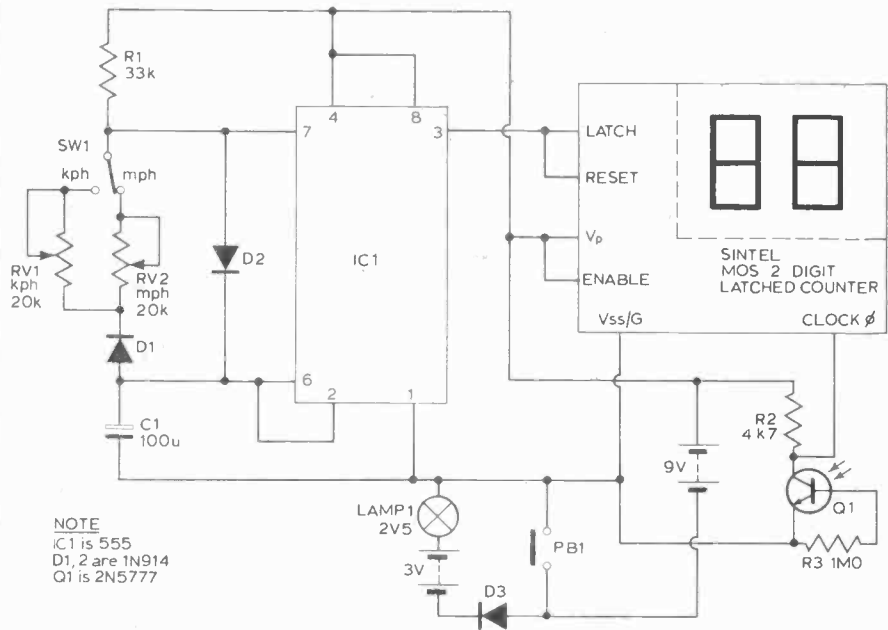
The sustain to be described here holds the output at a constant level over a wide range of input levels. It was designed for use with electric guitars and has a maximum effect with the guitar pick-up volume full up.

The principle employed is that of an AGC, whereby the circuit output is monitored by a DC voltage follower which controls the gain of the VCA through which the signal passes. The advantages of this circuit are that, unlike many such devices, it does not use opto-coupling which draws too much current for battery powered equipment; it produces no audible distortion; components are easily obtained — and cost is low.

Construction method is not critical.

Digital Bike Speed

B. Lemming



This unit provides push-bike speed measurement between zero and 100 km/hr or 100 mph! The circuit is based on the Sintel MOS counter block, which counts the pulses from the photo transistor Q1.

These pulses are provided by fixing 18 aluminium 'barriers' to the wheels. Q1 was an unmarked type in the prototype, in a TO 18 package. This mounts in an old felt-tip pen

case opposite the lamp so that the barriers interrupt the beam in operation. The counter operates whilst PB1 is pressed, but latches after a time determined by RV1 or RV2. IC1 and associated components. IC1 forms a square-wave oscillator with

variable mark-space ratio. The time for which pin 3 is taken low is determined by RV1/RV2 — this enables the counter.

The speed accuracy is determined by the accuracy of setting of controls RV1 and/or RV2.

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.

FLADAR DUAL VOLTAGE TRANSFORMERS

PRIMARY 220-240 50HZ.
ALTERNATIVE SECONDARY VOLTAGE AND CURRENT
AVAILABLE BY SERIES OR PARALLEL CONNECTION

Type	Voltage	Current	£	p/p	Type	Voltage	Current	£	p/p
60FE12	12+2	3A EACH	3.60	75p	12FE06	6+6	1A EACH	2.0	60p
60FE15	15+15	2A EACH	3.60	75p	12FE09	9+9	0.75A EACH	2.0	60p
60FE20	20+20	1.5A EACH	3.60	75p	12FE10	10+10	0.6A EACH	2.0	60p
60FE28	28+28	1.1A EACH	3.60	75p	12FE12	12+12	0.5A EACH	2.0	60p
60FE30	30+30	1A EACH	3.60	75p	12FE15	15+15	0.4A EACH	2.0	60p
					12FE20	20+20	0.25A EACH	2.0	60p
50FE12	12+12	2A EACH	3.10	70p	08FE06	6+6	0.6A EACH	1.80	50p
50FE15	15+15	1.6A EACH	3.10	70p	08FE09	9+9	0.5A EACH	1.80	50p
50FE20	20+20	1.2A EACH	3.10	70p	08FE10	10+10	0.4A EACH	1.80	50p
50FE28	28+28	0.9A EACH	3.10	70p	08FE12	12+12	0.3A EACH	1.80	50p
50FE30	30+30	0.8A EACH	3.10	70p	08FE15	15+15	0.25A EACH	1.80	50p
20FE06	6+6	1.6A EACH	2.60	65p	06FE06	6+6	0.5A EACH	1.50	50p
20FE09	9+9	1.0A EACH	2.60	65p	06FE10	10+10	0.35A EACH	1.50	50p
20FE12	12+12	0.8A EACH	2.60	65p	06FE12	12+12	0.25A EACH	1.50	50p
20FE15	15+15	0.6A EACH	2.60	65p	06FE15	15+15	0.20A EACH	1.50	50p
20FE20	20+20	0.5A EACH	2.60	65p					
60FE52	26-0-26	1A EACH	3.60	75p	30FE30	0-12-15-20-24-30	1A	2.95	1.00
60FE60	30-0-30	1A EACH	3.60	75p	60FE30	0-12-15-20-24-30	2A	4.70	1.00
80FE52	26-0-26	1.5A EACH	4.50	75p	100FE30	0-12-15-20-24-30	3A	5.60	1.00
80FE60	30-0-30	1.5A EACH	4.50	75p	100FE60	30-0-30	2	5.10	1.00
100FE28	28-0-28	2.0A EACH	4.50	75p	100FE26	26-0-26	2	4.80	1.00

FLADAR ELECTRIC
P.O. BOX 19
WEST CLIFF-ON-SEA
ESSEX. 0702-613314

TRADE ENQUIRIES
WELCOME

PLEASE ENQUIRE
FOR OTHER TYPES
NOT SHOWN

PAYMENT TERMS:
C.W.O. Cheques,
Postal Orders
Please Add 8% VAT
After post & packing.

HOME COMPUTING NASCOM 1 Build and tested £267.30

CHESS SETS		1/12 Scale R/C Electric Car Kit	TV GAMES
Set	Height of king Price	Just add Porsche or two channel R/C £44.87 Escort Body	Programmable TV Game in colour Main console + mains adaptor £38.90 Cartridge Price No 1 1D games FREE (with above) £20.25 No 2 Stunt rider £16.95 No 3 Roadrace £23.50 No 4 Tank battle
Camelot	3 7.30	4 Digit Alarm Clock chip and display G1 CK3000 I.C. + Plasma Display £4.90	Hand controls supplied with cartridges
Military	4 10.45	Microminiature Mercury Tilt Switch £1.00	
Lewis	3 15.70	Universal Mains Adaptor 6: 7 1/2-9V 250ma £2.90	
British Birds	5 18.95	Sound Modulator £2.90 Vision Modulator £2.90 Colour Encoder £2.50 Encoder/Vision Mixer £4.90	
Reynard the fox	7 1/2 25.00		

All prices include P&P & VAT
NIC MODELS, 27 Sydney Road, London N22
Other chess set available—15p illustrated lists

UNBEATABLE LOW PRICES WE STOCK PARTS TO BUILD MUSICAL PROJECTS

As published by leading magazines
Send large s.a.e. for lists

DALSTON ELECTRONICS
40A Dalston Lane
Dalston Junction E8 2AZ
Tel. 01-249 5624

HB ELECTRONICS 22 NEWLAND STREET, KETTERING TELEPHONE KETTERING 0536 83922 520910

BULK OFFERS

TRANSISTORS	PER 10	PER 100
BC107/8/9	£0.85	£7.50
PBC107/8/9	£0.85	£5.50
BC547/8/9	£0.75	£6.50
BC557/8/9	£0.75	£6.50
BC212/3/4	£0.75	£6.50
BC194/5	£0.80	£7.00
8F199	£1.50	£11.00
8F200	£2.50	£22.00
8F50/1/2	£1.85	£15.00
TIP31A/2A	£3.20	£30.00
TIP41A/2A	£4.80	£43.00
2N3055 (TO3)	£4.20	£38.50
2N3702/3/4	£0.80	£7.00
2N3819	£1.70	£15.50

DIODES	PER 10	PER 100
1N4001/2/3	£0.48	£3.90
1N4004/5	£0.55	£5.00
1N4007	£0.70	£6.00
1N4148	£0.75	£2.20
Zener Diodes 400mW	£0.75	£5.80

LEDs	PER 10	PER 100
0.2 Red	£0.90	£8.00
0.125 Red	£0.95	£8.00
0.2 Red Flat Sides COX10	£1.60	£15.00
0.2 Yellow/Green	£1.20	£10.00
0.125 Yellow/Green	£1.30	£10.00
0.2 Yellow/Green Flat Sides COX11/12	£2.20	£20.00

ORDERING DETAILS

VAT: Add high rate to items. Standard rate to others.
POST & PACKING: 30p on all orders under £5.00. Otherwise free. Overseas please add freight costs and state surface or air. No VAT on overseas or BFPO orders. All orders sent first class post in heat sealed padded bags.
DELIVERY: All orders processed on day of receipt. Goods offered subject to availability.

BARGAIN PACKS

ICs	PER 10	PER 100
LM324 (14 KIL)	£7.00	£51.00
LM555 (8 DIL)	£2.60	£23.00
LM741 (8 DIL)	£1.80	£15.50

TANT BEADS	PER 10	PER 100
0.1µf 0.22µf 0.47µf		
1µf 35v	£0.75	£6.30
2.2µf 35v	£0.95	£8.00
4.7µf 35v	£1.20	£11.00
10µf 35v	£1.50	£12.00
22µf 16v	£1.50	£12.00

HARDWARE	PER 10	PER 100
8 pin DIL Socket	£1.00	£9.00
14 pin DIL Socket	£1.10	£9.50
16 pin DIL Socket	£1.20	£10.00
24 pin DIL Socket	£2.00	£18.00
Min slide switches	£1.50	£12.00
Min push to make switches	£1.60	£12.00

RESISTORS 1/2 Watt Carbon Film (Min Type)	PER 10	PER 100
Single Values £1.25 per 100		
Mixed lots of 100 £10.00 per 1000		

MICRO PROCESSORS

Wide range of micro parts stocked. Send for free list or visit our showrooms in Kettering and get hands on experience of the PET2001, in stock now. (PET 2001 is distributed by our sister company HB Computers)

and our conditions of sale. Cash returned for out of stock items.

PAYMENT: Cash, cheque, postal order. Credit card orders accepted by letter or telephone.

GUARANTEE: All devices are brand new and full spec. No manufacturers fall outs or rejects. Any faulty items returned in good condition will be replaced or refunded.

ENQUIRIES: Please enclose a suitable S.A.E.

INES FROM OUR VAST STOCKS—IMMEDIATE DELIVERY

All below manufacturers' prices — all new stocks. Quantity discounts — export enquiries invited.

Postage & packing 35p per order
CALCULATOR CHIPS General instrument GIMT4 on anti static foam 24 pin DIL socket for use with Bowmar display £1.50 ea. Pack of 25 chips £25.

BOWMAR 9 DIGIT CALCULATOR DISPLAY with PC connector 0.2 digits Common cathode with red bezel £1.25 ea 10—£10.

TEXAS 19 gold plated snap key contacts on gold plated P.C. board Size 70x80x2mm 75p ea 10 for £6.

ORP12 light dependent resistance (Eq = RPY30) 2 for £1, 10—£4, 100—£35.

FAIRCHILD FND10 0.15 7 segment display C cathode 50p 10 for £4.50.

TBA 120A T.V. I.C. amplifier Siemens 75p 10—£6, 100—£50, 1000—£350.

BECKMAN 500 kca Triggerable clocking oscillator for use with calculator chips 5v supply with circuit £1 10 for £8.

BURROUGHS 9 DIGIT Panaplex calculator display 7 segment 0.25 digits Neon type with red bezel socket and data £2.50 ea 10 for £20.

ALMA PUSHBUTTON high reliability reed switches. Push to make 18x27x18mm 40p ea 10 for £3.50.

SMITHS INDUSTRIES Audible warning devices 6-12 volts 2 transistors 30x10mm encapsulated 50p ea 10 for £4 100 for £30.

HONEYWELL PROXIMITY DETECTOR integral amplifier 8v D.C. £2.50 ea 10 for £20 100 for £175.

OSMOR CHANGE OVER REED RELAY 12v coil 20m/a operating current 59x17x13mm 75p ea 10 for £5 100 for £45.

MAINS TRANSFORMERS (miniature) all with 240v primary per per
12 volt 100 m/amp ea 10 100
60x40x42 m/m 95p £8 £60

12.0-12v 100 m/amp 28x25x27mm
Valve output 40 1 61x15x42 m/m
£1.20 £10 £80

EL84 output 80x53x34mm 75p £6 £50
2 1/2 40 ohms 75p £8 £65

SOLDER (multicore type) by Servical 10 metres for £1.50 metres for £4.

SPEAKERS (miniature) per per
ea 10 100
2 1/2 8 ohms 75p £6 £50
2 1/2 8 ohms 75p £6 £50
2 1/2 40 ohms 75p £5 £40

CLOCKING OSCILLATOR (Pye Dynamics) thick film 1mHz supply 5v 19x25x6mm 85p 10 for £7.
T.V. TUNERS by G.E.C. UHF 38 mcs size 3 1/2 x 2 1/2 x 1 1/2 £2.50 ea 10 for £20.

T.V. SOUND TUNER KIT. Through your F.M. tuner Kit of parts with instructions £5.50. Ready-built, tested, £7.00.

JOYSTICK CONTROLS. (Ideal for TV Games, model control), sturdily constructed compact giving full 360° movement and control. Each unit fitted 4-off 100K linear controls. Pair £5.00.

T4/R/LONG-MEDIUM & F/M TUNER WITH MC1310 DECODER * 5-BUTTON SELECTOR SWITCHES * INPUT SELECTORS FOR GRAM AND TAPE * Supplied complete with FRONT-END TUNER AND FERRITE AERIAL * SIMPLE INTER-CONNECTIONS * Size 19x13x6cm

THIS QUALITY AMPLIFIER £10.95 WITH CIRCUIT

POWER UNIT KIT FOR ABOVE MODELS 25/28 VOLTS £2.95

TAPE HEADS 1/4 track Record Marriot XRP536 £5. XES11 erase £1.25. XRP5 18 £3.50.

MULLARD TUNER MODULES with data LP1171 combined AM/FM IF strip—£4.

* LP1179 FM front end with AM tuning gang, used with LP1171—£4. * LP1171 and 79 pair—£6.50. * LP1157 complete AM strip—£2.05. * Ferrite Aerial—85p.

SEVEN DIGIT MINATURE COUNTER by Durant 12-24 volts D.C. 3 Watts. Size 40x25HX 55L mm £1 each, 10 for £9, 100 for £80.

