

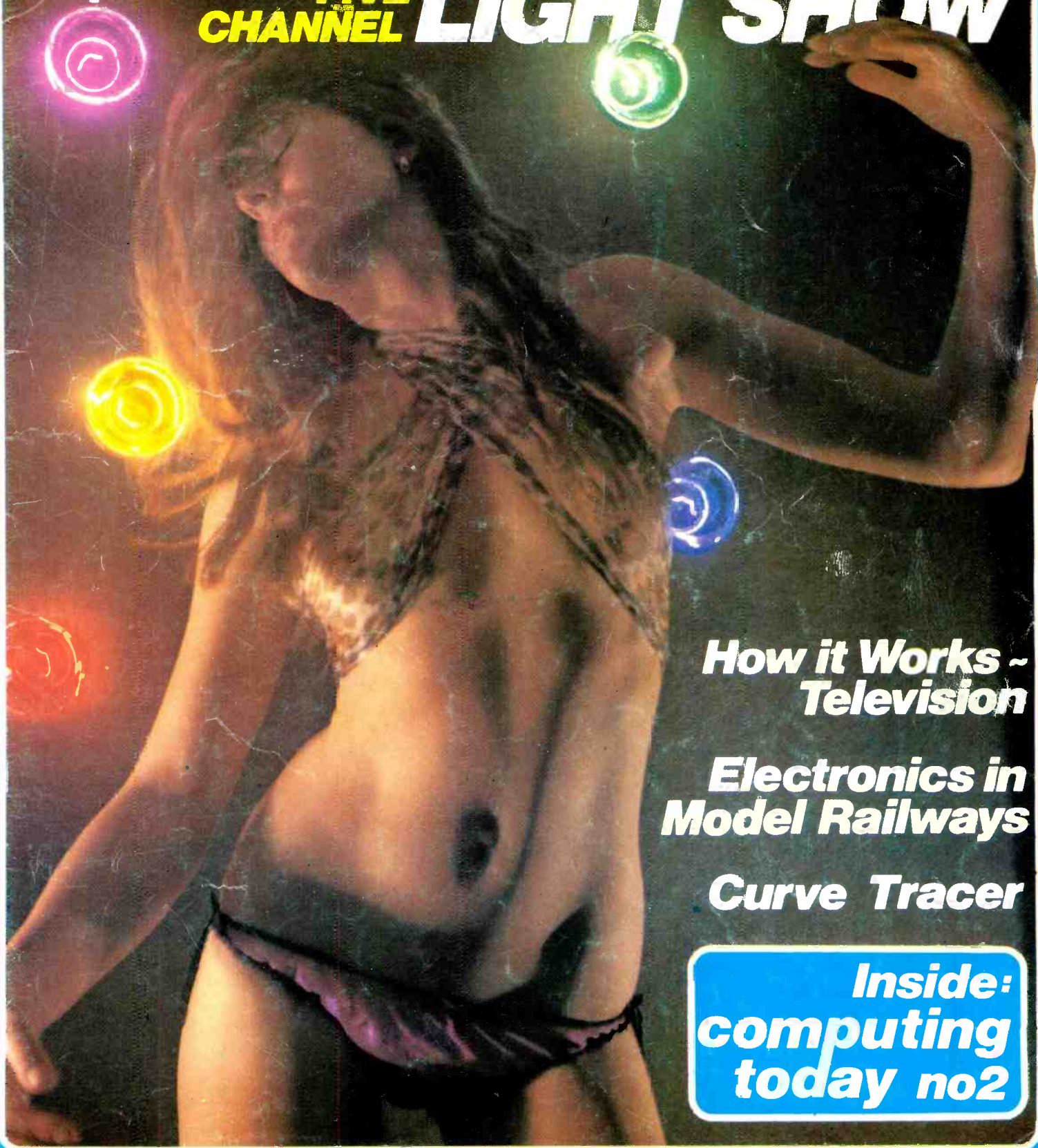
electronics today

DECEMBER 1978

INTERNATIONAL

45p

FIVE CHANNEL LIGHT SHOW



**How it Works -
Television**

**Electronics in
Model Railways**

Curve Tracer

**Inside:
computing
today no2**

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

TRANSCENDENT 2000

SINGLE BOARD SYNTHESIZER

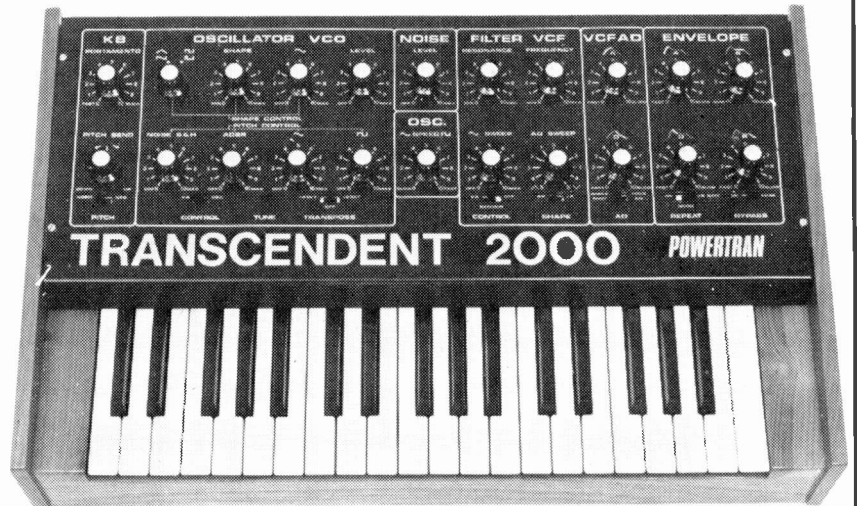
LIVE PERFORMANCE SYNTHESIZER DESIGNED BY CONSULTANT TIM ORR (FORMERLY SYNTHESIZER DESIGNER FOR EMS LIMITED) AND FEATURED AS A CONSTRUCTIONAL ARTICLE IN ELECTRONICS TODAY INTERNATIONAL.

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, fully assembled solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 1/2% 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!

**COMPLETE KIT
ONLY
£172.00 + VAT!**

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



Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

THIS MONTH'S FRONT COVER FEATURE!



**COMPLETE KIT
ONLY
£49.50 + VAT!**

PSI 4002 STUDIO MODEL



cabinet size 17.2" x 17.2" x 6.7"

COMPLETE KIT ONLY £196.90 + VAT

The kits shown on this page are also available as separate packs (e.g. PCB component sets, hardware sets etc). Prices are given in our FREE CATALOGUE

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!

OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

PORTWAY INDUSTRIAL ESTATE
ANDOVER, HANTS SP10 3NM

ANDOVER
(STD 0264) 64455

PRICE STABILITY: Order with confidence irrespective of any price changes we will honour all prices in this advertisement until January 31st, 1979 if ETI December 1978 issue is mentioned with your order. Errors and VAT rate changes excluded.

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

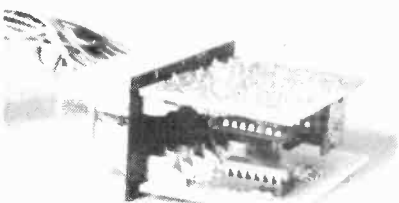
SALES COUNTER: If you prefer to collect your kit from the factory — call at Sales Counter (at rear of factory). Open 9 a.m. - 4.30 p.m. Monday-Thursday.

electronics today

DECEMBER 1978 VOL 7 NO 12 INTERNATIONAL



Leave a trace p.73



Keep your wheels p.16



A project for a fling p.44

FEATURES


NEWS DIGEST	7	Latest on the latest
HOW IT WORKS — TELEVISION	21	A new series on circuits
ELECTRONICS IN MODEL RAILWAYS	36	Tips for the living room express drivers!
INDEX 78	53	A listing of all we've done since April 77
IONOSPHERE	61	An atmospheric article!
DATA SHEET	69	Amplify at speed
MICROFILE	77	Micro-men take note
AUDIOPHILE	88	Strathern speak to us, and Sony arm us!
TECH TIPS	93	All your own work

PROJECTS

CAR ALARM	16	Hang on to what's yours!
WINE TEMPERATURE METER	31	Don't make them the grapes of wrath!
LIGHT SHOW CONTROLLER	44	Five channels to run a disco through
CURVE TRACER	73	Not 36-24-36 — but useful nonetheless
AUTOCHORD PART 2	80	Full construction details

INFORMATION

SUBSCRIPTIONS	8	Make it easy on yourself
BINDERS	9	Take care of us!
BACK NUMBERS	11	Wot we got and wot we ain't
ETIPRINTS	29	The only boarding card you need
ETI BOOK SERVICE	43	Good sound stuff all in fine print
COME AND JOIN US	51	ETI needs you — well 3 of you anyway!
MARKETPLACE	57	Timely offers!
ETI JANUARY PREVIEWED	59	On its way to you
SPECIALS	67	All our wares on show
HOBBY ELECTRONICS	87	Coming up up in number two

<p>INTERNATIONAL EDITIONS</p> <p>AUSTRALIA Collyn Rivers Publisher Les Bell Acting Editor</p> <p>Holland Anten Kriegsman Editor-in-Chief</p> <p>CANADA Steve Braidwood Editor Graham Wideman Assistant Editor</p> <p>GERMANY Udo Wittig Editor</p> 	<p>EDITORIAL AND ADVERTISEMENT OFFICE 25-27 Oxford Street, London W1R 1RF. Telephone 01-434 1781/2. Telex 8811896</p>	
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BOOKS AND COMPONENTS

BOOKS BY BABANI

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

BP2	Handbook of Radio, TV & Industrial & Transmitting Tube & Valve Equivalents	60pt
BP6	Engineers and Machinists Reference Tables	40pt
BP7	Radio & Electronic Colour Codes and Data	15pt
BP10	Modern Crystal and Transistor Set Circuits for beginners	35pt
BP15	Constructors Manual of Electronic Circuits for the Home	50pt
BP22	79 Electronic Novelty Circuits	75pt
BP23	First book of Practical Electronic Projects	75pt
BP24	52 Projects Using IC741 (or equivalents)	75pt
BP26	Radio Antenna Handbook for Long Distance Reception and Transmission	85pt
BP27	Giant Chart of Radio Electronic Semiconductor and Logic Symbols	60pt
BP29	Major Solid State Audio Hi-Fi Construction Projects	85pt
BP32	How to Build Your Own Metal & Treasure Locators	85pt
BP34	Practical Repair & Renovation of Colour TVs	95pt
BP35	Handbook of IC Audio Pre-amplifier & Power Amplifier Construction	95pt
BP36	50 Circuits Using Germanium, Silicon & Zener Diodes	75pt
BP37	50 Projects Using Relays, SCRs and TRIACS	£1.10†
BP39	50 (FET) Field Effect Transistor Projects	£1.25†
BP43	How to Make Walkie Talkies	£1.25†
BP44	I.C. 555 Timer Projects	£1.45†
BP47	Mobile Discotheque Handbook	£1.35†
BP129	Universal Gram-motor Speed Indicator	10pt
BP160	Coil Design and Construction Manual	75pt
BP196	AF-RF Reactance — Frequency Chart for Constructors	15pt
BP202	Handbook of Integrated Circuits (ICs) Equivalents and Substitutes	75pt
BP205	First Book of Hi-Fi Loudspeaker Enclosures	75pt
BP213	Electronic Circuits for Model Railways	85pt
BP214	Audio Enthusiasts Handbook	85pt
BP216	Electronic Gadgets and Games	85pt
BP217	Solid State Power Supply Handbook	85pt
BP219	Solid State Novelty Projects	85pt
BP220	Build Your Own Solid State Hi-Fi and Audio Accessories	85pt
BP222	Solid State Shortwave Receivers for Beginners	95pt
BP223	50 Projects Using IC CA3 130	95pt
BP224	50 CMOS IC Projects	95pt
BP225	A Practical Introduction to Digital ICs	95pt
BP226	How to Build Advanced Short Wave Receivers	£1.20†
RCC	Resistor Colour Code Disc Calculator	10pt

BOOKS BY NEWNES

No. 229	Beginners Guide to Electronics	Price £2.25†
No. 230	Beginners Guide to Television	Price £2.25†
No. 231	Beginners Guide to Transistors	Price £2.25†
No. 233	Beginners Guide to Radio	Price £2.75†
No. 234	Beginners Guide to Colour Television	Price £2.25†
No. 235	Electronic Diagrams	Price £1.80†
No. 236	Electronic Components	Price £1.80†
No. 237	Printed Circuit Assembly	Price £1.80†
No. 238	Transistor Pocket Book	Price £3.90†
No. 225	110 Thyristor Projects Using SCRs & Triacs	Price £2.50†
No. 227	110 COS/MOS Digital IC Projects for the Home Constructor	Price £2.75†
No. 226	110 Operational Amplifier Projects for the Home Constructor	Price £2.50†
No. 242	Electronics Pocket Book	Price £3.90†
No. 239	30 Photoelectric Circuits & Systems	Price £1.80†

NUTS AND BOLTS

BA BOLTS — packs of BA threaded cadmium plated screws slotted cheese head. Supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
1in OBA	83	£1.20	1/4in 4BA	846	£0.32
1/2in OBA	840	£0.75	1/4in 4BA	847	£0.25
1in 2BA	842	£0.65	1in 6BA	848	£0.40
1/2in 2BA	843	£0.45	1/2in 6BA	849	£0.21
1/4in 2BA	844	£0.52	1/4in 6BA	850	£0.25
1in 4BA	845	£0.44			

BA NUTS — packs of cadmium plated full nuts in multiples of 50

Type	No.	Price	Type	No.	Price
OBA	855	£0.72	4BA	857	£0.30
2BA	856	£0.48	6BA	858	£0.24

BA WASHERS — flat cadmium plated plain stamped washers supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	859	£0.14	4BA	861	£0.12
2BA	860	£0.12	6BA	862	£0.12

SOLDER TAGS — hot tinned supplied in multiples of 50.