INDUSTRIAL RELAYS Price ea 10 100+

By I.M.O.UMRON At less than Distributor prices
60 43 24V DC £1.10 £9.00 £85.00

2-Pole Open 60 13 48V AC £1.20 £10.00 £90.00
Octal Plug in type enclosed

60 02 12V AC 85p £7.50 £65.00
2-Pole C. Over Octal Enclosed type All relays are 250V 6 Amp AC Current Rating

2N3055A TO3 POWER 80 VOLT VERSION 10 for £2.50 100 for £22.00 1,000 for £200.00

Carriage £2.00 on 1,000 Lots

FREE
TRANSISTOR
CATALOGUE

SEND STAMPED 12 1/2 p U.K. ADDRESS ENVELOPE min 9 1/2 x 6 1/2 FOR YOUR COPY NOW

Buy it with Access **HENRY'S** RADIO

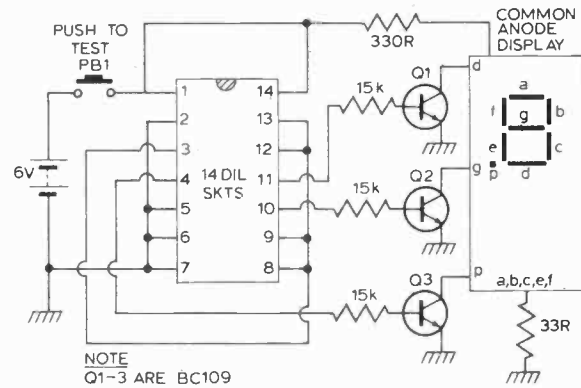
All mail to:
Henry's Radio
404 Edgware Rd
London W2
Phone (01) 723 1008



CMOS Gate Identifier

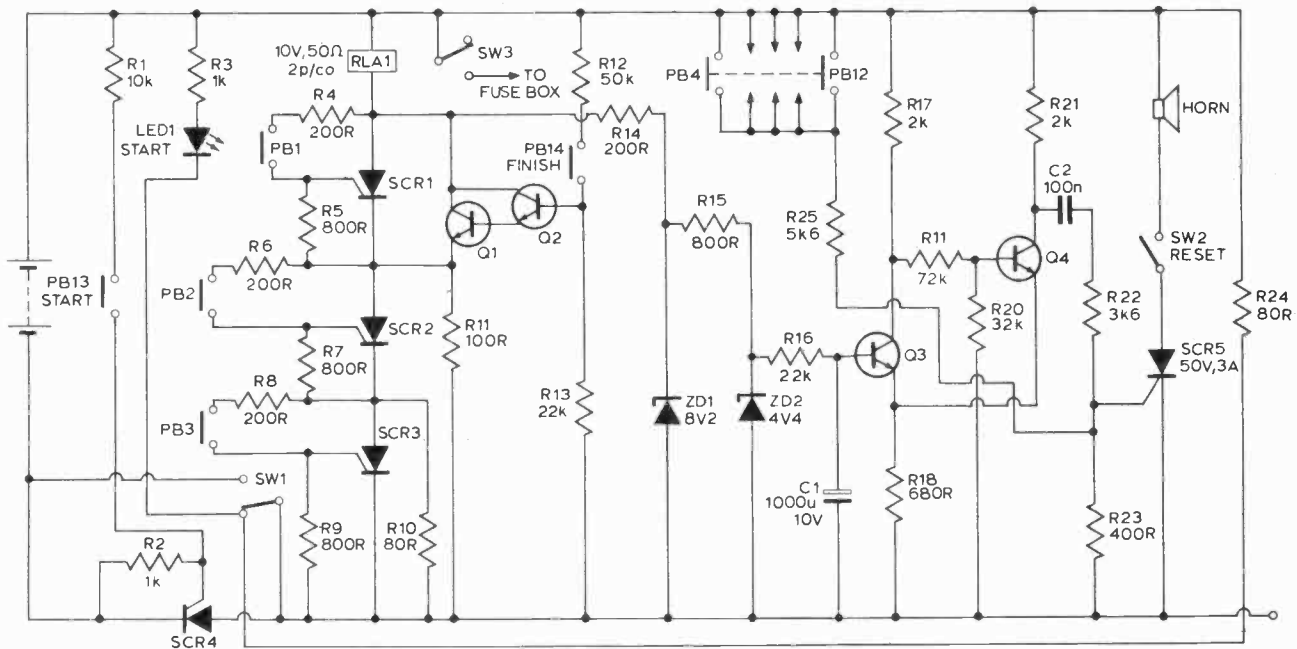
C. Ching

This circuit can be used to distinguish four types of dual input gates — AND, OR, NAND, NOR — it is also a quick method of checking IC function. If an AND gate is inserted into the socket, an A appears on the LED. An O denotes an OR gate. The decimal point is used to denote inverted function, i.e. .A is an NAND gate.



Electronic Ignition Switch

K. A. Last



NOTE

Q1 is BFY50
 Q2,4 are BC108
 Q3 are BC108C
 SCR1-4 50V, 1A TYPES
 SCR5 50V, 3A
 LED1 is TIL 209
 RLA1 is 10V, 50R COIL WITH 2p/co CONTACTS

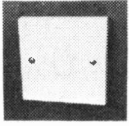
When used with a calculator type keyboard, this circuit provides a 'combination lock' ignition switch which only activates if the correct sequence of three numbers is keyed in. The keyboard has 14 keys numbered 1 to 12, 'START' and 'FINISH'. To start the car, the 'start' key is pressed and the start LED will light. The correct sequence of 3 numbers is

then keyed in. If the sequence is wrong, the cars horn will be sounded. If the right sequence is entered, the 'START' LED will extinguish and the ignition will be energised. The correct sequence will be PB1, PB2, PB3, but these can be arranged amongst the other keys in the keyboard, and given any numbers.

BAD NEWS FOR KNOB TWIDDLEERS
A 300W Lightdimmer with NO knob. Dimming and on/off functions are controlled by touch. Features include

- * No mains rewiring
- * Switches on to preset brightness
- * Can be switched and dimmed from many locations using TDE/K kit making 2-way switching easy

****PRICE £8.99 TDE/K £1.00**



TRIAC BARGAINS

- 400V Plastic Case
- 3A 58p
- 6.5A with trigger 80p
- 8A 74p
- 12A 84p
- 16A 105p
- 20A 165p
- 25A 190p
- SCR (C106D) 5A/400V 50p
- Diac 21p

COMPONENTS

- 0.2" L.E.D.S.**
- Red 12p £1/10
 - Green 21p, Yellow 25p
 - DL727 5 digit £1.50
 - LCD 5 4 digit £9.00
 - LDR .5 dia
 - NE555 (4 for £1.00)
 - 741 (5 for £1.00)
 - LM3911 temperature IC £1.00
 - AY-5-1224 £3.25
 - AY-5-1230 £4.85
 - ZN1034E £1.80
 - ICL7106 DVM IC £9.25
 - 1N4001 6p
 - 1N4148 4p
 - 8C182L 10p
 - 2N3819 20p

LIGHTING CONTROL KITS (300W)
TSD300K TOUCHSWITCH & DIMMER combined. One touch-plate for on/off. Small knob controls brightness. **£5.50**
TS300K TOUCHSWITCH. Two touchplates. ON/OFF **£4.00**
TSA300K AUTOMATIC. One touchplate. Preset time delay off. **£4.00**
LD300K LIGHTDIMMER. **£2.80**

DIGITAL VOLTMETER THERMOMETER KIT

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



ONLY £21.99

MINI MAINS TRANSFORMERS

- Standard 240V mains primary
100mA secondary
- 6.0-6V 85p
 - 9.0-9V 90p
 - 12.0-12V 95p

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 PCBs and full instructions

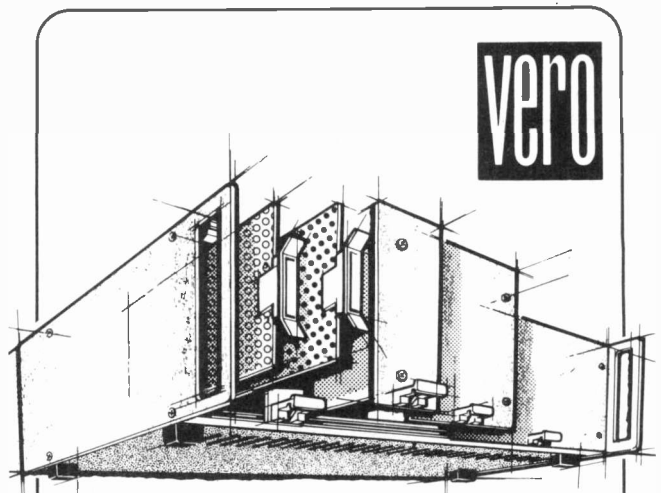
White box (56x131x71mm)—drilled undrilled **£2.50**
..... **£2.50**



PLEASE ADD 8% V.A.T. (*12½%) TO ABOVE PRICES

QUANTITY DISCOUNTS ON REQUEST. ADD 25p POSTAGE & PACKING. MAIL ORDER ONLY TO:

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



VERO

Our new 1978 catalogue lists a card frame system that's ideal for all your module projects — they used it in the ETI System 68 Computer. And we've got circuit boards, accessories, cases and boxes — everything you need to give your equipment the quality you demand. Send 25p to cover post and packing, and the catalogue's yours.

VERO ELECTRONICS LTD. RETAIL DEPT.
Industrial Estate, Chandlers Ford, Hants. SO5 3ZR
Telephone Chandlers Ford (04215) 2956

TRANSISTORS	BC328 15p	8U208 160p	2N4061 12p	7490 32p	74194 92p	4501 19p	DIODES	ZENER DIODES 400mW
AC126 18p	BC338 15p	OC25 76p	2N4062 20p	7491 65p	74195 85p	4507 59p	8Y127 16p	2.7V to 33V 10p
AC127 17p	BC547 11p	OC28 108p	2N4123 23p	7492 45p	74196 92p	4510 110p	0A47 10p	
AC128 16p	BC548 10p	OC35 108p		7493 34p	74197 92p	4516 110p	0A81 15p	VERO BOARDS 0.1" copper
AC141 24p	BC549 11p	OC71 19p		7494 80p	74198 150p	4518 75p	0A200 6p	2.5" x 5" 57p
AC142 24p	BC557 14p	OC72 34p		7495 55p	74199 150p	4519 60p	0A202 9p	3.75" x 5" 67p
AC151 42p	BCY30 67p	OC84 46p	TTL	7496 62p		4520 110p	IN914 4p	
AC152 53p	BCY34 74p	TIP29 40p	7400 12p	7497 240p	CMOS	4528 107p	IN916 5p	CERAMIC CAP 50V
AC153 58p	BCY59 24p	TIP30 40p	7401 12p	74100 95p	4000 15p	4578 27p	IN4001 4p	22pF to 47000pF 2p
AC176 18p	BCY70 14p	TIP31 50p	7402 12p	74104 50p	4001 15p	4583 83p	IN4002 4p	
AC187 23p	BCY71 14p	TIP32 55p	7403 12p	74105 40p	4002 16p	4585 105p	IN4003 6p	POLYESTER CAP 250V
AC188 23p	BCY71 14p	TIP33 75p	7404 13p	74107 28p	4006 110p		IN4004 7p	.01, .015, .022, .033, .047, .068, .1 uF
AD149 65p	BC121 79p	TIP34 98p	7405 13p	74109 45p	4007 16p	VOLTAGE REGULATORS	IN4005 10p	.15, .22, .33 7p
AD161 38p	BC123 79p	TIP35A 253p	7406 29p	74110 46p	4008 94p	7805 82p	IN4006 10p	.47, .68 uF 13p
AD162 38p	BC124 97p	TIP36A 389p	7407 29p	74116 160p	4009 46p	7812 82p	IN4007 11p	1uF 17p
AF114 30p	BC131 35p	TIP41A 59p	7408 14p	74118 82p	4010 50p	7815 82p	IN5400 16p	2.2 uF 28p
AF118 30p	BC132 35p	TIP42A 59p	7409 14p	74120 125p	4011 15p	7818 82p	IN5401 16p	6.8 uF 48p
AF125 27p	BC135 38p	TIP2955 126p	7410 12p	74121 26p	4012 16p	7824 82p	IN5402 18p	
AF126 27p	BC136 38p	TIP3055 64p	7411 19p	74122 55p	4013 108p	7905 98p	IN5403 20p	ELECTROLYTIC CAP 25V
AF127 27p	BC137 38p	ZTX108 14p	7412 21p	74123 40p	4014 108p	7912 98p		1uF to 47 uF 7p
AF139 36p	BC138 38p	ZTX109 14p	7413 21p	74125 45p	4015 108p	7915 98p		68uF, 100uF 8p
AF186 54p	BC139 35p	ZTX300 16p	7414 54p	74126 46p	4016 45p	7918 98p		150uF 9p
AF239 40p	BC140 35p	ZTX500 16p	7416 27p	74132 70p	4017 90p			220uF 10p
ASYS3 81p	BF115 25p	2N706 13p	7417 27p	74136 79p	4018 90p			330uF 12p
ASYS4 81p	BF167 29p	2N1131 23p	7420 12p	74141 56p	4019 65p			470uF 15p
ASYS5 69p	BF173 27p	2N1132 23p	7421 28p	74142 202p	4020 95p	THYRISTORS	BRIDGE RECTIFIERS	RESISTORS 0.25W
BC107 8p	BF178 34p	2N1302 38p	7422 18p	74145 65p	4021 98p	1A/50V 28p	1A/50V 22p	4.7 ohms to 1 Mohm 1p
BC108 8p	BF179 37p	2N1304 54p	7427 25p	74147 135p	4022 85p	1A/100V 30p	1A/100V 24p	POTENTIOMETERS (carbon)
BC109 8p	BF180 37p	2N1305 25p	7428 34p	74148 120p	4023 15p	1A/200V 38p	1A/200V 27p	1 Kohm to 2 Mohms log/linear 26p
BC113 17p	BF181 37p	2N1306 39p	7430 12p	74150 70p		1A/400V 40p	1A/400V 30p	5 Kohm to 1 Mohm log switched 60p
BC117 20p	BF182 37p	2N1308 40p	7432 24p	74151 50p	CMOS	2A/50V 34p	2A/50V 34p	
BC119 29p	BF183 37p	2N1613 22p	7433 32p	74153 60p	4024 68p	3A/100V 36p	2A/100V 36p	PRESETS 0.1W horizontal
BC140 34p	BF184 28p	2N1711 21p	7437 24p	74154 106p	4025 15p	3A/200V 38p	2A/200V 38p	100 ohm to 1 Mohm 6p
BC142 27p	BF185 30p	2N1893 44p	7438 24p	74155 63p	4027 35p	3A/400V 51p	2A/400V 40p	
BC143 27p	BF194 13p	2N2217 27p	7440 13p	74156 63p	4028 70p	LINEARS		
BC147 7p	BF196 13p	2N2219 21p	7441 52p	74157 63p	4029 90p	710CN 41p		
BC149 8p	BF197 16p	2N2369 16p	7442 45p	74160 80p	4030 50p	741 OIL8 22p	OPTO/DISPLAYS	TRANSFORMERS 240V primary
BC157 9p	BF198 16p	2N2483 26p	7443 90p	74161 80p	4035 130p	747C OIL14 70p	2N5777 50p	6.0-6V 100mA 95p
BC158 9p	BF200 36p	2N2484 22p	7444 90p	74162 80p	4041 85p	748C OIL8 35p	OCPT71 70p	0.6VX2 1AX2 360p
BC159 9p	BF224 16p	2N2905 22p	7445 70p	74163 80p	4042 85p	CA3011 80p	ORP12 70p	9.0-9V 100mA 250p
BC168 8p	BF257 37p	2N2906 22p	7446 70p	74164 70p	4043 96p	CA3018 80p	OL704 90p	9.0-9V 1A 290p
BC170 9p	BF258 40p	2N2907 22p	7447 55p	74165 90p	4044 95p	CA3028A 85p	OL707 90p	9.0-9V 2A 400p
BC171 9p	BF259 44p	2N2926G 110p	7448 58p	74166 100p	4047 96p	CA3035 140p	LED 3/5mm 70p	0.12V 2A 370p
BC172 9p	BF259 44p	2N2926R 110p	7450 14p	74167 270p	4048 63p	CA3036 120p	Red 10p	0.15VX2 200MAX2 240p
BC173 9p	BF260 44p	2N3053 18p	7451 14p	74173 120p	4049 50p	CA3046 75p	Yellow 17p	
BC182 10p	BF279 30p	2N3054 50p	7452 13p	74174 90p	4050 45p	CA3054 110p	Green 17p	
BC183 10p	BF280 30p	2N3055 50p	7453 19p	74175 70p	4066 16p	CA3080 70p	Clip 3p	
BC184 10p	BFX29 25p	2N3072 8p	7454 14p	74176 90p	4068 16p	CA3140E 74p		
BC186 23p	BFX30 38p	2N3703 8p	7460 14p	74177 90p	4069 16p	LM301AN 30p		
BC187 26p	BFX85 29p	2N3704 8p	7472 28p	74178 120p	4070 16p	LM308N 54p		
BC207 13p	BFX86 31p	2N3706 9p	7472 24p	74180 85p	4071 16p	LM380N 76p		
BC212 10p	BFX87 20p	2N3707 9p	7473 25p	74181 195p	4072 20p	LM381N 105p		
BC213 10p	BFY50 15p	2N3710 8p	7474 25p	74182 75p	4073 20p	NE555 25p		
BC214 10p	BFY51 15p	2N3711 8p	7475 48p	74184 243p	4077 65p	NE556 65p		
BC237 14p	BFY53 28p	2N3772 177p	7476 28p	74190 72p	4078 18p	T8A641 240p		
BC238 14p	BSX19 25p	2N3773 230p	7480 46p	74191 100p	4081 19p	T8A800 70p		
BC301 30p	BSX20 21p	2N3866 61p	7485 90p	74192 100p	4082 23p	T8A810 113p		
BC303 30p	BU205 140p	2N3904 8p	7486 26p	74193 110p	4086 24p			