Type	No.	Price	Type	No.	Price
OBA	851	£0.40	4BA	853	£0.22
2BA	852	£0.28	6BA	854	£0.22

SWITCHES

Description	No.	Price
DPDT miniature slide	1973	£0.11*
DPDT standard slide	1974	£0.14*
Toggle switch SPST		
1 1/2 amp 250V a.c.	1975	£0.33*
Toggle switch DPDT		
1 amp 250V a.c.	1976	£0.42*
Rotary on-off mains switch	1977	£0.50*
Push switch — Push to make	1978	£0.13*
Push switch — Push to break	1979	£0.18*

ROCKER SWITCH
A range of rocker switches SPST — moulded in high insulation. Material available in a choice of colours ideal for small apparatus.

Colour	No.	Price
RED	1980	£0.30*
BLACK	1981	£0.30*
WHITE	1982	£0.30*
BLUE	1983	£0.30*
YELLOW	1984	£0.30*
LUMINOUS	1985	£0.30*

Description	No.	Price
Miniature SPST toggle, 2 amp 250V a.c.	1958	£0.50*
Miniature SPDT toggle, 2 amp 250V a.c.	1959	£0.85*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0.70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0.85*
Push-button SPST, 2 amp 250V a.c.	1962	£0.78*
Push-button SPDT, 2 amp 250V a.c.	1963	£0.83*
Push-button DPDT, 2 amp 250V a.c.	1964	£0.98*

MIDGET WAFER SWITCHES
Single-bank wafer type — suitable for switching at 250V a.c. 100mA or 150V d.c. in non-reactive loads make-before-break contacts. These switches have a spindle 0.25in dia. and 30° indexing.

Description	Order No.	Price
1 pole 12 way	1965	£0.48*
2 pole 6 way	1966	£0.48*
3 pole 4 way	1967	£0.48*
4 pole 3 way	1968	£0.48*

MICRO SWITCHES

Description	Order No.	Price
Button gives 1 pole change over action	1970	£0.25
Rating 10 amp-250V a.c.		

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0.07*
1 1/4in x 1/4in chassis mounting	507	£0.12*
1 1/4in car inline type	508	£0.15*
Panel mounting 20mm	509	£0.20
Panel mounting 1 1/4in	510	£0.30

QUICK BLOW 20mm

Type	No.	Type	No.	Type	No.
150mA	611	1A	615	3A	619
250mA	612	1.5A	616	4A	620
500mA	613	2A	617	5A	621
800mA	614	2.5A	618	6p	

ANTI-SURGE 20mm

Type	No.	Type	No.	Type	No.
100mA	622	1A	625	2.5A	628
250mA	623	2A	626	3.15A	629
500mA	624	1.6A	627	5A	630

QUICK BLOW 1 1/4in

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

QUICK BLOW 1 1/4in

Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	5A	642
2A	637	3A	639		

QUICK BLOW 1 1/4in

Type	No.	Type	No.	Type	No.
1A	635	2.5A	638	5A	642
2A	637	3A	639		

CASES AND BOXES

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

No.	Length	Width	Height	Price
155	8in	5 1/2in	2in	£1.25
156	11in	6in	3in	£2.12
157	6in	4 3/4in	1 3/4in	£1.30
158	9in	5 1/4in	2 1/2in	£1.76

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

No.	Length	Width	Height	Price
159	5 1/4in	2 1/4in	1 1/2in	62p
160	4in	4in	1 1/2in	62p
161	4in	2 1/4in	1 1/2in	62p
162	5 1/4in	4in	1 1/2in	70p
163	4in	2 1/2in	2in	84p
164	3in	2in	1in	44p
165	7in	5in	2 1/2in	£1.04
166	8in	6in	3in	£1.32
167	6in	4in	2in	86p

METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor-like Mullard C280 series. Mixed values ranging from .01uF-2.2uF. Complete with identification sheet O/N 16204

TRANSFORMERS

MINIATURE MAINS Primary 240V

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

MINIATURE MAINS Primary 240V
with two independent secondary windings

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

1 AMP MAINS Primary 240V

No.	Secondary	Price	P & P
2026	6V-0-6V 1 amp	£2.50*	45p
2027	9V-0-9V 1 amp	£2.90*	45p
2028	12V-0-12V 1 amp	£2.60*	55p
2029	15V-0-15V 1 amp	£2.75*	66p
2030	30V-0-30V 1 amp	£3.45*	86p

STANDARD MAINS Primary 240V
Multi-tapped secondary mains transformers available in 1/2 amp, 1 amp and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V.
Voltages available by use of taps: 4, 7, 8, 10, 14, 15, 17, 19, 25, 31, 33, 40, 25-0-25V.

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

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0.60*
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	£0.75*
114	5 pin DIN plug to 3.5mm Jack connected to pins 3 & 5. Length 1.5m	£0.85*
115	5 pin DIN plug to 3.5mm Jack connected to pins 1 & 4. Length 1.5m	£0.85*
116	Car aerial extension. Screened insulated lead. Fitted plug & socket	£1.10*
117	AC mains connecting lead for cassette recorders & radios, 2 metres	£0.68*
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.05*
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0.2m	£0.90*
120	Car stereo connector. Variable geometry plug to fit most car cassette, 8-track cartridge & combination units. Supplied with inline fused power lead and Instructions	£0.60*
123	6.8m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1.50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.75*
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.05*
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.68*
131	5 pin DIN plug to 3 pin DIN plug, 1 & 4 and 3 & 5. Length 1.5m	£0.83*
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£0.98*
133	5 pin DIN plug to 2 phono plugs. Connected pins 3 & 5. Length 1.5m	£0.75*
134	5 pin DIN plug to 2 phono sockets. Connected pins 3 & 5. Length 23cm	£0.68*
135	5 pin DIN socket to 2 phono plugs. Connected pins 3 & 5. Length 23cm	£0.68*
136	Coiled stereo headphone extension lead. Black. Length 6m	£1.75*
178	AC mains lead for calculators, etc.	£0.45*

ELECTROLYTIC PAKS

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

16201	— values from 47mF-10mF	80p*
16202	— values from 10mF-100mF	80p*
16203	— values from 100mF-680mF	60p*

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NEW EDITION NOW AVAILABLE

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

ONLY 65p POST FREE

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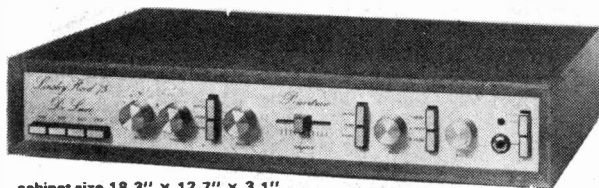
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BI-PAK

DEPT. ET110, P.O. Box 6, Ware, Herts

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

AUDIO KITS OF DISTINCTION FROM **POWERTRAN**



cabinet size 18.3" x 12.7" x 3.1".