Add 25p for p&p All items new and full spec

DELTA TECH & CO.
62 NAYLOR ROAD, LONDON, N20 0HN

DIODES/ZENERS				SOCKETS/BRIDGES				TRANSISTORS, LEDS, etc.						
1N914	100v	10mA	.05	8-pin	pcb	.20	ww	.35	2N2222	NPN (2N2222 Plastic .10)	.15	2N2907	PNP	.15
1N4005	600v	1A	.08	14-pin	pcb	.20	ww	.40	2N3906	PNP (Plastic - Unmarked)	.10	2N3904	NPN (Plastic - Unmarked)	.10
1N4007	1000v	1A	.15	16-pin*	pcb	.20	ww	.40	2N3054	NPN	.35	2N3055	NPN 15A 60v	.50
1N4148	75v	10mA	.05	18-pin	pcb	.25	ww	.75	T1P125	PNP Darlington	.35	LED Green, Red, Clear, Yellow		.15
1N4733	5.1v	1 W Zener	.25	22-pin	pcb	.35	ww	.95	D.L.747	7 seg 5/8" High com-anode	1.95	MAN72	7 seg com-anode (Red)	1.25
1N753A	6.2v	500 mW Zener	.25	24-pin	pcb	.35	ww	.95	MAN3610	7 seg com-anode (Orange)	1.25	MAN82A	7 seg com-anode (Yellow)	1.25
1N758A	10v	"	.25	28-pin	pcb	.45	ww	1.25	MAN74A	7 seg com-cathode (Red)	1.50	FND359	7 seg com-cathode (Red)	1.25
1N759A	12v	"	.25	40-pin	pcb	.50	ww	1.25						
1N5243	13v	"	.25	Molex pins .01	To-3 Sockets	.25								
1N5244B	14v	"	.25	2 Amp Bridge	100-prv	.95								
1N5245B	15v	"	.25	25 Amp Bridge	200-prv	1.95								

C MOS		- T T L -									
4000	.15	7400	.10	7473	.25	74176	.85	74H72	.35	74S133	.40
4001	.15	7401	.15	7474	.30	74180	.55	74H101	.75	74S140	.55
4002	.20	7402	.15	7475	.35	74181	2.25	74H103	.55	74S151	.30
4004	3.95	7403	.15	7476	.40	74182	.75	74H106	.95	74S153	.35
4006	.95	7404	.10	7480	.55	74190	1.25			74S157	.75
4007	.20	7405	.25	7481	.75	74191	.95	74L00	.25	74S158	.30
4008	.75	7406	.25	7483	.75	74192	.75	74L02	.20	74S194	1.05
4009	.35	7407	.55	7485	.55	74193	.85	74L03	.25	74S257 (8123)	1.05
4010	.35	7408	.15	7486	.25	74194	.95	74L04	.30		
4011	.20	7409	.15	7489	1.05	74195	.95	74L10	.20	74LS00	.20
4012	.20	7410	.15	7490	.45	74196	.95	74L20	.35	74LS01	.20
4013	.40	7411	.25	7491	.70	74197	.95	74L30	.45	74LS02	.20
4014	.75	7412	.25	7492	.45	74198	1.45	74L47	1.95	74LS04	.20
4015	.75	7413	.25	7493	.35	74221	1.00	74L51	.45	74LS05	.25
4016	.35	7414	.75	7494	.75	74367	.75	74L55	.65	74LS08	.25
4017	.75	7416	.25	7495	.60			74L72	.45	74LS09	.25
4018	.75	7417	.40	7496	.80	75108A	.35	74L73	.40	74LS10	.25
4019	.35	7420	.15	74100	1.15	75491	.50	74L74	.45	74LS11	.25
4020	.85	7426	.25	74107	.25	75492	.50	74L75	.55	74LS20	.20
4021	.75	7427	.25	74121	.35			74L93	.55	74LS21	.25
4022	.75	7430	.15	74122	.55			74L123	.85	74LS22	.25
4023	.20	7432	.20	74123	.35	74H00	.15			74LS32	.25
4024	.75	7437	.20	74125	.45	74H01	.20	74S00	.35	74LS37	.25
4025	.20	7438	.20	74126	.35	74H04	.20	74S02	.35	74LS38	.35
4026	1.95	7440	.20	74132	.75	74H05	.20	74S03	.25	74LS40	.30
4027	.35	7441	1.15	74141	.90	74H08	.35	74S04	.25	74LS42	.65
4028	.75	7442	.45	74150	.85	74H10	.35	74S05	.35	74LS51	.35
4030	.35	7443	.45	74151	.65	74H11	.25	74S08	.35	74LS74	.35
4033	1.50	7444	.45	74153	.75	74H15	.45	74S10	.35	74LS86	.35
4034	2.45	7445	.65	74154	.95	74H20	.25	74S11	.35	74LS90	.55
4035	.75	7446	.70	74156	.70	74H21	.25	74S20	.25	74LS93	.55
4040	.75	7447	.70	74157	.65	74H22	.40	74S40	.20	74LS107	.40
4041	.69	7448	.50	74161	.55	74H30	.20	74S50	.20	74LS123	1.00
4042	.65	7450	.25	74163	.85	74H40	.25	74S51	.25	74LS151	.75
4043	.50	7451	.25	74164	.60	74H50	.25	74S64	.15	74LS153	.75
4044	.65	7453	.20	74165	1.10	74H51	.25	74S74	.35	74LS157	.75
4046	1.25	7454	.25	74166	1.25	74H52	.15	74S112	.60	74LS164	1.00
4049	.45	7460	.40	74175	.80	74H53J	.25	74S114	.65	74LS193	.95
4050	.45	7470	.45			74H55	.20			74LS367	.75
4066	.55	7472	.40							74LS368	.65

9000 SERIES		LINEARS, REGULATORS, etc.									
9301	.85	95H03	1.10	MCT2	.95	LM320T5	1.65	LM340K15	1.25	LM723	.40
9309	.35	9601	.20	8038	3.95	LM320T12	1.65	LM340K18	1.25	LM725N	2.50
9322	.65	9602	.45	LM201	.75	LM320T15	1.65	LM340K24	1.25	LM739	1.50
				LM301	.45	LM324N	1.25	78L05	.75	LM741 (8-14)	.25
				LM308 (Mini)	.95	LM339	.75	78L12	.75	LM747	1.10
				LM309H	.65	7805 (340T5)	.95	78L15	.75	LM1307	1.25
				LM309K (340K-5)	.85	LM310	.85	78M05	.75	LM1458	.65
				LM310	.85	LM340T12	.95	LM373	2.95	LM3900	.50
				LM311D (Mini)	.75	LM340T15	.95	LM380 (8-14 PIN)	.95	LM75451	.65
				LM318 (Mini)	1.75	LM340T18	.95	LM709 (8, 14 PIN)	.25	NE555	.35
				LM320K5(7905)	1.65	LM340T24	.95	LM711	.45	NE556	.85
				LM320K12	1.65	LM340K12	1.25			NE565	.95
										NE566	1.25
										NE567	.95

MICRO'S, RAMS, CPU'S, E-PROMS			
74S188	3.00	8214	8.95
1702A	4.50	8224	3.25
MM5314	3.00	8228	6.00
MM5316	3.50	8251	8.50
2102-1	1.45	8255	10.50
2102L-1	1.75	8T13	1.50
2114	9.50	8T23	1.50
TR1602B	3.95	8T24	2.00
TMS 4044	9.95	8T97	1.00
		2107B-4	4.95
8080	8.95	2708	9.50
8212	2.95	Z80 PIO	8.50

INTEGRATED CIRCUITS UNLIMITED

7889 Clairemont Mesa Blvd., San Diego, CA 92111 U.S.A.

No Minimum

All prices in U.S. dollars. Please add postage to cover method of shipping. Orders over \$100 (U.S.) will be shipped air no charge.

Payment should be submitted with order in U.S. dollars.

All IC's Prime/Guaranteed. All orders shipped same day received.

SPECIAL DISCOUNTS	
Total Order	Deduct
\$35 - \$99	10%
\$100 - \$300	15%
\$301 - \$1000	20%

Phone (714) 278-4394 BarclayCard / Access / American Express / BankAmericard / Visa / MasterCharge

IN4148 Diodes by ITT/Texas. 100 for **£1.50**. These are full spec. devices.

Unencoded Hexadecimal 19 keyboard 1-10 ABCDEF. 2 optional keys. Shift key. **£12.50**.

MM2102 AN-4L 1024 x 1 Bit. 450 nano sec. Static Ram. **£1.00** each.

FND500 Seven Segment Common Cathode Display **£1.30** each. 4/**£5.00**.

AY5-1013 UART/T **£6.00**.

Red Leds 01.125" or 0.2". 10 for **£1.20**. 100/**£9.00**.

2112 256 x 4 Bit Static Ram 450 nanosec. **£2.95** each. 4/**£11.60**. 8/**£22.60**.

Murata Ultrasonic Transducer **£2.50** each. **£4.00** pair.

741 Op Amp **25p** each. 10/**£2.00**.

555 Timer. **28p** each. 10/**£2.50**.

4001	14p	4029	110p
4007	16p	4047	100p
4011	14p	4049	40p
4012	14p	4060	120p
4013	50p	4066	55p
4015	90p	4069	20p
4106	40p	4071	16p
4017	90p	4072	16p
4020	100p	4081	16p
4022	90p	4082	16p
4023	16p	4510	120p
4024	65p	4511	150p
4025	16p	4516	110p
4026	160p	4518	130p
4027	50p	4528	100p
4028	90p		

Prices include Post and VAT

T. POWELL
306 ST. PAUL'S ROAD, HIGHBURY CORNER, LONDON N.1. Tel. 01-226 1489.

Callers welcome

24 hr. Ansaphone order service with ACCESS or BARCLAYCARD No.

THE SINCLAIR PDM35 digital Multimeter

Now a digital multimeter at an analogue price and look at the spec!

D.C. VOLTS 1mV-1000V(1% - 1 count) 10mΩ input.

A.C. VOLTS 1v-500v 40Hz-5kHz (1% + 2 counts).

D.C. CURRENT 1 inA-200mA (1% count).

RESISTANCE 1Ω-20MΩ (1.5% + 1 count).

£27.95 cash with order or £29.95 company purchase order.

A.C. Mains adaptor **£3.95**
deluxe padded carrying case **£3.20**
30kV probe **£18.64**

THE SINCLAIR MICROVISION

The amazing pocket T.V. that will pick up programs throughout the world, complete with rechargeable batteries.

£189.95 inc. VAT
See (for detailed Brochure ex-stock)

SINCLAIR DM235

Portable 3 1/2 digit 6 function Multimeter.

DC volts 1mV to 1000V
AC volts 1mV to 750V
AC & DC current 1μA to 1A
Resistance 1Ω to 20MΩ
Diode test 0.1μA to 1mA
10mΩ input, DC acc. 1.0% AC acc 1.5% 30Hz-10KHz

Cash with order **£52.80** inc VAT or £53.70 on company purchase order.

A full range of optional accessories. (Prices include VAT)

DM 235 meter complete with test leads and prods **£52.80**
Eveready carrying case with lead storage compartment **£8.95**
Rechargeable battery units **£8.50**. AC adaptor/charger 240V 50 Hz **£3.75**. 30kV voltage probe **£18.64**

We accept govt./company purchase orders on all goods.

KRAMER & CO

We will match any lower advertised price on a cash with order basis if competitor has goods in stock

9 October Place, Holders Hill Road, London NW14 1EJ
Telax 688941 Attn. Kramer K7. Tel. 01-203 2473
Mail order only. SAE for data sheets. Export enquiries welcome

INTER-LOCKING PLASTIC STORAGE DRAWERS

NEAT! HANDY! TIDY!

DISCOUNT PRICES

5 SIZES ALL INTERLOCK

Newest neatest systems ever devised for storing small parts and components resistors capacitors diodes transistors etc Rigid plastic units interlock together in vertical and horizontal combinations Transparent plastic drawers have label slots 1D and 2D have space dividers Build up to any size cabinet for wall bench or table top

As supplied to Post Office, Industry and Government Depots.

SINGLE UNITS (1D)
(5in. x 2 1/4in. x 2 1/4in.) **£3.50** DOZEN

DOUBLE UNITS (2D)
(5in. x 4 1/2in. x 2 1/4in.) **£5.50** DOZEN

TREBLE (3D) £5.50 for 8

DOUBLE TREBLE 2 drawers, in one outer case (6D2) **£7.90** for 8

EXTRA LARGE SIZE (6D1) £6.90 for 8

PLUS QUANTITY DISCOUNTS
Orders over £20. less 5%. Orders over £60 less 7 1/2%
PACKING/POSTAGE/CARRIAGE Add £1.00 to all orders under £10 Orders £10 and over, please add 10% carriage
QUOTATIONS FOR LARGER QUANTITIES
Please add 8% V.A.T. to total remittance
All prices correct at time of going to press

4-WAY IN-LINE POWER PANEL

13 AMP PATENT CABLE LOCK

NEON INDICATOR LAMP

EASILY ACCESSIBLE FUSE

MOUNT IT OR TRAIL IT!

Modern slim-line power panel countless uses in home office factory showrooms Perfectly safe unbeatable. Can be mounted on wall or trailed anywhere in room. Neat rubber base. Smart PVC outer cover. Black **£3.10**, White **£3.30**, P & P 60p each. State cable length required 20p per yard

FLAIRLINE SUPPLIES (Dept. ET20)
124 Cricklewood Broadway, London N.W.2
Telephone 01-450 4844

BLOB BOARD BUILDS BETTER PROJECTS CHEAPER, FASTER & BEAUTIFULLY BLOB-BOARD

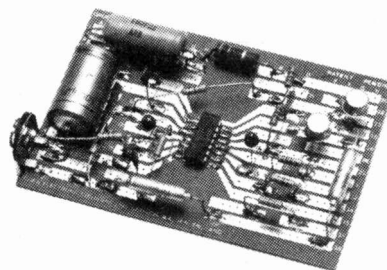
Blob-Board is now available in many different layouts and sizes to allow the home constructor to build any project from the most simple to the most complicated without the need of layout drawings or having to work out complex component patterns.

Blob-Boards are normally much cheaper than existing matrix boards and do not need any cutting or breaking of contact rails.

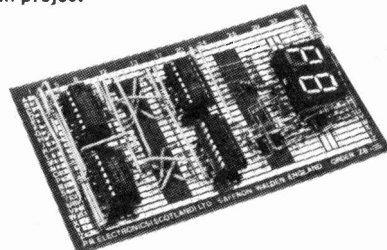
The roller tinned tracks and letter number identification of holes make soldering so much easier than non-tinned copper boards and make transferring from circuit diagram to Blob-Board virtually error free.

Components can be re-used and resoldered making circuit project modifications and amendments fast and cheap. All Blob-Board packs contain step-by-step instructions of how to build projects and a project booklet. The "IC" range has a 20 project booklet with easy to follow circuit diagrams and the "D" range has a 9 project booklet including Radio Receiver, Radio Microphone, Light Operation Switch etc.

IC Range



Bread circuit board BCB4 with project



CODE	SIZE mm	PRICE
ZB5D	92 x 61	£0.44
ZB6D	61 x 186	£0.85
ZB7D	125 x 186	£1.67
ZB8D	165 x 241	£2.88
ZB1 IC	114 x 76	£0.66
ZB2 IC	115 x 78	£0.71
ZB4 IC	127 x 203	£1.90
ZB8 IC	254 x 203	£3.69
BCB 1	120 x 150	£1.03
BCB 2	175 x 65	£0.63
BCB 3	125 x 75	£0.54
BCB 4	125 x 50	£0.49
ZB4V	229 x 165	£2.55
ZB4V5	229 x 165	£2.55



PB Electronics (Scotland) Ltd
9 Radwinter Road
Saffron Walden, Essex CB11 3HU

All prices include VAT
Please add 35p p & p minimum order £3.00
Available from all good component stockists

O.S.T.S. now from ambit international

"One Stop Technology Shopping"

Ambit stress...news on items available.....KV1210: triple AM tuning diode with 2.9v bias only £2.75.....DT1200 Digital frequency readout module 911223 ultra low THD/IMD mpX decoder module £9.95.....944378 'Hyperfi' mpX decoder with post decoder muting and pilot cancel £19.95..... VMOS

COUNTER ATTRACTIONS:

New this month from Interfil, the ICM 7216. This is probably the most significant new IC for frequency counter/timer applications ever devised. It drives a full 8 digit display (LED) and operates on inputs of up to 10MHz minimum. The single 28 pin DIL also has:
 *Leading zero blanking *Frequency ratio *Period *Unit counter *Time Interval *overrange
 The IC cost is £19.82, and the 10MHz HC18U Xtal £2.50 (for timebase functions). The circuit data is free with the IC, or £1 purchased separately. Input preamp board £7.00.

New from Ambit is the MC3357. 6v, 2mA standby NBFM IF, detector and squelch with 10.7 - 455 kHz balanced mixer, onboard oscillator device, and 5uV sensitivity. It is ideally suited to our CFM and LFY filter series, and costs £3.12 with full data. Xtal £2.50.

Please note that OSTS prices exclude VAT at 8% throughout this side of the page. Most ambit items are at 12½% except those marked *. Please keep orders separately totalled, although a single combined payment, and 25p postage charge, will be sufficient.

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	400p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4030	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	190p	4098	110p	4568	281p
4031	250p	4099	122p	4569	303p
4032	100p	4101	90p	4572	25p
4033	145p	4102	90p	4581	319p
4034	200p	4103	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	248p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	100p	4512	99p		
4047	99p	4513	265p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

Micromarket PRICES SLASHED

6800 series	8216	1.95	2114	£10	
6800P	6.50	8224	3.50	2708	£10.55
6820P	£6	8228	4.78		
6850P	2.75	8251	6.25		
6810P	£4	8255	5.40		
6852	3.65				
8080 series	2102	£1.70			
8080	6.30	2112	£3.40		
8212	2.30	2513	£7.54		
4027	£5.78				

Voltage Regs

NEW LOW PRICES	
7800 series UC TO220 package 1A	all 95p
7900 series UC TO220 package 1A	all £1
78MUC series TO220 package 1/4A	all 90p
78LCP series TO92 100mA	all 35p
L200 up to 3A/adjustable V&A	195p
78MG72C 2½amp adjustable volts	175p
79MG72C 2½amp adjustable volts	175p
723C precision controller	65p
MAINS FILTERS FOR NOISE/RFI etc	
1 amp in IEC connector	£4.83
5 amp in 'wire in' case	£3.87
NE550A	73p

LINEARS non-consumer

LM301AH	67p	741CH to5	65p
LM301AN	30p	741CN 8dil	27p
LM308	97p	747CN	70p
LM318H	29p	748CN	36p
LM318N	224p	NE531T	120p
		NE531N	105p

OPTO 7 seg displays

LM324N	71p	5082	7650	red CA	
LM339N	66p	5082	7653	red CC	
LM348N	186p	5082	7660	yellow CA	233p
LM3900N	60p	5082	7663	yellow CC	
709HC to5	64p	5082	7670	green CA	
709PC dil	36p	5082	7673	green CC	
710HC to5	65p	5082	7677	green CC	
710PC dil	59p	5082	7678	green CC	
Op amps					
723CN	65p				
741CH to5	65p	5082	7730	red CA	
741CN 8dil	27p	5082	7740	red CC	147p
747CN	70p				
748CN	36p				
NE531T	120p				
NE531N	105p				

0.43" High Efficiency HP:

ICM7217	count & display	£9.50
ICM7207	clock pulse IC	£4.95
ICM7208	count & display	£14.95
ICL7106CP	LCD DVM IC	£9.55
KIT	£24.80	
LED DVM with ICL7107	£20.65	

Ambit overspill

74248	90
74251	90
74253	105
74257	108
74279	52
74283	120
74290	90
74295	120
74298	100
74280	26
74298	26
74365	42
74366	49
74367	43
74368	49
74375	60
74376	130
74379	130
74445	92
74447	90
74490	140
74668	110

MISCELLANY

NE555	30p
NE556	78p
NE558	180p
LM3909	72p
11C90DC	140p
8629	divide by 100 to 150MHz
95H90DC	320MHz divide by ten 7.80p

From the World's leading radio innovation source:

Apart from the MC3357, mentioned alongside, Ambit has the first easy-to-use low noise, low cost UHF dual gate MOSFET - the BF960 from Siemens. With a gain of 18dB, and a noise figure of only 2.8dB at 800MHz, you will see what we mean. At 200 MHz, the gain is 23dB, and NF only 1.6dB. Combine these figures with the famous ease of use of a dual gate MOSFET, and you have the easiest and most effective front end device yet. £1.60 each

Moving Coil Meters

Ambit offers a very wide range of low cost meters, together with the unique 'Meter Made' scale system for professional grade scale customizing:

Series	Scale Area	Illumination	cost*
900	14x31mm	internal 12v	250p
920	30x50mm	from behind	275p
930	36x63mm	internal 12v	375p
940	twin 35x45mm	from behind	350p
950	55x45mm	from behind	300p

Radio/Audio/Comms ICs:

Only the very best quality - and only types we have used in our own laboratory tests (Radio frequency + mixers + oscillator[s])

TD1A1062	DC to VHF front end system	1.95
TD1A1083/ULN2204	am/fm/aud in one IC	1.95
TD1A1090/ULN2242	am/fm/hi tuner system	3.35
HA1197	LF/30MHz am receiver system	1.40
CA3123E/uA720	LF/30MHz linear system	1.40
TBA6251	LF/30MHz linear system	1.81
SD6000	DMOS RF/Mixer pair	3.75
IF amplifiers		
CA3089E/KB4402	famous FM IF system	1.94
HA1130W	4420 as 3089 + deviation mute	2.20
CA3189E	update with deviation mute	2.25
TBA120A/SN76600N	FM if and detector	0.75
TBA120S	hi gain version TBA120	1.00
MCI350P	agc IF amp	1.30
MCI330P	synch AM demodulator	1.25
MCI495L	precision 4 quad multiplier	6.86
MCI496P	popular double balanced mixer	1.25
Communications circuits		
KB4406	differential amplifier	0.50
KB4412	2 best mixers/agc/fan/doub. conv	2.55
KB4413	am/tm/ssb det. AGC, ANL, mute	2.75
KB4417	3mV mic processor preamp	2.55
KB4423	FM noise blanker system	2.55
Audio preamps		
LM381	stereo high gain/low THD	1.81
LM1303	stereo audio optimized OA	0.99
TD1A1054	high quality with all option	1.95
see above		
Audio Power amps		
TBA10AS	7W RMS overload protected	1.09
TD2A200K	3W/2Ω in pentaxatt package	1.95
TD2A200	15W RMS hi power dc coupled	2.99
TCA9A9	10W higher voltage B10	1.80
ULN2283	1W 2.5 to 12v supply capability	1.00
LM3808N	1W power	1.00
LM380N14	2.5W power	1.00
HA1370	HiFi 15w in easy heatsink pack	2.99
Stereo Decoder Devices		
MC1310/KB4400	original pll decoder	2.20
CA3090A/C	RCA's pll decoder	3.25
IC1758	Buffered version of 1310	2.20
LM1307/uA707	non pll type	1.55
HA1196	advanced agc/dsp pll thd thd	3.95
HA11223	new pilot cancel low thd/ldm	4.35

Discrete semiconductors

Some of the biggest stocks of specialist MOS and FET transistors for radio in the UK.
 BF900 80p * 40673 55p * 40822 43p * 40823 51p * MEM680 75p * BF256S 34p *
 Most types for most RF circuitry, inc. new UHF T package types etc. See price list.

Hitachi VMOS 100W power devices:

Hitachi 2SK134 /2SJ48 100W comp. VMOS. Data and circuit info £1, and the devices themselves for £14.00 a pair *

DISCRETE LEDs from Telefunken, square sided and round, AMBIT has the best value.....

LED size	Imml	2.5x5	5 dia	2.5dia
RED	17p	14p	14p	14p
Yellow	20p	15p	15p	15p
Green	20p	16p	16p	16p
Orange	24p/he	29p/heL	17p	17p

Switch Systems: Check our combinations!

A very wide selection of BOTH Alps SUB series units, (Shadow/AB/Orator compatible) & the miniature Dialist units. Available in DIY systems for maximum flexibility and low cost.

And Finally

Further details of these, and many more of the wonders of the world of wireless in the new Ambit catalogue - with magazine supplement. 45p inc pp etc. Phone (0277) 216029/227050 9am-7pm callers welcome anytime

Coils & Filters by TOKO

After a period of relative price stability, please note that some prices are increased - as a direct result of the failure of £ versus stronger trading currencies. (Mainly Yen)

7 & 10mm IFTs for AM/FM - 1000s es 455/470kHz most types of appcs 30p 10.7MHz 33p

Short Wave Coils sets

Now two ranges of impedance/coupling ea 33p
 TV video and sound IFs/detectors
 Another new range in 10mm 33p
 6MHz ceramic IF sound filter 80p

Molded VHF coils full catalogue 15p

Ultra stable coils for 30 - 200MHz from 20p

Chokes - biggest range/biggest stocks

Most E12 values ex stock, any to order
 BLR2007 Stereo 3k3 impedance 16p
 BRB series 10uH to 1mH 79p
 10BR series 33mH to 120mH 33p

FM IF FILTERS ceramic and linear phase

CFSE/SFE10.7 stereo ceramic IF 10.7MHz filters in 5 groups 50p
 CFSE10.7 mono roofing IF filter 50p
 BBR3125N 4pole linear phase 10.7MHz 45p
 BBR3132A 6pole linear phase 10.7MHz 250p

MPX pilot tone filters for 19 & 38kHz

BLR3107N Stereo 4k7 impedance 215p
 BLR2007 Stereo 3k3 impedance 220p
 BLR3152 Mono 4k7 impedance 100p
 BLR3157 Mono 4k7/3k0 imp 100p

AM/FM/SSB IF FILTERS

MFL series 2.4kHz sat /455kHz carrier 1195p
 MFH series 4/5/7kHz BW on 455kHz 195p
 MFK series 7/9kHz BW on 455kHz 165p
 LFY455D 12kHz 4 e ladder on 455kHz 125p
 CFM2455 6kHz micro mechanical 65p
 SFD455/470kHz murata IF filter 85p
 CFT455B/C 6/8kHz min + 2IFTs 60p
 CFU470C 6kHz on 470kHz 65p

Ratio Detectors for FM/NB/FM

1A651/7 455kHz ratio det 135p
 KAN1508/9 10.7MHz ratio detector 66p
 9A4C515/106/7 10.7MHz ratio detector 66p
 Quadrature detectors for CA3089E etc
 KACSK586HM single 33p
 KACS3432/3 double 66p

Polystyfon: tuning capacitors + trimmers

2A205T7 2x266pF AM 95p
 CY222172 2x335p AM 175p
 CY23217PX 2x335p FM (2 trimmers) 245p

Tuner Modules

From the biggest and best range.....

TUNERHEADS for 88-108MHz band 2 (varicap)
 EF5803 6 cct, 3 MOSFETs, amp. osc. 19.75
 EF5801 6 cct, 2 MOSFETs, osc op. 17.45
 EF5800 5 cct, MOSFET RF, by TOKO 14.95
 EF5400 4cct balanced mixer/pln agc 9.75
 EC3302 3cct Fet input miniatur 8.25

TUNERSETS by LARSHOLT (head+IF)

7252 Dual MOS head/low dist IF 26.50
 7253 Fet head, mpX decoder inc 26.50
 IF AMPLIFIERS all with deviation mute, agc, etc. meter drives etc

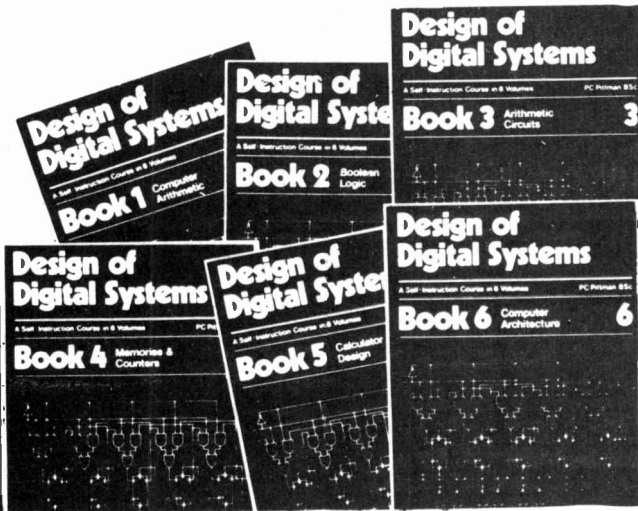
7020 HiGain dual ceramic filter 6.95
 7030 Mos preamp, linear phase filter 10.95
 7130 2 mos preamps, 3 Ipfilters 16.25
 NBFM1 455/470kHz NBFM module 9.95

MPX decoders, all with pilot tone filters and buffer amplifiers for min 300mV RMS

92310 1310 based system 6.95
 3090A0 3090A0 based system 8.85
 91196 HA1196 based + birdy filter 12.99

Understanding Digital Electronics

New teach-yourself courses



Design of digital Systems is written for the engineer seeking to learn more about digital electronics. Its six volumes — each A4 size — are 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 finally to a complete understanding of the design and operation of calculators and computers.

The contents of Design of Digital Systems include:

- Book 1** Octal, hexadecimal and binary number systems; conversion between number systems; representation of negative numbers; complementary systems; binary multiplication and division.
- Book 2** OR and AND functions; logic gates: NOT, exclusive OR, NAND, NOR and exclusive-NOR functions; multiple input gates; truth tables; De Morgans Laws; canonical forms; logic conventions; Karnaugh mapping; three-state and wired logic.
- Book 3** Half adders and full adders; subtractors; serial and parallel adders; processors and arithmetic logic units (ALUs); multiplication and division systems.
- Book 4** Flip flops; shift registers; asynchronous and synchronous counters; ring, Johnson and exclusive-OR feedback counters; random access memories (RAMs) and read only memories (ROMs).
- Book 5** Structure of calculators; keyboard encoding; decoding display data; register systems; control unit; program ROM; address decoding; instruction sets; instruction decoding; control program structure.
- Book 6** Central processing unit (CPU); memory organisation; character representation; program storage; address modes; input/output systems; program interrupts; interrupt priorities; programming; assemblers; computers; executive programs; operating systems and time sharing.



Digital Computer Logic and Electronics is designed for the beginner. No mathematical knowledge other than simple arithmetic is assumed, though the student should have an aptitude for logical thought. It consists of four volumes — each A4 size — and serves as an introduction to the subject of digital electronics. Everyone can learn from it — designer, executive, scientist, student, engineer.

Contents include: Binary, octal and decimal number systems; conversion between number systems; AND, OR, NOR and NAND gates and inverters; Boolean algebra and truth tables; De Morgans Laws; design of logic circuits using NOR gates; R-S and J-K flip flops; binary counters, shift registers and half adders.

CAMBRIDGE LEARNING ENTERPRISES, UNIT 12, RIVERMILL SITE, FREEPOST, ST. IVES, HUNTINGDON, CAMBS. PE17 4BR, ENGLAND
 TELEPHONE: ST. IVES (0480) 67446
 PROPRIETORS: DRAYRIDGE LTD. REG. OFFICE: RIVERMILL LODGE, ST. IVES
 REGD. IN ENGLAND No. 1328762

In the years ahead the products of digital electronics technology will play an important part in your life. Calculators and digital watches are already commonplace. Tomorrow a digital display could show your vehicle speed and petrol consumption; you could be calling people by entering their name into a telephone which would automatically look up their number and dial it for you.

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

After completing these courses you will have broadened your career prospects and increased your fundamental understanding of the rapidly changing technological world around you.

The six volumes of Design of Digital Systems cost only:

£8.10

+ 90p. post & packing

And the four volumes of Digital Computer Logic and Electronics cost only:

£4.60

+ £1 post & packing

But if you buy both courses, the total cost is only:

£12.00

Price includes surface mail anywhere in the world — Airmail extra.

Flow Charts & Algorithms

HELP YOU PRESENT

safety procedures, government legislation, office procedures, teaching materials and computer programs by means of YES and NO answers to questions.

THE ALGORITHM WRITER'S GUIDE explains how to define the questions, put them in the best order and draw the flow chart, with numerous examples shown. All that students require is an aptitude for logical thought. Size: A5, 130 pages. This book is a MUST for those with things to say.