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

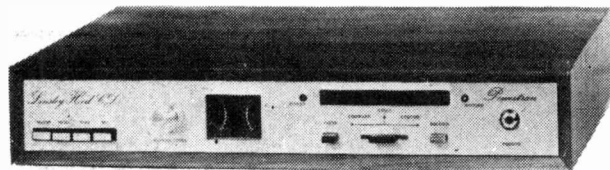
This easy to build version of our world-wide acclaimed 75W amplifier kit based upon circuit boards interconnected with gold plated contacts resulting in minimal wiring and construction delightfully straightforward. The design was published in Hi-Fi News and Record Review and features include rumble filter, 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.



cabinet size 18.3" x 12.7" x 3.1".



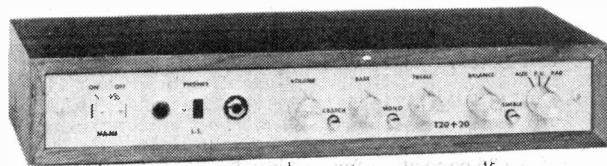
cabinet size 18.3" x 12.7" x 3.1".

LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

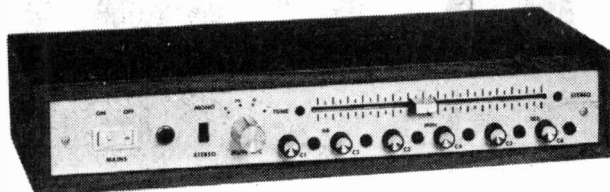
This design, published in Wireless World, although straightforward and relatively low cost provides a very high standard of performance. There are separate record and replay amplifiers and switchable equalisation together with a choice of bias levels are also provided. The mechanism is the Goldring-Lenco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



cabinet size 15.5" x 6.7" x 2.8".



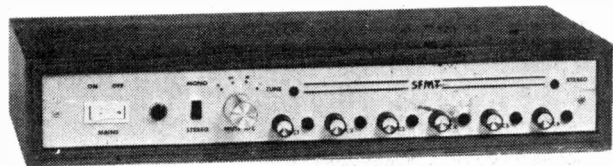
cabinet size 15.5" x 6.7" x 2.8".

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.



cabinet size 15.5" x 6.7" x 2.8".

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 January 31st, 1979. If ETI December, 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.

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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.

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POWERTRAN ELECTRONICS

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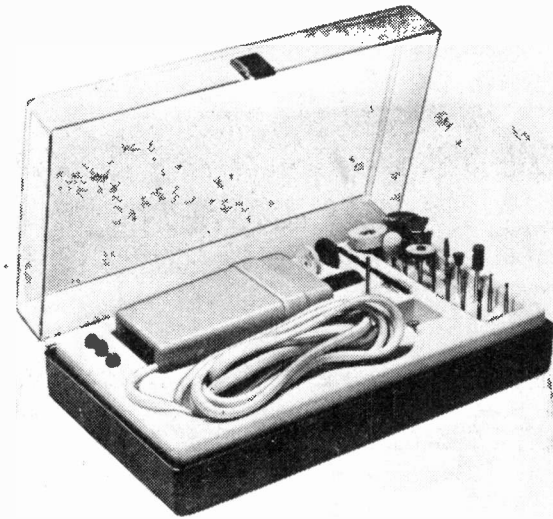
ANDOVER
(0264) 64455

news digest

Be boring better!

This is known as a Bimdrill (Don't blame us — it's their name). It costs £19.50 + VAT and comes complete as you see it here. It

is mains powered, runs at 7500 RPM, and looks very useful indeed. Any more questions to: Boss Mouldings Ltd, Higgs Industrial Estate, 2 Herene Hill Road, London SE24 0AU.



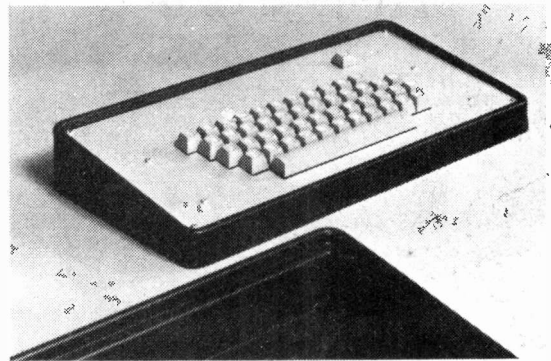
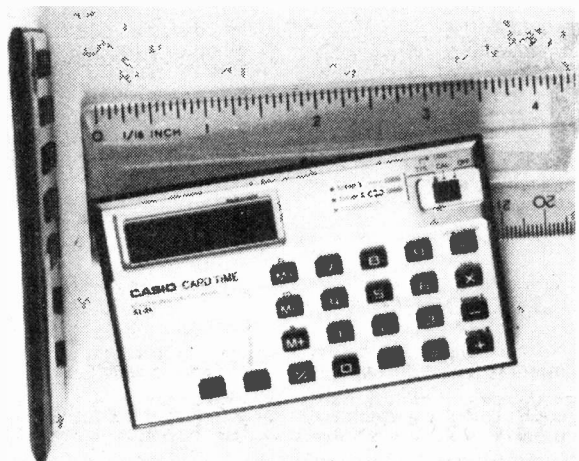
Catch these

Two more companies sent us in catalogues this month. The first was ACE who do a 36 page affair for 30p. The range they stock is pretty good as are the prices. A nice touch is the new range of new kits for the beginner. Worth having.

The other was Stevenson. This catalogue is produced superbly and as it's free it's worth a look just to see how these things

should be done. IC's are a strong point here, and a range of books is also included. Some very useful data is given in the back of the booklet which should also be on your bookshelves.

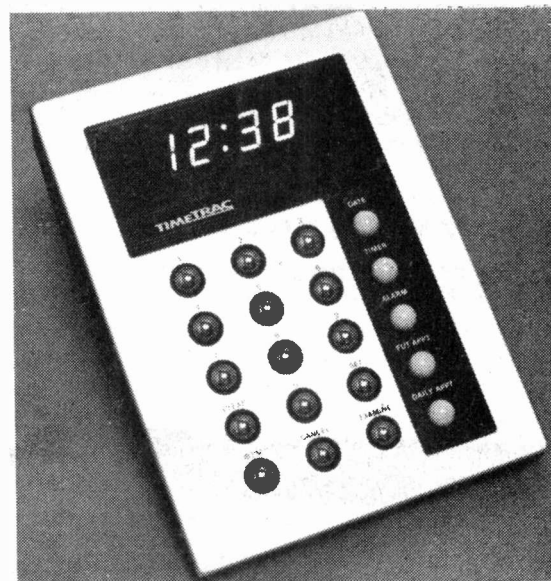
Addresses for these people appear on their ads elsewhere in this issue. Catalogues are things you should collect if you're serious about the hobby, as there is always something you'll want from somewhere at sometime or other!



Key feature

New from Vero of box frame is this new keyboard enclosure. Supplied as a kit it comes complete as a one piece ABS enclosure, anodised aluminium cover plate with self adhesive

feet and all fixings. It will house a standard keyboard or individual keys as required — ideal for small desk-top terminals. Vero Electronics Ltd, Industrial Estate, Chandlers Ford, Eastleigh, Hampshire.