£2.95

+ 45p post & packing by surface mail anywhere in the world. Airmail extra.

GUARANTEE

If you are not entirely satisfied your money will be refunded.

Cambridge Learning Enterprises, Unit 12, Rivermill Site, Freepost, St. Ives, Huntingdon, Cambs. PE17 4BR England.

Please send me the following books.

- sets Digital Computer Logic & Electronics @ £5.50, p & p included
- sets Design of Digital Systems @ £9.00, p. & p. included
- Combined sets @ £13.00, p & p included
- The Algorithm Writer's guide @ £3.40, p & p included

Name

Address

I enclose a cheque/PO payable to Cambridge Learning Enterprises for £.....

Please charge my *Access/ Barclaycard/ Visa/ Eurocard/ Mastercard/ Interbank account number

Signature

*deleted as appropriate
 Telephone orders from credit card holders accepted on 0480-67446 (ansafone). Overseas customers should send a bank draft in sterling drawn on a London Bank.

ETI 12

The latest kit innovation!

from Sparkrite



the quickest fitting
CLIP ON
capacitive discharge
electronic ignition
in KIT FORM

- Smoother running
- Instant all-weather starting
- Continual peak performance
- Longer coil/battery/plug life
- Improved acceleration/top speeds
- Optimum fuel consumption

Sparkrite X4 is a high performance, high quality capacitive discharge, electronic ignition system in kit form. Tried, tested, proven, reliable and complete. It can be assembled in two or three hours and fitted in 1/3 mins. Because of the superb design of the Sparkrite circuit it completely eliminates problems of the contact breaker. There is no misfire due to contact breaker bounce which is eliminated electronically by a pulse suppression circuit which prevents the unit firing if the points bounce open at high R.P.M. Contact breaker burn is eliminated by reducing the current to about 1/50th of the norm. It will perform equally well with new, old, or even badly pitted points and is not dependent upon the dwell time of the contact breakers for recharging the system. Sparkrite incorporates a short circuit protected inverter which eliminates the problems of SCR lock on and, therefore, eliminates the possibility of blowing the transistors or the SCR. (Most capacitive discharge ignitions are not completely foolproof in this respect). The circuit incorporates a voltage regulated output for greatly improved cold starting. The circuit includes built in static timing light, systems function light, and security changeover switch. All kits fit vehicles with coil/distributor ignition up to 8 cylinders.

THE KIT COMPRISES EVERYTHING NEEDED

Die pressed epoxy coated case. Ready drilled, aluminium extruded base and heat sink, coil mounting clips, and accessories. Top quality 5 year guaranteed transformer and components, cables, connectors, P.C.B., nuts, bolts and silicon grease. Full instructions to assemble kit neg. or pos. earth and fully illustrated installation instructions.

NOTE - Vehicles with current impulse tachometers (Smiths code on dial RV1) will require a tachometer pulse slave unit. Price £3.35 inc. VAT, post & packing.

Electronics Design Associates, Dept. ET 10
82 Bath Street, Walsall, WS1 3DE. Phone: (9) 614791

Name

Address

Phone your order with Access or Barclaycard

Send SAE if brochure only required.

Inc. V.A.T. and P.P.

QUANTITY REQD.

I enclose cheque/PO's for

X4 KIT £14.95

TACHS PULSE SLAVE UNIT £3.35

£

Cheque No.

Access or Barclaycard No.

GREENWELD

443 Millbrook Road Southampton
SO1 0HX Tel: (0703) 772501

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

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**

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

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

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

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

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

K021 Miniature carbon film 5% resistors, CR25 or similar, 10 of each value from 10R to 1M, E12 series. Total 610 resistors **£5.00**

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**

STEREO AMPLIFIER CHASSIS £5.50

Complete and ready built Controls Bass, treble, volume/on-off, balance. 8 transistor circuit gives 2 watts per channel output. Just needs transformer and speakers for low cost stereo amp. Suitable metal cabinet (W374) **£2.00** - or buy the amp, case and transformer for **£10.00** and get DIN speaker sockets and knobs free!!

AMPLIFIER KIT £1.75

Mono gen. purpose amp with tone and vol./on-off controls. Utilizes sim. circuitry to above amp. Output 2W into 8 ohms. Input matched for crystal cartridge. 4 transistor circuit. Simple to build on PCB provided. Can be either battery or mains operated. (For mains powered version add **£2.20** for suitable transformer) Blue vinyl covered aluminium case to suit (W372) **£1.30**.

BC182B OFFER

Special Offer for quantity users. 1k 035 + VAT, 5k 032 + VAT Price negotiable on 10k + approx. 80k available.

PC ETCHING KIT MK III

Now contains 200 sq. ins. copper clad board, 1lb. Ferric Chloride, DALO etch-resist pen, abrasive cleaner, two miniature drill bits, etching dish and instructions. **£4.25**.

EDGE CONNECTORS

Special purchase of these 0.1 pitch double-sided gold-plated connectors enables us to offer them at less than one-third of their original list price! 18 way **41p**; 21 way **47p**; 32 way **72p**; 40 way **90p**.

THE NEW 1978-9 GREENWELD CATALOGUE

FEATURES INCLUDE:

- ★ 50p Discount Vouchers
- ★ Quantity prices for bulk buyers
- ★ Bargain List Supplement
- ★ Reply Paid Envelope
- ★ Priority Order Form
- ★ VAT inclusive prices

HEAT SINK OFFER

Copper T05 sink 17mm dia x 20mm. 10 for 40p; 100 for £3; 1,000 for £25.

74 SERIES PACK

Selection of boards containing many different 74 series ICs. 20 for £1; 50 for £2.20; 100 for £4.

TMS4030 RAM

4096 bit dynamic RAM with 300ns access time; 470ns cycle time; single low capacitance high level clock i/p. Fully TTL compatible. Low power dissipation. Supplied with data **£2.75**.

MISCELLANEOUS ICs

Supplied with data if requested. MC3302 quad comp **120p**; 710 diff comp. (T099) **40p**; ZN1034E precision timer **£2.25**; LM711 Dual diff comp **65p**; LM1303 dual stereo pre-amp **75p**; MC1469R voltage reg **£1.50**; UPC1025H audio **£3.50**; 575C2 audio **£2.88**; TDA2640 audio **£2.92**; TBA810S audio **70p**; SN75110 dual line driver **70p**; MC8500 CRCC gen POA.

EXPERIMENTERS CALCULATOR

Based on the C500 chip, this pack of parts enables the more experienced constructor to make an 8 digit 4 function calculator. The comprehensive data supplied includes full-size layout of PCB required, types of suitable display and keyboard that can be used etc. Components included in the pack are C500 calculator chip, driver IC, all components for inverter/clock circuits, Rs Cs etc. All for only **£3.50**.

RELAYS

W847 Low profile PC mntg 10 x 33 x 20mm 6V coil. SPCO 3A contacts **93p**.
W832 Sub. min type, 10 x 19 x 10mm 12V coil DPCCO 2A contacts **£1.15**.
W701 6V SPCO 1A contacts 20 x 30 x 25mm. Only **56p**.
W817 11 pin plug in relay, rated 24V AC, but works well on 6V DC. Contacts 3 pole c/o rated 10A, 95p.
W819 12V 1250R DPCCO 1A contacts. Size 29 x 22 x 18mm min. plug-in type **72p**.
W839 50V ac (24V DC) coil, 11 pin plug-in type, 3 pole c/o 10A contacts. Only **85p**.
W846 Open construction mains relay, 3 sets 10A c/o contacts **£1.20**.
Send SAE for our relay list - 84 types listed and illustrated.

LOW COST PLASTIC BOXES

Made in high impact ABS. The lids are retained by 4 screws into brass inserts. Interior of box has PCB guide slots (except V219).

V210	80x62x40mm black	58p
V213	100x75x40mm black	72p
V216	120x100x45mm black	86p
V219	120x100x45mm white	86p

SPECIAL SUMMER OFFERS

Audio ICs		
76003N	£1.40	76013N £1.00
76023N	£1.00	76033N £1.40
LM380	80p	TBA810S 90p

Linear ICs etc.		
741(BDIL)	18p	BD131 24p
555	25p	BD132 28p
1N4148	2p	2N3819 18p

DIODE SCOOP!!!

We have been fortunate to obtain a large quantity of untested, mostly unmarked glass silicon diodes. Testing a sample batch revealed about 70% useable devices - signal diodes, high voltage rets and zeners may all be included. These are being offered at the incredibly low price of **£1.25/1,000** - or a bag of 2,500 for **£2.25**. Bag of 10,000 **£8**. Box of 25,000 **£17.50**. Box of 100,000 **£60**.

ELECTROVALUE Buying Guide

Section 5

If you have bought from us before, you will know just how large and varied our stocks are. For those who have yet to know, we are publishing a series of five advertisements month by month to give up-to-date information and prices on the most important items we carry. These advertisements will appear in stepped rotation in five journals — E.T.I., Elektor, Practical Wireless,

Practical Electronics and Everyday Electronics, so that the complete series will be available each month. In this way, no matter which journals you read, BY DETACHING AND SAVING THESE PAGES, YOU WILL HAVE A VALUABLE AND COMPREHENSIVE MONEY SAVING CATALOGUE. Next month — Section One.

HARDWARE/SOLDER TOOLS

SOLDER TOOLS

ORYX50 Temp. controlled
Spare element **£8.90N**
Bits (11 types) **£3.60N**
ORYX Super 30
Spare element **£3.50N**
Bits as for ORYX50 **£2.50N**

ISO-TIP Quick Charge cordless iron **£18.50N**
Bits micro 7566 **£2.30N**
fine 7545 **£2.30N**
h.d. 7546 **£2.30N**
Std 7535 **£2.30N**
PC drill attachment 6500 **£10.60N**
Spare bulb **35pN**

ERSA Sprint
Solder gun **£8.62N**
Spare element **£5.00N**
Bit No. 862VN **40pN**
ERSA solder station
Temp. controlled iron with stand **£59.00N**

GREENWOOD PYROMETER **£25.00N**

DESOLDER TOOL
SR3A **£5.95N**
Spare nozzle, PTFE SR3AN **65pN**
ANTEX C-240V 15W **£3.60N**
Spare element **£1.60N**
Nickel plated bits **46pN**
No. 2 .094"; No. 4 .187"; No. 6 .047"

Iron coated bits **46pN**
No. 102, 104, 106
ANTEX CCN-240V **£3.80N**
(low capacitance) 15W
Spare element **£1.90N**
Iron coated bits **46pN**
1100 .094"; 1101 225" 1102, 187"

ANTEX CX 240V **£3.60N**
Spare element **£1.60N**
Bits for CCN above
ANTEX X25-240V 25W **£3.60N**
Spare element **£1.60N**
Iron coated bits **50pN**
50 .094"; 51 125" 52 187"

ANTEX STAND ST3 **£1.50N**
No. 666 Sponge **6pN**
SOLDERSTAN RANGE
HMS 240V 16W **£4.75N**
HMS 240V 24W **£4.75N**
HMS 110V 16W **£4.75N**
HMS 110V 24W **£4.75N**
Spare elements **£2.35N**

Nickel plated bits
2037 3.2mm **80pN**
2038 2.4mm **80pN**
2003 2mm stub **80pN**
Iron plated
2032 4.5mm **£1.90N**
2033 6.5mm **£1.90N**
IC desolder head for HMS
Irons
14-way **£5.70N**
16-way **£5.70N**
HMS 240V Solder Kit in presentation box **£8.90N**
HMS 12V solder kit in wallet **£7.60N**

POT CORES
FERRITES
BOOKS
Latest price list of all ranges free on request

***GOODS SENT POST FREE U.K.**
on C.W.O. orders over £5 list value. If under, add 27p. handling charge

***ATTRACTIVE DISCOUNTS** on C.W.O. orders — 5% where list value is over £10 10% where list value is of £25

***TOP QUALITY MERCHANDISE** — ALL BRAND NEW GUARANTEED.

VERO PRODUCTS

VEROBOARD
0.1" matrix copper clad 3.75" x 2.5" **46p**
5" x 2.5" **55p**
5" x 3.75" **55p**
5" x 3.75" **62p**
8.45" x 1.5" **53p**
DIP-BOARD **£2.24**
VQ Dip-Board **91p**
24-way plug-in **£2.20**
32-way **£2.40**
EURO Dip-Board **£3.57**

0.1" matrix unclad
3.75" x 2.5" **31p** 5" x 3.75" **50p**
EURO Board **89p**
0.15" matrix, copper clad
3.75" x 2.5" **36p** 5" x 2.5" **50p**
3.75" x 3.75" **50p** 5" x 3.75" **53p**
67p 8.45" x 1.5" **53p**
0.2" matrix, copper clad
5" x 3.4" **76p**

PIN INSERTION TOOLS
No. PIT1 for 0.040" pins (0.1" matrix) **£1.10**
No. PIT5 for 0.052" pins (0.15" matrix) **£1.10**

SPOT FACE CUTTER
Suitable for any matrix **81p**

TERMINAL PINS

(Not made by Vero)
0.040" dia for 0.1" matrix per 100 **35p** per 500 **£1.15**
0.052" dia for 0.15" matrix per 100 **40p** (Both types double ended)
VEROBX STANDARD BOXES
High Impact polystyrene light grey top, dark grey bottom section.
Type L W H
2514F 100 50 25 **£1.64**
2516G 100 50 40 **£1.86**
2518H 120 65 40 **£2.07**
2520J 150 80 50 **£2.35**
2522K 188 110 60 **£3.13**

VEROBX CASES
Constructed from ABS material light grey top & dark grey bottom section. Anodised ali. front and rear panels Internal guides for PC boards
Type L H D
1237J 154 40 85 **£2.56**
1238D 154 60 85 **£2.82**
1239K 154 80 85 **£3.38**
1410J 205 40 140 **£3.53**
1411D 205 75 140 **£3.96**
1412K 205 110 140 **£5.12**

SLOPING FRONT PLASTIC CASES

The 1798K has white top and grey bottom section, the 2523E has light grey top and dark grey bottom section.
Both have anodised aluminium panels.
Type W H1 H2 D Price
1798K 171 38 75 121 **£4.19**
2523E 220 52 100 156 **£6.36**

19" CARD/FRAME CASE SYSTEM
accepts plug-in modules and standard European size circuit boards.
Light blue with natural anodised aluminium end plates
Can be rack-mounted.
Type Item Price
3841L Case **£20.71N**
3842F End plate angles (pr.) **83pN**
3843A B" Module **£4.00N**
3844G 4" Module **£3.05N**
3845B 2" Front panel **£1.02N**
3846H 1" Front panel **97pN**
3979K Board for module **£1.39**
1034E Vero-board, clad **£1.42**
1041J DIP-board **£3.59**
0267H 31-way plug **97pN**
0258C 31-way socket **£1.06N**

EUROCARD CONNECTORS
2876D 64-way plug **£2.47N**
2874C 64-way socket **£4.48N**

NEW ANOTHER SPECIAL FROM ELECTROVALUE WE ARE NOW NATIONAL DISTRIBUTORS FOR

NASCOM 1 MICROCOMPUTER KITS

FOR DELIVERY FROM STOCK
NETT PRICES FROM £197.50 + V.A.T.
QUANTITY DISCOUNTS
TRADE ENQUIRIES INVITED

TRANSFORMERS
All mains transformer primaries suitable for 240V input except for 50T52A
GP302 30V 2A tapped at 12, 15 20, 24V **£4.60**
GP501 50V 1A tapped 19, 25, 33, 40V **£4.30**
GP502 50V 2A tapped 19, 25, 33, 40V **£6.30**
GP601 60V 1A tapped 24, 30, 40, 48V **£4.60**
GP602 50V 2A tapped 24, 30, 40, 48V **£6.70**
50T5 50V 2A tapped 25, 45V Pri/sec shield **£6.55**

50T52A 50V 2A (110/120V pri) tapped 25, 45V Pri/sec shield **£6.55**
28T05 12V, 12V, 2.0-2.0V 0.5A **£3.85**
28T1 12V, 12V, 2.0-2V 1A **£4.80**
28T2 12V, 12V, 2.0-2V 2A **£5.30**
12T05 6V, 6V, 0.5A **£3.30** (Split primary 120, 120V)
CT1 17V 1A charger duty tapped 9V **£2.95**
CT2 17V 2A charger duty tapped at 9V **£3.25**
CT4 17V 4A charger duty **£3.85**
FT1 6 3V 1.5A **£2.45**
GP12 12V 1.5A **£2.30**

606/1 6.0-6V 100mA **£1.00**
MT280 6V, 6V, 250mA **£1.40**
909/1 9.0-9V 75mA **£1.00**
GP909 9.0-9V 0.5A **£2.10**
12012/1 12.0-12V 50mA **£1.00**
1200 12.0-12V 100mA **£1.20**
MT150 12V, 12V, 150mA **£1.70**
151A 15.0-15V 1A **£3.20**
GP202 20.0-20V 0.75A **£2.30**
301A 30.0-30V 1A **£3.80**
Miniature L.S. transformer
LT700 Pri 1K2 C.T. Sec 3.2n **39p**

PRINTED CIRCUIT MATERIALS
COPPER CLAD BOARD 300 x 150mm
Single Sided **£1.65**
SRBP 85p; Fibreglass **£1.00**
Double sided SRBP **£1.00**
UNCLAD SRBP 300 x 150mm **56p**
FERRIC CHLORIDE, Lab. grade 100gm pack **47p**; 500gm jar **£2.30**
POSITIV-20 Aerosol, 75cc with instructions **£1.30**
ETCH RESIST PEN Decon with spare tip 73.00 63.00 **85p**
SILVER CONDUCTIVE PAINT 3gm vial Eleccolit 340 **£1.92 £1.68 £2.20**

RELAYS
MINIATURE CONTINENTAL TYPE
Type R42 12V 185n 2 C/OE **£1.80**
Type R44 12V 185n 4 C/OE **£2.00**
PC socket type P40 **97p**
Ordinary wiring kit. W40 **88p**
Mounting strip 6 posn R40 **26p**
PIGMY MAINS RELAY 3 C/O 10 amp 6V 29n, 12V 110n, 24V 475n all d.c. **each £2.30**
240V a.c. 8200n coil **£2.55**

REED RELAYS open construction
5V 106n CSA5 single n/o **90p**
12V 645n CSA 12 single n/o **90p**
5V 57n CDA5 double n/o **£1.28**
12V320n CDA 12 double n/o **£1.19**
REED RELAYS enclosed type n/o
LPS12 single 590n **98p**
LPD12 double 355n **£1.32**
LATCHING RELAYS enclosed n/o
CLA5, 5V 400n **£2.30**
CLA12, 12V 225n **£2.30**

SWITCHES

ERG Dual in Line
One pole change over SDC1 **42p**
Two-SDC2, 78p — SDC3, **£1.08**
On Off 2 pole SDC2 **42p** 4 pole SDC4 **75p**, 6p SDC6 **£1.08**, 8p — SDC8, **£1.32**
Multiple — 1p/B way DS16A1—B **99p** 2p/4W DS16A2-4 **£1.08**

ROTARY MAINS
Lorlin MS 4 amp **48p**
WAVECHANGE
Lorlin CK series, MBB contacts
12W **37p** 1p
6W **37p** 2p
4W **37p** 3p
3W **37p** 4p

ROTARY SWITCH KIT Type RA 6 wafers **60p**
RA Wafers MBB
1P 1W or 2P 5W **66p**
RA Wafers BMB
1P 12W, 2P 6W, 3p 4W, 4P 3W, 6P 2W **66p**

RA Shorting wafer, MBB
Rotating open-circuit **66p**

PUSH BUTTONS
Standard Size
SSP10, 250V 3A a.c. push on, push off panel hole 0.5" **59p**
SSP11, as SSP10 push to make **52p**
Sub-Miniature 250V 0.5A a.c. 8531 push to make **62p**
8533 push to break **62p** (Panel hole 0.25")

CASTELCO RANGE 250V 1A a.c.
0.375" hole with long white fixing ring unless otherwise ordered.
No. 2644 SP make **18p**
No. 3244 DP make **34p**
No. 2648 SP break **18p**
No. 3248 DP break **34p**
No. 2634 SP on/off **17p**
No. 3234 DP on/off **30p**
No. 4434 as 3234 but switch sections reversed **30p**
No. 4444 as 3244 but switch sections reversed **34p**
Spare rings in black, red, yellow, green, blue, white or pink **each 1p**

TOGGLE 250V 1.5A a.c.
Chrome finish
1011C SPST **56p**
1016C SPDT **61p**
1019C SPDT centre-off **64p**
409 DPDT **77p**
Sub-Miniature 250V 2A a.c. Panel hole 0.25"
S7101 SPDT **63p**
S7201 DPDT **84p**
S7203 DPDT centre-off **84p**
S7205 DPDT biased each side **£1.20**
S7207 DPDT biased one side **£1.51**
S7211 SP 3-way **£1.10**
S7301 3PDT **£1.42**
S7401 4PDT **£1.80**

MICROSWITCHES SPDT
SSU01 button, lever or roller **85p**
TIME SWITCHES (Smith's)
For electrical use, 13A rating
IMERSET for wired-in situations, 2 on & 2 off actions per day **£11.60N**
AUTOSET 13A socket outlet. Otherwise as Imeriset **£10.95N**

MEET US AT BREADBOARD '78 STAND D.8

TEAR OUT AND TAKE GOOD CARE OF THIS PAGE AND REMEMBER TO LOOK OUT FOR NEXT MONTH'S ADVERTISEMENT TO ADD TO IT

OUR COMPUTER-AIDED SERVICE TAKES GOOD CARE OF YOUR ORDER NO MATTER HOW LARGE OR SMALL

ELECTROVALUE LTD

28, ST. JUDES ROAD, ENGLEFIELD GREEN, EGHAM, SURREY TW20 0HB

Telephone Egham 3603 Telex 264475

Northern Branch - 680, BURNAGE LANE, BURNAGE, MANCHESTER M19 1NA(061)432 4945



WIRE WRAPPING CENTRE



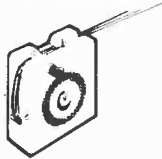
HOBBY WRAP Model BW 630



£26.75 B £31.95 C £2.82 D £7.44

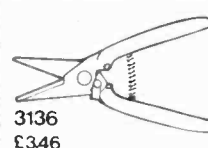
WIRE-WRAPPING TOOL

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



3 IN 1 WIRE DISPENSER
New wire dispenser cuts and strips three different colours of wire. Quick and easy to use pocket size. Wire Size: 30 AWG. 50 ft. Red, Blue, White Kynar insulated.

£4.07



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

3136 £3.46

DIP/IC EXTRACTOR TOOL £119

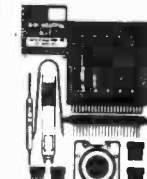
The EX-1 Extractor is ideally suited for hobby enthusiast or lab engineer. Featuring one piece spring steel construction, it will extract all LSI, MSI and SSI devices of from 8 to 24 pins. Extractor Tool EX-1.

DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER



£2.79

INS-1416



WIRE-WRAPPING KIT

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

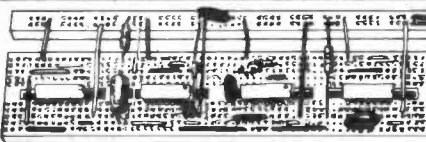
Wire-Wrapping Kit WK-4B (Blue) £19.22



IC TEST CLIPS £2.97

FOR DUAL-IN-LINE PACKAGES

- Provide full access to integrated circuit DIP leads.
- Remove DIP's damage free.
- Available in sizes to accommodate all DIP's; TC-14 fits 14-pin DIP's etc.



FROM 80P TERMINAL AND DISTRIBUTION STRIPS

Bread boarding building blocks with universal matrices of solderless plug-in tiepoints.

- Facilitate quick, solderless circuit build-up and check-out on universal, 1" x 1" matrix.

- Are offered in ten configurations.
- Accept all components with leads up to .032" diameter.
- Require no special patch cords.
- Includes integral non-shorting instant mounting backing.



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

A £4.74 B £5.07

Regular Wrap	A	WSU-30
Modified Wrap	B	WSU-30M



DIP SOCKET
Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, tin inlay finish pins .025 (0,63mm) sq., .100 (2,54mm) centre spacing.

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

FROM 29p

RIBBON CABLE ASSEMBLY £2.92

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



See us at
BREAD BOARD '78
21st-25th November.
Seymour Hall, London
Stand Nos. A5-A6

OK Machine & Tool U.K. Limited
48a The Avenue, Southampton SO12SV
Telephone Southampton (0703) 38966 7 Telex 477222 Cablegram OKMAC

DISTRIBUTORS WANTED***

TAMTRONIK LTD. (DEPT. ETI)

217 Toll End Road, Tipton
West Midlands DY4 0HW. Tel. 021-557 9144

Mag. issue	PROJECT	Ref.	PCB	Components Pack	Hardware Pack	Case (Screened)	Total
TOP	Graphic Equaliser	601	1.60	14.23	4.30	—	20.13
	Graphic Equaliser PSU	602	.55	1.29	—	1.84	3.64
	R.F. Attenuator	603	—	.26	1.54	1.35	3.15
	Watchdog	604	.85	4.69	7.68	5.53	18.75
	Watchdog PSU	605	.65	1.49	3.95	—	6.09
PROJECTS	Sweep Oscillator	606	2.60	21.07	8.16	4.28	36.11
	Stereo Simulator	607	.60	2.30	.53	2.24	5.67
	Freezer Alarm	608	.55	.92	3.85	1.65	6.97
NO.	General Purpose Pre-Amp	609	.65	—	—	—	3.78
	G.S.R. Monitor	612	.70	4.70	7.10	3.95	16.45
	Burglar Alarm	613	.60	2.15	6.15	—	8.90
	Headlight Reminder	614	—	.55	1.65	—	2.20
6	Bench Amplifier	615	.70	3.40	2.95	3.95	10.00
	Audio Visual Metronome	616	—	1.31	1.62	—	2.93
	Compunder	617	1.60	10.10	8.30	3.15	23.15
	50 watt High Power Amp	618	1.30	6.46	—	—	7.76
	100 watt High Power Amp	619	1.30	9.16	—	—	10.46
	High Power Amp PSU	620	1.10	5.66	7.89	—	14.65
	LED Dice	624	.50	2.92	.66	1.65	5.73
	Marker Generator	626	.80	3.68	1.49	.90	6.87
	Skeet	627	1.60	11.12	.97	4.53	18.22
	Flash Trigger	628	.65	3.48	.84	1.65	6.62
	Disco Lightshow	629	3.05	12.79	5.85	—	21.69
	Pink Noise Generator	630	.60	1.00	—	1.65	3.25
Nov 76	541 Train Controller	T001	.75	5.27	5.84	3.95	15.81
Jan 77	444 5-watt Stereo	T002	2.00	14.03	6.84	3.45	26.32
Feb 77	448 Stereo Disco Mixer	T003	1.60	13.74	.87	—	16.21
Dec 77	Click B	T004	2.10	11.31	—	—	13.41
Jan 78	House Alarm A	T005	2.00	10.93	—	—	12.93
Jan 78	House Alarm B	T006	.85	3.04	3.05	9.50	29.37
Feb 78	Metal Locator Mk. II	T007	.92	5.91	8.76	3.38	18.97
Mar 78	Frequency Shifter PSU	T008	.65	4.14	—	—	4.79
Mar 78	Frequency Shifter	T009	1.50	16.99	—	2.40	20.89
Mar 78	LCO Meter	T010	1.00	24.62	—	—	25.62
Mar 78	Light Dimmer	T011	.55	3.40	3.12	—	7.07
Apr 78	Gas Monitor	T012	.80	10.11	1.10	1.35	13.36
May 78	Star Trek Radio	T013	.84	6.19	.83	—	7.86
Jun 78	Stars & Dots	T014	1.83	5.33	11.49	3.46	22.11
Jun 78	Spectrum Analyser	T015	8.32	35.76	16.02	5.00	65.10
June 78	Wave Oscillator	T016	.69	6.36	4.80	2.40	14.45
Jul 78	UFO Detector	T017	1.45	10.18	.80	—	12.43
Jul 78	Torch Finder	T018	.45	1.27	—	—	1.72
Jul 78	Temperature Meter	T019	1.00	24.41	—	—	25.41
Aug 78	Etiwet	T020	.90	2.87	1.16	—	4.93
Sep 78	Cross Hatch Generator	T021	1.40	5.93	3.66	1.65	12.64
Sep 78	Stac Timer	T022	2.30	14.27	11.04	1.65	29.26
Sep 78	Wheel of Fortune	T023	1.35	4.34	4.43	2.24	8.36
Oct 78	Complex Sound Generator	T024	2.95	10.15	11.96	—	25.06
Oct 78	R.F. Power Meter	T025	1.10	2.24	7.12	2.38	12.84
Oct 78	Power Bulge	T026	.60	7.71	.78	.79	2.88
Oct 78	Telephonic Bell Extension	T027	.95	3.48	3.02	2.15	9.50
Oct 78	Proximity Switch	T028	1.95	7.91	3.25	—	13.11
Feb 78	Ultra Sonic Receiver	T029	.60	3.38	4.95	—	8.93
Feb 78	Ultra Sonic Transmitter	T030	.45	.82	3.20	—	4.47

ONE STOP SHOPPING — P.C.B.s

Components, Hardware, Cases, Part Kits, Full Kits. A complete service to the ETI Constructor.
All Prices incl. VAT P&P 30p per order.

Except where copyright restrictions exist PCBs are available for all projects from Sept., 1976 and include

560 A, B, C (set 3)	4.60	Bongos	.65
710 2m Power Amp	.80	Loudhailer	.60
Double Dice	1.35	Continuity Tester	.50
152 A, B TV Patter Gen. (set 2)	2.85	Spirit Level	.85
Heart Rate Monitor	1.00	3-channel Tone Control	.70
Reaction Tester	1.45	Clock A	1.05
Metal Locator 549	.85	Experimenters Power Supply	.90
Door Bell	.65	555 Timer Board	.60
Drill Controller	.60	Hammer Throw (set 3)	4.80
630	.60	Porch Light	.70
Digital Frequency Meter (set 4)	2.90	RMS Meter	.95
Digital Thermometer	1.20	Rain Alarm	1.00

SYSTEM 68

M/F PSU	.90	VDU 'A'	2.70	VDU 'B'	2.85
CPU	2.35	631	2.50	TTY	2.00
Cuts & Ram	2.25	(PCBs are modified)	—	—	—

Discounts on any 3 PCBs 5%, any 4 PCBs 10%, Full Set £12.00
568, any 5 PCBs 12½%, any 6 PCBs 15%

"SON OF ETI"

HOBBY ELECTRONICS

THIS MONTH'S BARGAINS

100 x ½W 1K carbon resistors * 30p

PCBs and Kits available from TAMTRONIK.

PCBs and Kits also available for everyday electronics, send SAE for details

1 plug-in mains PSU 3V/6V/9V/12V DC 300MA, suitable for calculators and TV Games Only £2.99

For a few kits it is not possible to supply ALL components. To avoid disappointment we recommend you send SAE requesting kit details. Please quote project and kit reference number when details of a specific kit is required. SAE automatically brings free catalogue.

OVER 100 KITS NOW AVAILABLE

TRADE AND EDUCATIONAL ENQUIRIES WELCOME

Visit our shop at:
32 MARKET PLACE, GREAT BRIDGE, TIPTON, WEST MIDLANDS

Mail Order or Telephone

Access

**SAME AS
ETI OFFER**

5 FUNCTION LCD

Hours, mins, secs.
month, date, auto calendar,
back-light, quality
metal bracelet.

£8.95



**SPECIAL
TO
ETI
READERS**

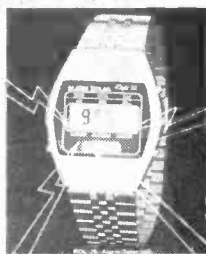
**Solar + alarm
LCD watch**

(See article on p. 18 for quartz battery prices)

**SOLAR ALARM
WATCH**

- * Hours, mins, secs displayed.
- * Day, date, day of week
- * 24 hour penetrating alarm
- * Quality metal bracelet.
- * Powered from solar panel.
- With battery back-up.
- * Back-light + auto calendar.

£29.95



*** QUARTZ LCD ALARM ***

Snooze + backlight. Batteries last 1 year approx. Includes batteries and travel pouch. Excellent value

£17.65



**THOUSANDS SOLO
11 FUNCTION
SLIM CHRONO**

- 6 digit 11 functions
 - * Hours, mins, secs.
 - * Day, date, day of week.
 - * 1/100, 1/10, secs, 10 x secs, mins.
 - * Split and lap modes.
 - * Back light, auto calendar.
 - * Only 8 mm thick.
- This same watch is being sold for £22.00 in newspaper and magazine special offer ads.