Just the thing for Casanova?

Timetrac is a new little helper for people with busy lives and lousy memories. It contains a calendar preprogrammed, and can sound alarms

when required. Two stopwatch facilities are also included.

Power is normally from AC adaptor, but battery power is provided as standby. Optimisation Ltd, 45 South Street, Bishop's Stortford, Hertfordshire.

Time to calculate?

'Credit card' calculators do have advantages. Here's another one that can tell you how long you took to spend a fortune. Called the ST 24, it is a four-function plus % and stopwatch calculator. Maximum time to be

watched — 23hrs 59mins 59secs. Lap timing, second place timing normal stop/start and 1/10th sec indication are all possible.

The calculator can be used while the timers (with possible repeat option) or stopwatch is being used. The most you'll pay for it is £24.95 anywhere. Available now.



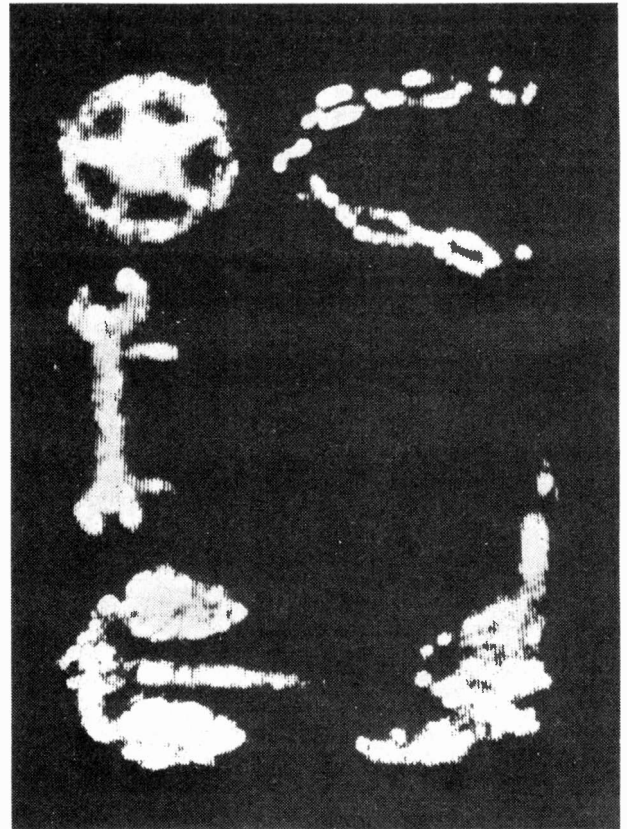
KEY:

- 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!

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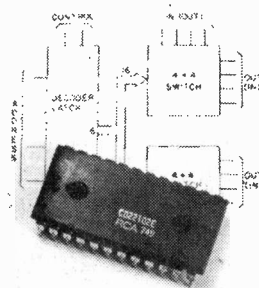


The image of it

The picture shows images achieved in lousy conditions by EMIs new wonder underwater TV system. The system has just won the IR100 award in America for its solving of the problems associated

with the quartz and frequency troubles earlier systems experienced.

The whole thing is comparatively simple, and uses 201 lines per frame, 12½ frames per second. A range of several meters is possible even in atrocious conditions.



Cross point

Now available from Jermy are 2 new Crosspoint Switches complete with control memory which are ideally suited where numerous analogue or

data lines have to be switched.

These CD22101 and CD22102 devices consist of 4x4x2 arrays of crosspoint transmission gates, 4 to 16 line decoders and 16 latch circuits, with any one of the 16 crosspoint pairs being selected by applying the appropriate four-line address and any number of crosspoints being ON simultaneously.

Bandwidth is 10 MHz and low ON resistance is typically 75ohms @ 12 Volts V_{DD} . Other significant features include closely matched switched characteristics, high linearity and standard CMOS noise immunity.

Mogul Electronics Ltd, 272 High Street, Epping, Essex CM16 4DA.

digest



Less than (h)armless?

This mechanical arm is controlled by a microcomputer and has been designed to enable even the most severely paralysed patients to fend for themselves. The electronic super-arm of the future was amongst new developments shown for the first time at a two-day 'Aids to Independence' exhibition organised by North Surrey, Community Health Council at Ashford Hospital, Middlesex.

Although the arm is only in its prototype form, Dr. Jackson Todd of Queen Mary College, London (pictured above), demonstrated that it could be programmed to carry out separate or a series of quite delicate movements. A patient only able to move his head could con-

trol it using a stick held in his mouth to activate control buttons.

The so-called bionic arms that are now becoming available depend on the patient having some muscle movement. But this microprocessor controlled version can be programmed to carry out any type of function independently of the patient. The project has been underway at Queen Mary College for about a year and the control system, believed to be the first of its kind in the world, is complete. The next step is to produce a properly engineered prototype arm and integrate it with the input devices and the microprocessor control unit.

For further information contact:
Tom West, Director of Public Relations, Surrey Area Health Authority.



It's not all old hat

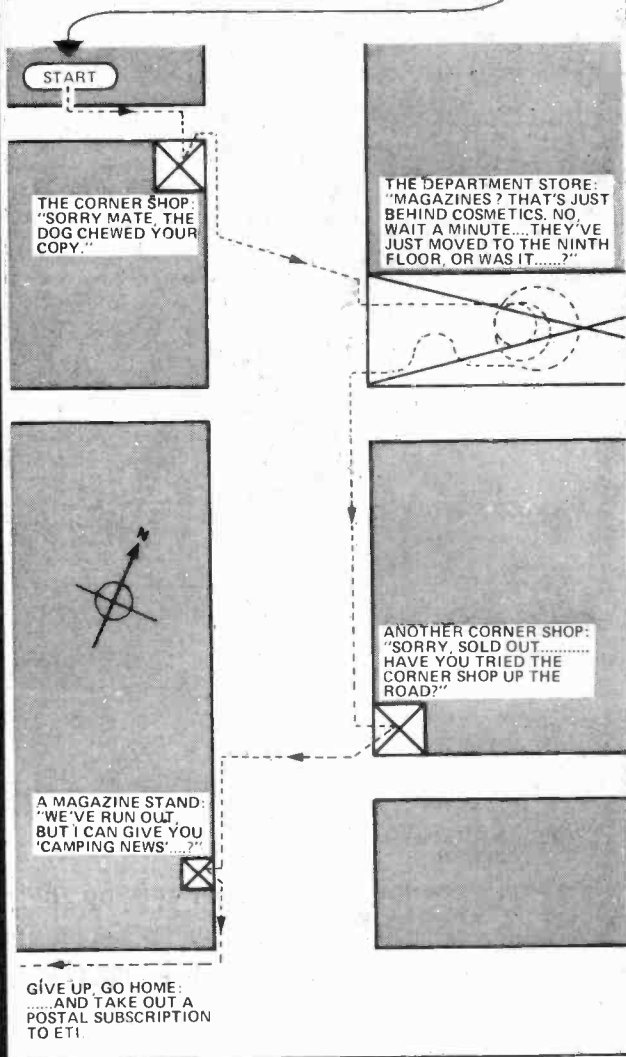
A new magazine is to be launched soon — January

— specifically for enthusiasts of vintage sound equipment. It will be bi-monthly and on subscription only. Among the areas covered will be wireless equipment, gramophones and cylinders, valves, pre-war pioneering exploits and tales of the companies involved.