**Metac Price
£12.65**



SEIKO

The Seiko Quartz Collection encompasses a wide and exciting range of quartz watches for men and women. Day/Date quartz. Ultra-thin quartz. Digital quartz watches with liquid crystal display for continuous readout. Even a digital quartz alarm chronograph. It's what you'd expect of Seiko. The first quartz watch ever sold was a Seiko. And Seiko's expertise in every phase of the watchmaking process makes it possible for Seiko to make any part of any Seiko watch, and to exercise a unique quality control system through every step from design to completion. Whichever Seiko Quartz model you select, you get more than just a technologically advanced timepiece.



List Price £130
Metac Price £105



List Price £85
Metac Price £68

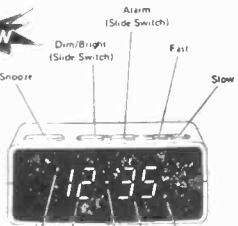


List Price £120
Metac Price £98



List Price £165
Metac Price £125

**HANIMEX
Electronic
LED Alarm Clock**



Feature and Specification

- * Hour/minute display
- * Large LED display with p.m. and alarm on indicator
- * 24 Hours alarm with on-off control
- * Display flashing for power loss indication
- * Repairable 9 minute snooze
- * Display bright/dim modes control

Size 5 1/2 x 3 9/32 x 2 3/16 (131mm x 100mm x 60mm)
Weight 1.43 lbs (0.65 kg)

£8.95 (Inclusive of VAT and Postage)

SOLAR

5 function LCD

- * Solar panel with battery back-up.
- * Back light + auto calendar.
- * Hours, mins, secs, day, date.
- * Quality metal bracelet.

£12.95



**LADIES
LCD**

Only 25 x 20 mm and 6 mm thick. 5 function: hours, mins, secs, day, date. + back light and auto cal. Elegant metal bracelet in silver or gold. State preference.

£10.95



**ALARM
LCD**

6 digit 7 function hours, mins, secs, day, date, day of week, 24 hour penetrating alarm. Back light + auto calendar

Only £24.95



**★ 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

PRICE £6.65



**MICRO
CASSETTE
RECORDER**

Hand-held only 2 1/2 x 5 x 1 1/2 inch. Identical to well known models being sold at £35

**OUR PRICE
£24**



**SINCLAIR SCIENTIFIC
PROGRAMMABLE
+ free program library
worth £4.00**

ONLY £12.95 FROM METAC

COMPONENTS

- 2N3055 transistors 50p
- 2 inch LED's, red 12p
- green 15p
- yellow 15p
- orange 15p

- DL 704 displays 80p
- DL 707 displays 80p
- Watch batteries 70p (state type)
- Mercury tilt switches 50p
- Crystal mic. inserts 50p

Also useful for sonic applications and sound transmitters (buzzers etc)

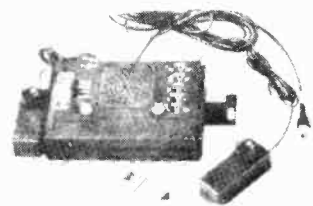
**METAC
EXCLUSIVE
CALCULATOR
WATCH +
STOP-WATCH
SEIKO STYLE**

Calculator: X, +, x, -, K
Time: hours, mins, secs, day, date, day of week

PRICE £49



TV GAMES



Black & white £9.95 Colour £12.95
4 games. 2 ball speeds. 2 ball angles.
2 bat sizes

All products carry full 12-month guarantee. Please add 30p P&P with all orders. All prices include VAT.

Shops open 9.30 to 6.00 daily.

Trade enquiries welcome.



METAC Electronics & Time Centre
67 HIGH STREET
DAVENTRY, NORTHANTS
Tel. (032 72) 76545

327 EDGWARE ROAD
LONDON W2
Tel. (01) 723 4753

Barclay & Access welcome
Phone or Send Card Number
with order



MINI-ADS & CLASSIFIED

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, 4 1/2" x 6 1/2", 99p all up

CROFTON ELECTRONICS LIMITED

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

HAPPY MEMORIES

21102 RAM (450ns) 1-15 @ 95p, 16-63 @ 92p, 64 up @ 89p
2114EMM RAM (300ns) 1-3 @ £6.25, 4 up @ £6
2708 EPROM (450ns) 1-3 @ £7.25, 4 up @ £7
16 PIN DIL SOCKETS Gold 22p, 100 up 21p
Tin 12p, 100 up 11p

RAMS LIKE A SPARE BIT — 1.2mm bits for Antex CX17 and CCN soldering irons 45p
Cheque or P.O. to G. J. Greaves
5 Cranbury Terrace Southampton Hants. SO2 0LH
C.O.D. available at cost
All prices include V.A.T Add 20p postage

AT LOW COST

MICROCOMPUTER

The experimenter and hobbyist needs

VIM-1

Use the VIM by itself with its on board 28 double function keypad and 6 character LED display
Then expand to full mainframe via 3-44 way edge connectors
It comes to you assembled and tested
Just connect your +SV D1 5A power supply and

VIM-1 is operational in minutes
Three manuals provided enable you to MASTER MICROPROCESSOR TECHNOLOGY
Plus features include

- Hi speed cassette interface 185 bytes/sec
- 1K user RAM with sockets for additional 3K
- Sockets for 20K ROM expansion
- ASCII alpha/numerics direct to an oscilloscope.

- 4K SUPERMON MONITOR includes
- Single step with variable trace speed
- Register modify/inspect whilst in program
- Hex displacement calculator
- Black transfer plus much more

£199 plus 8% VAT = £214.92
TOTAL = £214.92

Plus full technical support and demonstrations from

ANDOR ELECTRONICS LTD.

11 The Precinct, Romiley, Stockport SK6 4AE
Tel: (061) 430-4770

DEAD or ALIVE OR JUST MIXED UP?

5-FUNCTION 13 AMP. SOCKET TESTER SAFELY SHOWS YOU!



Safety fast! Shows: **1**, If all wires correct, **2**, Live wire faulty, **3**, Live and Neutral wires reversed, **4**, Earth faulty, **5**, Neutral faulty. Shows exact fault instantly. British made. **£3.95** post free. Save time. Be sure. Be safe.

PERSONAL SAFETY CO.
Dept. ETI, P.O. Box 1 LLANRWST Gwynedd, North Wales

1.2V NICADS

For UK orders add 60p for post and packing
All prices include V.A.T.

BUTTON CELLS

	Dia.	Hgt.	Price / Cell
225mAh	25 0	7 5	0.65
600mAh	34 5	10 0	1.15

VENTED CELLS

(for fast charge)

			Price
0.45 Ah	17 5	28 0	0.95
0 5 Ah	HP7 or	Size "AA"	1.10
1 2 Ah	22 5	49 0	1.45
1 8 Ah	HP11 or	Size "C"	1.95
4 0 Ah	HP2 or	Size "D"	2.75
10 0 Ah	41 5	90 0	6.00
6.0V Pack	5x1.2 Ah nicads		7.50

Tags available at extra 10p per cell for 0.5Ah, 1.2 Ah and 1.8 Ah nicads only.
Charger — Suitable for any of the above vented nicads — charges up to twelve similar cells in a series at a 50mA or 200mA rate **£9.95**

Sizes approx. in mm
Mail order only

V & F SMALLCRAFT (POPLAR) LTD.
38 Stoneleigh Road, Clayhall, Ilford
Essex
01-550 6642

E.T.I. P.C.B.s

Epoxy glass laminate — drilled and tinned

Complex Sound Gen.	2.05
R.F. Power Meter	0.54
Power Bulge	0.30
Bell Extender	0.59
STAC Timer	1.99
Wheel of Fortune	0.98
Cross Hatch Gen.	1.32
ETIWET	0.76
Metal Loc II	0.88
Metronome	0.55
House Alarm A & B	2.47
Hammer Throw (3 of)	3.98
Clock A & B	2.85
3 ch. Tone Con	0.56
Dig Thermometer	1.08
Graphic Equal	1.38
TV Game	1.25

Many more available including this month's circuits

S.A.E. for full list Prices include VAT. Please add 20p post and packing Orders over £5 post free

P.C.B.s from your own artwork — write for quote

T.S.I. (St. Ives) Ltd.
37 Telegraph Street
Cottenham, Cambridge, CB4 4QU
Tel. (0954) 51177

TELERADIO for INSTRUMENTS AMPLIFIERS RADIO CONTROL COMPONENTS SEMI CONDUCTORS



Send S.A.E. for lists required.

Illustration shows low distortion Audio Oscillator type A0146
Distortion 0015% Range 100hz to 100Khz Output 1v Sine & Square
Price £35 (or in kit form £30) Tax extra 8% P.P. £1.50.

TELERADIO ELECTRONICS

325 FORE STREET, EDMONTON, LONDON, N9 0PE
01-807 3719
Closed on Thursdays

A. Good quality ribbon microphones and amplifiers DCB includes 1 4 pole c/o level switch and 1 B pole c/o lever switch and lamp, holder and reflector	75p
B. Microswitch 5A	8p
C. Smaller microswitch	8p
D. Two-channel unit will provide 2 independent channels for telequipment servicescope	SAE for details
E. Receiver capsules	15p
F. Microphone capsules	10p
G. Black Bakelite telephones	£2.95
H. Handset only	50p
I. Modern phones	£6.95
J. Loudspeaking telephones	£39.50
K. Dials	£1.00
L. Coils	15p
M. 2 Microfarad condensers	10p
N. Ringers	40p
O. Cable, wire	per quote
P. Telephone Circuit boards	50p
Q. Solid metal work benches — wired — crated	£25.00
R. Radios, complete working without case	£1.50
S. Quantity Power Transistors V17X 94	Offers

Seven day delivery. Write to or telephone for further details
**CONVERSATION PIECES (ETII) 55 Swindon Road
Cheltenham, Glos. 0242 35707**

DIGITAC DIGITAL REV. COUNTER

The Digitac is a voltage impulse digital tachometer, which is suitable for all negative earth ignition systems. It has a 2 digit 7 segment display housed in a black case. Please specify no. of cylinders and if 6 or 12 volt system.

Ready built £19.78

Kit form £14.96

Prices are fully inclusive
(Quantity discounts)

ELECTRONEQUIP

36 Merton Avenue, Portchester
Hants PO16 9NE. 07018 73455

Linsley-Hood 75 watt Power Amp modules, built and tested, from £12.50. Complete module kit £10.50 inclusive. Linsley-Hood 75 watt amplifiers constructed and repaired, comprehensive range of spares in stock. Details and list free. I. G. Bowman (Dept. ETI), 59 Fowey Avenue, Torquay, S. Devon.

PRECISION POLYCARBONATE CAPACITORS

All high stability — extremely low leakage

440V AC RANGE ($\pm 10\%$)		63V DC RANGE (ϵ)	
μF	L (mm) D	Each	μF (Tol $\pm 1\%$) $\pm 2\% \pm 5\%$
0.1	27	12.7	1.34
0.22	33	16	0.01-0.2
0.25	33	16	1.80
0.47	33	19	1.22
0.5	33	19	0.88
1.5	33	19	1.66
2.0	33	19	0.22-0.47
2.2	33	16	1.82
2.5	33	16	1.24
4.7	33	19	2.08
5	33	19	2.2
10	33	19	2.80
15	33	19	1.94
22	33	19	2.24
33	33	19	4.00
47	33	19	2.72
68	33	19	2.24
100	33	19	2.48
150	33	19	6.8
220	33	19	4.88
330	33	19	3.36
470	33	19	2.66
680	33	19	2.64
1000	33	19	10.0
1500	33	19	6.94
2200	33	19	4.68
3300	33	19	3.56
4700	33	19	2.0
6800	33	19	22.0
10000	33	19	13.32
15000	33	19	9.98
22000	33	19	6.80

(Additional values and closer tolerances avail. upon request.)

TRANSISTORS, DIODES, I.C.s, Bridge Rectifiers, Capacitors, Plugs + Sockets, Verob, Fuses, etc. — a complete range is carried, please send for our free detailed price list which will be sent by return of mail.

RESISTORS High stability, low noise, carbon film $\pm 5\%$ tol $\frac{1}{2}W$ @ 40°C. 1/3W @ 70°C E12 series only — from 2.2 ohm to 4.7M. All 2p* each. 15p*/10 of any one value, 95p*/100 of any one value. £4.35/500 (may be mixed in 100s); £8/1000 (may be mixed in 100s)

SPECIAL DEVELOPMENT PACK: 10 of each value 2.2 ohm to 2.2M (70M resistors) — £6.50* each
1W c/f 5% 2.2 ohm to 10M — 5p* each, 2W c/f 5% 10 ohm to 10M — 8p* each

PRESETS: 01.W submin. skeleton presets — vertical or horizontal. 100 ohm to 1M. 7p* each. £3/50. £5/100. £22 50/500. £40/1,000. Values may be mixed.

ZENER DIODES: 1+ 10+ 50+ 100+ (Values 400mW $\pm 5\%$ 3V-33V 10p 9 $\frac{1}{2}$ p 9p 8p may be 1W 3V3-200V 18p 17 $\frac{1}{2}$ p 16 $\frac{1}{2}$ p mixed)

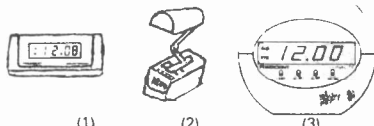
TANTALUM BEAD CAPACITORS: $\mu F/V$. 0.1 0.22 0.33 0.47 0.68. 1 μF all at 35V @ 10p*. 1.5/35 2.2/25 + 11p* 2.2/35 @ 12p*. 4.7/35 @ 15p*. 6.8/35 @ 17p*. 10/25 @ 17p*. 10/35 @ 21p*. 15/20, 22/15. 33/10. 47/6.3 @ 21p* 68/3 @ 17p* 100/3 @ 21p* (deduct 1p each for qty of 10+ — values may be mixed)

25p P&P — UK/Export add cost air/sea mail Add 8% VAT except those marked * add 12 $\frac{1}{2}\%$. Wholesale price lists available to bona fide companies. Shop open 9.00 am-5.00 pm, Mon.-Fri.

MARCO TRADING (Dept. T10)

The Old School, Edstaston, WEM,
Shropshire
Tel. WHIXALL 464 (STD: 094872)
(Props.: Minicost Trading Ltd.)

BARGAINS FOR THE ELECTRONIC HANDYMAN BRANDED LED DIGITAL ALARM CLOCKS



Returned to Service Department within guarantee period.

- (1) With alarm repeat — S.R.S.P. of £17.00 offered at **£4.95 inc. VAT**
- (2) With luxury lamp and repeat alarm as featured in most major U.K. Mail Order catalogues. S.R.S.P. £31.00 — offered at **£8.95 inc. VAT**
- (3) With integral luxury light and repeat alarm also as featured in most major U.K. Mail Order catalogues. S.R.S.P. of £32.00 — offered at **£8.95 inc. VAT**.

These will be sold as received from our customers with the existing fault(s) and without guarantee

**PRESCOTT CLOCK AND
WATCH COMPANY LIMITED**
Prescott House, Humber Road, London NW2 6ER

Capacitors. Tantalum Bead (ITT Union Carbide, NCC). 50v .33 uf, .68, 35v, .22 .33 47 1-0 1-5 4.7, 6.8 16v 2.2 4.7 = 10p. 10v 22uf 33 68 = 18p. 63v 100uf = 20p. 10v 100uf = 30p. Electrolytic 250v 10uf CE10 .08P. 1000 uf 63v erie. .50p 50v, 4.7uf CEW 80 .06p, 10uf CRO4W .07p, 35v 33uf ITT .07 47 uf CEO&W .08 30v, 4700 uf Plessy .50, 25v 100uf Mullard .09, 470uf Mullard 17p 10v 1000uf CEO4W .15. Price breaks 50-199 less 10% 199-500 less 15%. 500 + less 20%. Same type components obtained to order. Min. order £2.00, .35p P&P all orders below £10.00. Larkwood Electronics, 25 Larkwood Road, Chingford, London E4 9DS. 01-529 8255.

THE ROYAL FREE HOSPITAL HAMPSTEAD MEDICAL PHYSICS TECHNICIAN IV (ELECTRONICS)

An Electronics Technician is required for the Electronics Workshop of this major teaching hospital to assist with the development and maintenance of electronic circuits and equipment.

Applicants should hold the City and Guilds Final Certificate in appropriate subjects or an equivalent qualification. Some practical experience in the use of analogue and digital circuit techniques is desirable.

Salary on scale. £3,423-£4,488 per annum, including all allowances. The starting point depending on qualifications and experience and the successful candidate will be encouraged to study for a higher qualification, by means of Day Release.

Application Form (to be returned by 3rd November, 1978) and Job Description from the Personnel Department, The Royal Free Hospital, Pond Street, Hampstead, London NW3 2QC. Tel: 01-794 0500. Please quote ref: 0761.

Camden and Islington Area Health Authority (T)

L.C.D. CHRONOGRAPHS, 6 digit display, stopwatch to 100th seconds, Lap timer, P.M. indicator, S/S bracelet, display backlight, £16.96. L.C.D. Solar watch £16.95. Ladies L.C.D. watch S/S or gilt bracelet £13.95. L.C.D. watch/stopwatch to seconds £13.95. Prices fully inclusive. Cheques, P/Os to — RAM ELECTRONICS, 49 Avondale Road, Fleet, Hampshire.

ETI ADVERTISEMENT INDEX

Ace	90
Ambit	97
Astra-Pak	98
Audio Electronics	13
Bamber	84
Baydis	53
Bi-Pak	4 & 5
Birkett	10
B.N.R.S.	78
Bull	53
Cambridge Learning	99
Catronics	90
Chittmead	34
Chromasonics	90
Crimson Elektrik	98
C.S.C.	42 & 43
Dalston Electronics	92
Delta Tech. & Co.	94
Discount Computing	82
Doram	49, 53
E.D.A.	100
Electrovalve	101
Fladar	92
Flairline	96
Gould Advance	14
Greenbank	88
Greenwell	100
H.B. Electronics	92
Henry's	78, 88, 92
Ibek Systems	42
I.L.P.	69
Integrated Circuits	95
Jeremy Lord	84
Kramer	42, 84, 96
L.B. Electronics	64
Lektrakit	36, 70
Maplin	108
Marshalls	77
Metac	103
Minikits	42
Mountiandene	64
Nicholls	64
Nic Models	92
O.K. Machine	102
P.B. Electronics	96
Powell	96
Powertran	2, 6
Progressive Radio	64
R.F. Equipment	10
Roger Squires	78
R.T.V.C.	83
Sentinel Supply	78
Sintel	89
Stevenson	12
Sinclair Radionics	61
Swanley	82
Tamtronik	102
Target	36
Technomatic	11
Teleplay	107
Tempus	62
Trampus	70
T.K.	94
Trident	52
Vero	94
Videotime	50
Watford	8, 9
Wilmslow Audio	36

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).

Alfacs range of etch resist transfers, and other drawing materials for p.c. boards.

Send 15p for catalogue.

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

COMPUTER HOBBIST, components at lowest prices. Write for free price list, stating your specific interests. PACS, 12 Alma Road, Monkstown, Co. Dublin, Eire.

PLEASE MENTION ETI
WHEN REPLYING
TO ADVERTS

COLOUR MODULATOR

Kit **£6.95** **FOR ALL TV GAMES!**
● Red, Green & Blue inputs ● Switchable background colours ● FREE Interface

Complete details for tank battles — lifelike effects
WILLIAM STUART SYSTEMS
137 Billericay Road, Herongate, Brentwood, Essex CM13 3SD
Telephone (0277) 810244

STRATHAND SECURITY ALARMED?

If not you should be. We specialise in Alarm equipment suitable for home, office or factory. All items brand new top quality fully guaranteed.

- 101 Magnet and reed switch. Flush fitting. 4 wire. Requires hole 12mm diameter by 34mm deep 90p
 - 102 Magnet and reed switch. Flush fitting screw terminals. Requires hole 15mm diameter by 14mm deep £1.05
 - 103 Magnet and reed switch. Surface fitting. 4 wire. Size 65mm by 13mm by 11mm 90p
 - 104 Magnet and reed switch. Heavy duty. Size 103mm by 20mm by 18mm. Two hole fixing £3.00
 - 105 Pressure pad — stair tread 22½" by 6½" £1.35
 - 106 Pressure pad — large 29½" x 15" £2.05
 - 107 Window foil — self-adhesive — top quality. 70" roll by ¼" wide £3.17
 - 108 Foil blocks — self-adhesive. (Joins foil to cable) 19p
 - 110 Keyswitches with mounting plate and cover £3.70
 - 111 Bell boxes heavy duty plastic coated metal £8.05
 - 112 Bell 6" heavy duty — very loud 12v D.C. £10.25
 - 116 4 core cable 100mm — white £10.75
 - 123 Control panel to British Standard. Mains/battery. silent entry/exit. Anti-false alarm circuitry £46.40
- All prices include VAT and postage

PLUS
Radar (microwave) units, automatic 999 dialling units with tape message, and many other items.

STRATHAND SECURITY
44 St. Andrew's Square
Glasgow, G1
Tel: 041-552 6731/2
Callers Welcome



MOTOROLA 6800 COMPUTERS

Single board 6800.17 command 1K Mikbug compatible Monitor, 1K user RAM, 1K Crystal Controlled VDU. CUTS, fully buffered, room for extra 3 x 2708 PROMS **£175.00**

Single board 2. Similar to above but with QWERTY keyboard **£205.00**
NEW Mini 6800. Two p.c.b. kit, 1K monitor, 1K VDU, RAM, CUTS, QWERTY keyboard **£145.00**

VDU kit. 1K Crystal controlled, memory mapped, parallel input video output. Should suit most processors **£60.00**

All prices include VAT and post. Please send SAE for leaflets. Mail Order only.

**HEWART
MICROELECTRONICS**
95 Blakelow Road
Macclesfield, Cheshire

LED PPM Single chip Peak Programme Meter (SN16880N) drives 5 LED's directly, easily cascaded to increase range/resolution. £3-50 ea. inclusive. Applications sheets alone 18p. Peter Francis, 34 Ashley Dr., Twickenham TW2 6HW.

DIGITAL WATCHES. See my range of high quality L.C.D. watches and clocks all with 12 month guarantee from as little as £9.50. Send S.A.E. for colour brochure. D. HULLAH (Watches), 14 Willow Grove, Harrogate, N/Yorks.

Sound to Light Fantastic!



Videograph II links to the aerial socket of your tv and provides a full colour oscilloscope display! A must for hi-fi, home entertainment, discos, organs etc.

New — signal invert control, integral square wave generator. Plus — full details for testing your audio system for transient distortion, crosstalk etc.

Complete **£19.95** Luxury cabinet and Kit only **£9.95**

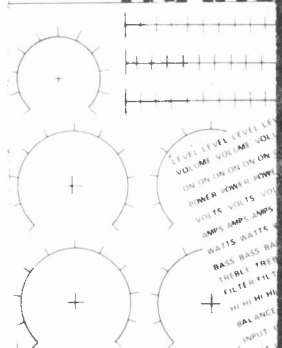
INC. POST. PACKING. VAT. READY BUILT VIDEOGRAPH £59.95
Dower House, Billericay Road,
Herongate, Brentwood,
Essex CM13 3SD
WILLIAM STUART SYSTEMS Ltd Telephone Brentwood (0277) 810244

A GENUINE BARGAIN OFFER. LCD

Twenty Function Square Slim Chronograph. **CONSTANT DISPLAY:** Hours, Minutes, Seconds, A.M., P.M., Month, Date, Day, Roll-over, Backlight. **CHRONOGRAPH:**— Minutes, Seconds, 10th., 100th., Lap Time, Lap Indicator, Total Time, Return Ordinary Time, Freeze Time, Memory, Stainless Steel Locking Bracelet. 12 Month Guarantee. Money Back Guarantee. **ONLY £18.50.** Without Chronograph **£14.50.** To **J. RAMINGER**, 1 St. Laurence Way, Stanwick, Northants, NN9 6Qs.

WE'RE OUT TO FINISH YOU OFF!

Rapitape #
eti PANEL
TRANS



... 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.

Teleplay presents the PROGRAMAGAME of all time!

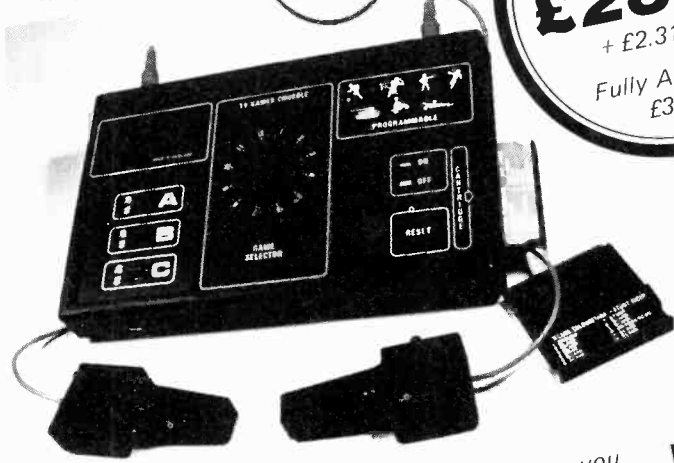
TELEPLAY have produced a new product of easy to assemble cartridge games, for you and all your family, that will not go out of date. Just ADD each new cartridge, as it becomes available, and your colour video centre will be up to date the Teleplay way. You will save pounds in the long run. Works OK on Black and White TV.

EX-STOCK IMMEDIATE DELIVERY

Money back if not satisfied

We offer all this to you for ONLY **£28.90** + £2.31 VAT Fully Assembled £35.90

The Teleplay Kit consists of a Professional Finished Inject Moulded Box - Joystick Hand Controls - one cartridge which consists of 10 games - Football, Tennis, Solo Squash (1 & 2 players), Hockey, Basketball (1 & 2 players), Shoot etc. Mains Adaptor. All holes are pre-drilled - No Special equipment required. You'll be surprised how easy it is to assemble this professional kit! Instruction Manual supplied separately at 0.45p. TELEPLAY GIVES YOU TWICE THE FUN BUILDING AND PLAYING THE MOST PROFESSIONAL TV GAME KIT EVER OFFERED.



Main Console has 3 Facility Handicapping Switches.

Every 3 months a NEW game will become available to you and those already under production include Submarines, Space War, Wipe Out and many more. The price of these will vary from £12 to £19 depending upon the complexity of the game.

Additional cartridges NOW available include:

- Stunt Cycle - 4 games - Cartridges and Hand Controls - £14.90 + £1.14 VAT
- Tank Battle - Cartridge and Hand Controls - £18.90 + £1.51 VAT
- Road Race - 2 games - Cartridge - Controls already with basic kit - £12.90 + £1.03 VAT

Cartridges come complete with printed case and easy to follow assembly instructions

REALISTIC SOUND EFFECTS

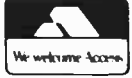
All parts fully guaranteed.

Electrical knowledge is not a necessity to assemble this project - just simple soldering.

Cheques and Postal Orders to be made payable to TELEPLAY; send your order (No Stamp Needed) to Teleplay, Freepost, Barnet, EN5 2BR or telephone your order quoting your Barclaycard or Access number. Queries and Technical Advice offered either by phone or by calling at our shop.



SHOP OPEN - 10am to 7pm - Monday to Saturday



Watch this page each month for new cartridges, as they become available. All prices include Postage. Compare our prices with similar products in the big stores, which cost well over £100. EUROPE'S LARGEST STOCKIST OF TV GAME COMPONENTS.



14 Station Road, New Barnet, Herts EN5 1QW Tel: 01-440 7033/01 441 2922

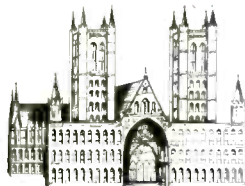
MAPLIN

everything for the modern D.I.Y. electronics enthusiast and more.



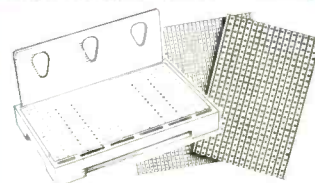
THE 'DRUMSETTE' RHYTHM GENERATOR

Organists, pianists, guitarists... an automatic drum set to accompany you! Nine highly realistic instruments play fifteen different rhythms. Fifteen rhythm-select touch switches and a touch plate for stop/start without rhythm change gives absolute ease of operation. Build it yourself for under £65 including smart teak-effect cabinet. See it and hear it in our shop! Send for full construction details now: MES49, price 25p.



REVERBERATION SYSTEMS

High quality spring line driver module uses 4 integrated circuits and two transistors. Built and tested circuit board with wiring instructions for spring line. XB85G, price £6.00. Power supply to suit drive module costs around £2.50 and construction details are in catalogue, or ask for leaflet MES24. Mechanical spring lines: Short line (XL08J) £4.49; Long line (XB84F) £10.39. (All prices include V.A.T. and p. & p.)



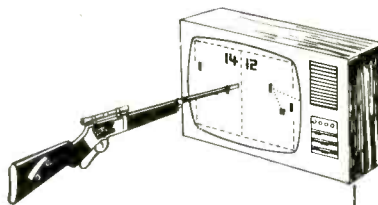
BOARDS AND PCB'S

Pages 59 to 61 of our catalogue show you our range of Veroboard and S-Decs or if you prefer to make your own pcb's a range of etching systems including the novel etch-in-a-bag system, plus printed circuit transfers for the professional finish to your boards.



9-CHANNEL RADIO CONTROL SYSTEM

A comprehensive model control system, featuring nine independent fully proportional channels achieved by a design using very few components thus keeping the cost to a minimum. Full construction details in our booklet (XF030) price £1.20.



T.V. GAME

A fascinating TV game kit that plays football, tennis, squash and practice for only £21.59. Reprint of construction details 25p. Add on rifle kit only £10.60. (All prices include V.A.T. and p. & p.)



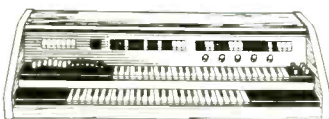
MASSIVE RANGE OF COMPONENTS

For instance the capacitor section in our catalogue includes non-polarised electrolytics and our resistor section includes even 1% tolerance types. Get our fascinating catalogue now - you won't regret it.



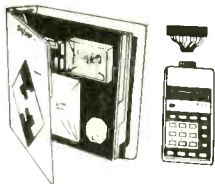
AUDIO MIXER

A superb stereo audio mixer. It can be equipped with up to 16 input modules of your choice and its performance matches that of the very best tape-recorders and hi-fi equipment. It meets the requirements of professional recording studios, FM radio stations, concert halls and theatres. Full construction details in our catalogue. A component schedule is available on request.



ELECTRONIC ORGAN

The only organ you can build in stages and tailor to your requirements as you go along - and at each stage you'll have a fully working instrument! We haven't got the gimmicks yet - (they're coming soon) but we have got the most beautiful sounds - you won't find them on any organ less than twice our price. So get our MESSD series leaflets now! 65p buys the three available so far.



MICROPROCESSOR

Build a mini-computer with our microprocessor kit. Features: 46 different instruction types; 256 bytes of read/write memory (more are easily added), micro-processor can address up to 65,536 B bit-bytes. Complete kit for use with teletype etc. (XB91Y) £74.10. 20-key keyboard for use with above (in place of teletype) (XB92A) £71.11. Both kits with detailed instruction books. See our newsletter for details of additional RAM's, tri-state interfacing chips, number-cruncher and standard cassette tape-recorder interface to store your programmes. (All prices include V.A.T. and p. & p.)



Our bi-monthly newsletter keeps you up to date with latest guaranteed prices - our latest special offers - details of new projects and new lines. Send 30p for the next six issues (5p discount voucher with each copy).



POST THIS COUPON NOW FOR YOUR COPY OF OUR 1979-80 CATALOGUE PRICE 75p

Please rush me a copy of your 216-page catalogue I enclose 75p, but understand that if I am not completely satisfied I may return the catalogue to you within 14 days and have my 75p refunded immediately.

NAME _____

ADDRESS _____

★ Come and see all our projects ★
★ on display at the Electronics ★
★ hobby show 'Breadboard' at ★
★ Seymour Hall, London W1 ★
★ stands E7-E9. ★

MAPLIN ELECTRONIC SUPPLIES

P.O. BOX 3 RAYLEIGH ESSEX SS6 8LR

Telephone: Southend (0702) 715155

Shop: 284, London Road, Westcliff-on-Sea, Essex

(Closed on Monday) Telephone: Southend (0702) 715157