It will begin life as a 32 page job and sample Nols can be obtained for 65p all inc. Subs rates will be £5.80.

U.K. Sounds Vintage, 28 Chestwood Close, Billericay, Essex.

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.

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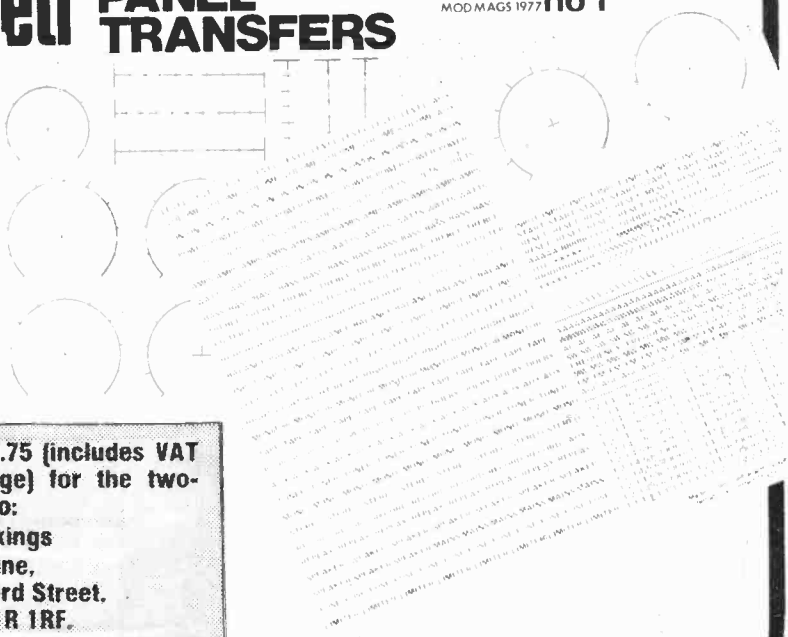
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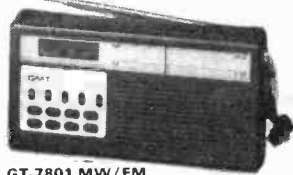
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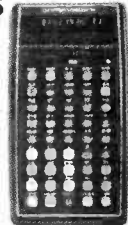


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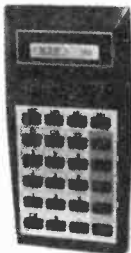


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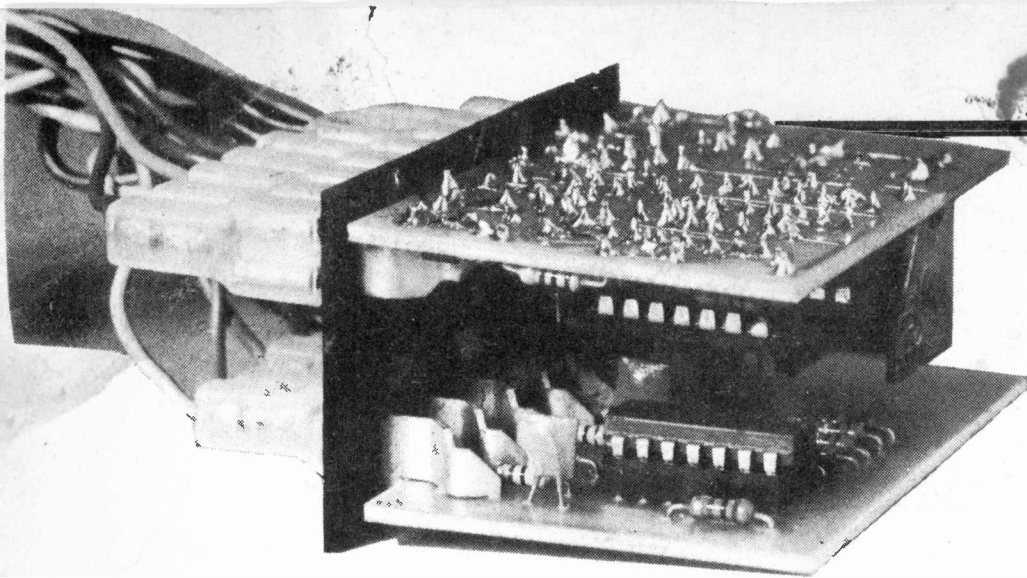
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CAR ALARM

THERE IS ONLY ONE way to ensure that you never have a car stolen and that is not to be stupid enough to buy one in the first place. However accepting the fact that many of us will feel the need to own a car how do we ensure that it remains ours amongst the ever increasing crime levels in this country. Well you could do worse than to fit the alarm system described here. Not *only* does this system protect the car itself, monitoring all doors and disabling the ignition when set, but also offers protection to the car's accessories.

The alarm provides an entry and exit delay before the horn is sounded, this means that there is no need to fit an external lock switch to the car. When leaving, the concealed alarm switch is activated whereupon the owner has 30 seconds before the alarm is set. On entry a 15 second delay is provided.

When triggered the system will sound the horn intermittantly for two minutes before resetting. However, if the initial cause of the alarm is still present, the alarm will retrigger.

The alarm provides for both active high and active low inputs allowing all types of sensor to be employed.

An additional accessory protection module provides an independent monitor of the car's accessories.

Construction is quite straightforward. The use of Incar connectors will allow the unit to be readily fitted and removed from any

BUYLINES

Compu-Tech Systems of 7 Sandhole Lane, Lt Plumstead, Norwich, NR13 5HZ will supply a complete kit of parts for this project.

car. These connectors should be fitted first. The rest of the components can then be fitted as shown in the appropriate overlay. Note that any polarity sensitive device is mounted in the correct position. The main board's jumper should be fitted when construction is complete. If your car's horn has one wire coming from it fit jumper A, if it has two wires with one going to earth also fit jumper A. If the horn has two wires neither going to earth, fit jumper B.

With construction complete the PCBs can be glued into the housing chosen for the alarm.

Installation of the alarm in the car must be left up to the constructor. The overall interconnection diagram is shown and it should be clear how to proceed in general. The detailed installation will however vary widely from car to car.

PARTS LIST

RESISTORS

R1,9	-	1kΩ
R2	-	100R
R3	-	1MΩ
R4,5,7,8,10	-	10MΩ
R6,11	-	4k7
R12	-	47R
R13	-	4M7

CAPACITORS

C1,2	10n ceramic
C3	16u 16 V tantalum
C4,6,7	4u7 16 V tantalum
C5	47n polyester

SEMICONDUCTORS

IC1,2	4001
Q1	BC337
D1-7	1N4148
ZBL	15 V 400mW

SWITCH

SW1 DPDT

RELAY

RLa 12 V 85R with 15A contacts

MISCELLANEOUS

PCB as pattern, connectors, case to suit, cable, etc.

RESISTORS

R14,16,18,20	10k
R15,17,19,21	100k
R22,24	100R
R23	1kΩ

CAPACITORS

C8-13 10n ceramic

SEMICONDUCTORS

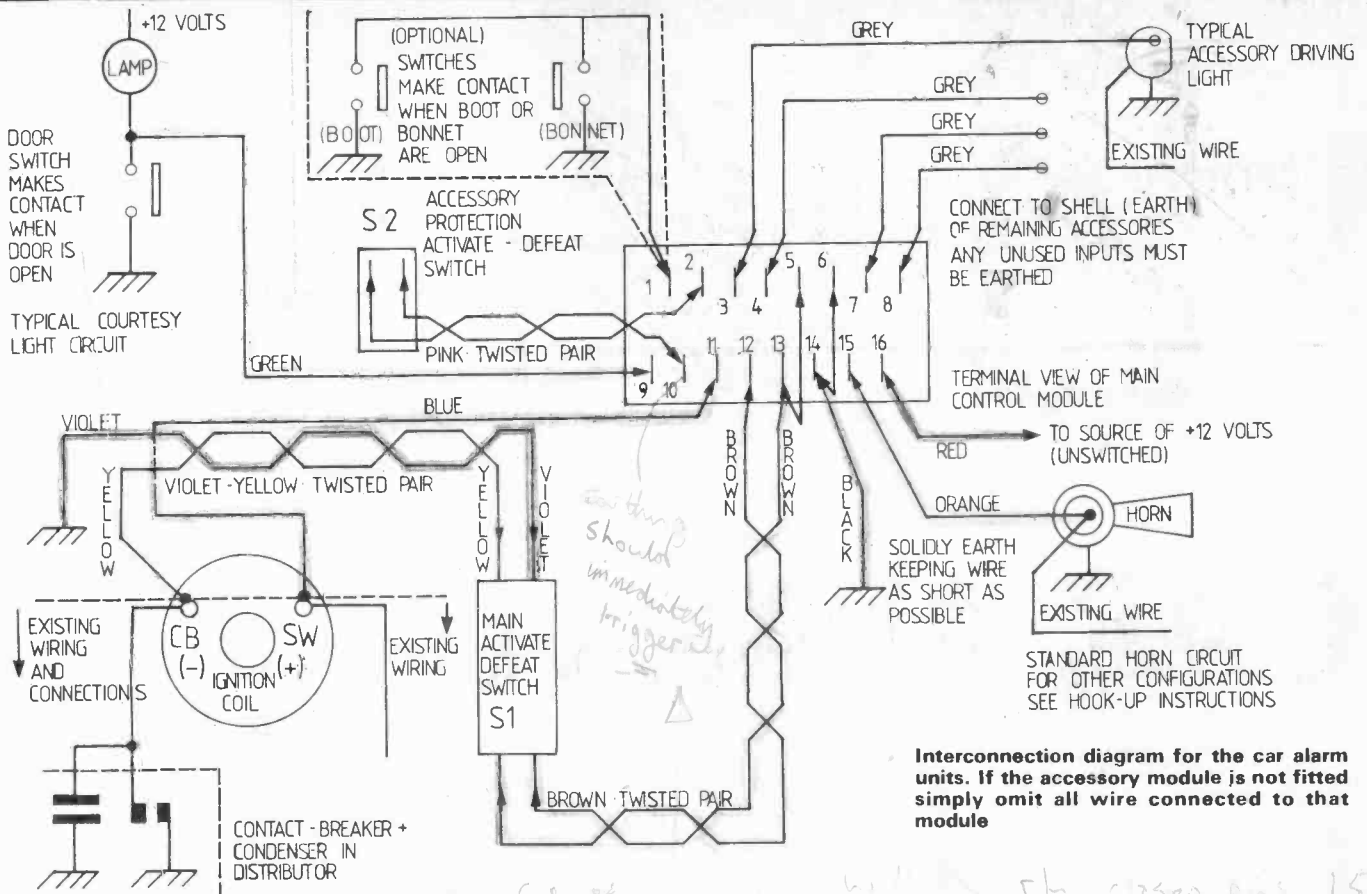
IC3	4002
D9	1N4148

SWITCH

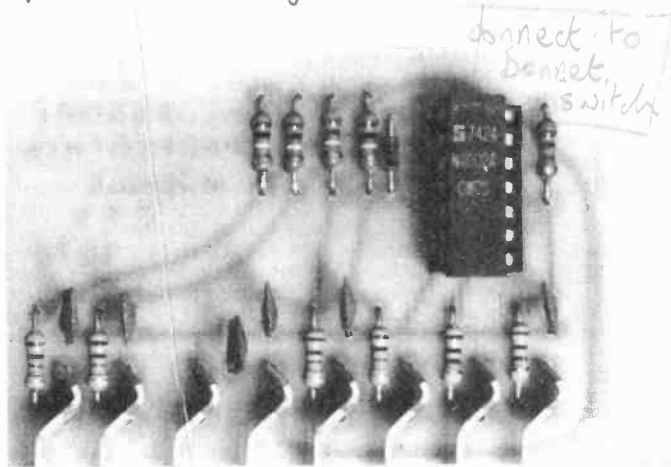
SW2 SPST

MISCELLANEOUS

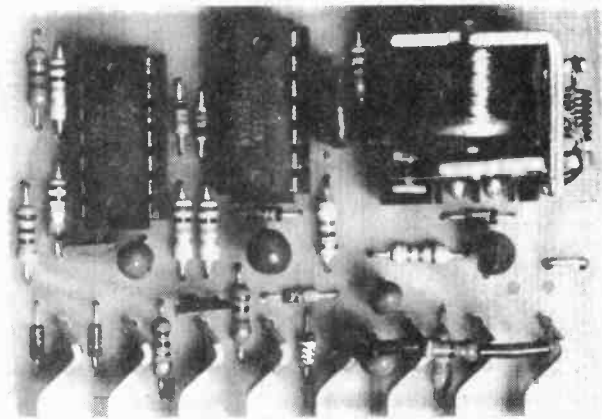
PCB as pattern, connectors, cable, etc.



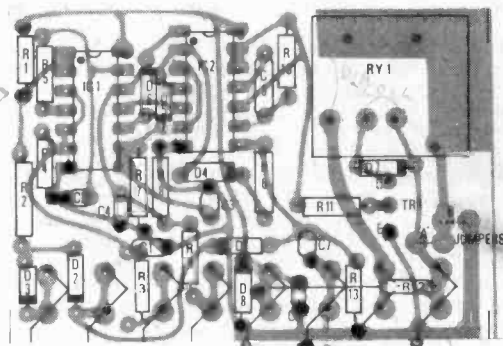
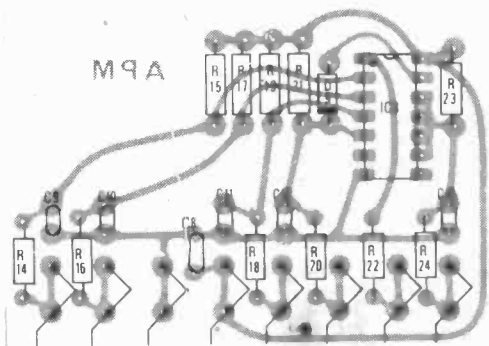
Interconnection diagram for the car alarm units. If the accessory module is not fitted simply omit all wire connected to that module

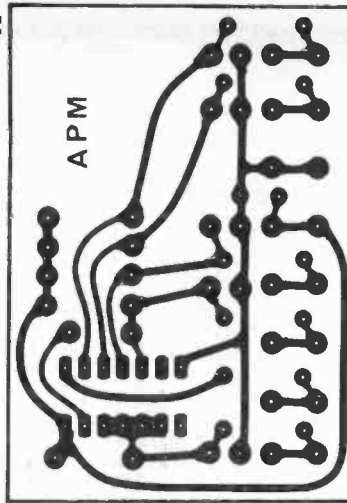
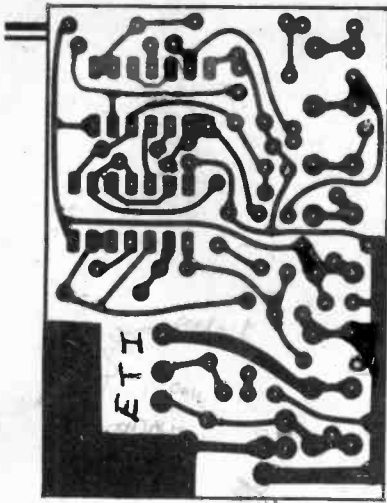


Overlay for the accessory protection board.



Overlay for main control board.





IC1A - either

To the far left is the foil pattern for the main control unit while left is the accessory module's PCB layout.

pulsating "normal" join for

HOW IT WORKS

In the quiescent state with the alarm defeated via S1 the following logic levels are present at the outputs of the gates indicated. IC1a-0, IC1b-1, IC1c-0, IC1d-0, IC2a-1, IC2b-0, IC2c-0, IC2d-1, transistor Q1 is cut-off, and RY1 is de-energized. R12, ZD1 and C6 form an overvoltage and electrical noise suppression circuit that protects the power supply rail of the circuit from spikes and battery overvoltage. The input of IC1a is held at logic 1 by pull-up resistor R1. R2 protects the input of IC1a from noise spikes.

If an earth appears at the inputs taken to D2 and D3 the logic 1 normally present at the input of IC1a changes to logic 0 which is inverted to a logic 1 by IC1a and connected to pin 5 of IC1b. D2 and D3 isolate the two inputs from each other. The input at D2 has a special function which is explained at the end of the text. Pin 6 of IC1b is held at Logic 0 by pull-down resistor R4. R3 and C1 form a noise suppression circuit for this input. If this input goes to +12 volts a logic 1 will be present at pin 6 of IC1b. Thus under normal conditions both inputs of IC1b are at logic 0 and in any alarm condition the input (s) will be at logic 1. Any logic 1 at the input of IC1b will force its output to logic 0. R5 and C2 form another noise suppression circuit to increase the noise immunity and prevent any noise spikes from reaching pin 13 of IC1c.

Whenever S1 is in the DEFEAT position a logic 1 is present at pin 12 of IC1c and pin 1 of IC2b. This logic 1 is buffered by R9 (spike protection). With a logic 1 at pin 12 of IC1c the output of this gate will remain logic 0 and ignore the input at pin 13. The vehicles ignition system works normally with S1 in the DEFEAT position. By placing S1 in the ACTIVATE position an earth is placed across the contact breaker and the vehicles ignition system will be disabled. Also when S1 is in the ACTIVATE position the logic 1 is removed from R9 and C4 will begin to discharge thru R8. D6 prevents C4 from discharging into IC1d.

In approximately 30 seconds C4 will have discharged to the threshold of IC2b pin 1 and IC1c pin 12 and a logic 0 will now be present at these points. The logic 0 present at pin 12 of IC1c will enable it and any alarm condition sensed by the inputs will be reflected by a logic 1 being present at the output of IC1c which is passed to IC2a pin 5. The 30 second delay after S1 changes states to the ACTIVATE position and IC1c being enabled is the EXIT delay.

IC2a and IC2b form a set reset flip-flop with the normal state as a logic 1 at pin 4 of

IC2a. It is set by a logic 1 at pin 5 of IC2a (alarm condition) and is reset by a logic 1 at pin 1 of IC2b (defeated or timed reset/validate condition). Once the flip-flop changes states it can only be changed back again by applying a logic 1 to the opposing input. Thus even a momentary logic 1 at pin 5 of IC2a would latch the flip-flop into the alarm status and initiate the alarm sequence. A momentary logic 1 would be generated by opening one of the vehicles doors and then closing it. When the flip-flop senses a logic 1 at pin 5 of IC2a it will change state and lock with a logic 0 at pin 4 of IC2a.

When the logic 0 appears at pin 4 two things happen: First C7 will begin to discharge through R13. D4 prevents C7 from discharging into IC2a. In approximately 15 seconds C7 will have discharged to the threshold of IC2c and a logic 0 will be present. With a logic 0 at pin 8 of IC2c the 1 Hertz astable multivibrator formed by IC2c, IC2d, R10 and C5 is enabled. Pin 10 of IC2c will alternate between logic and Logic 1 at a 1 Hertz rate driving Q1 in and out of condition via R11. As Q1 goes in and out of conduction RY1 energizes and de-energizes, closing and opening the contacts. These contacts are wired thru jumper "A" or "B" providing a pulsating +12V or pulsating earth which is connected to the horn circuit sounding the horn and raising the alarm. The 15 second delay between the flip-flop changing states (alarm detected) and the horn beginning to sound is the ENTRY delay.

The second thing that happen when the flip-flop changes states is that C3 will begin to discharge thru R7. D5 prevents C3 from discharging into IC2a. In approximately 2 minutes C3 will have discharged to the threshold potential of IC1d and a logic 0 will be present. IC1d inverts this to a logic 1 and presents it via D6 to pin 1 of IC2b resetting the flip-flop and to pin 12 of IC1c inhibiting the alarm condition (if present) from reaching IC2a. When the flip-flop resets a regenerative action takes place and begins to recharge C3 and C7. When C3 has charged past the threshold of IC1d a logic 0 will be present at its output and IC1c will be enable in a few seconds as the small charge placed on C4 prior to the regenerative action will have discharged thru R8. If the alarm is no longer present C3 and C7 will completely charge and the alarm will reset and wait for another intrusion. If the alarm condition is still present the flip-flop will again latch and the small charges that developed on C3 and C7 will discharge thru R7 and R13 respectively

in a few seconds. Thus every two minutes the alarm will reset itself for approximately 3 seconds and then start over again.

This cycle is the RESET/VALIDATE cycle and is provided to prevent the battery from being completely discharged by a momentary intrusion. The input T(OD)2 is a special function input and is for use with the accessory protection module. When this input goes to earth C7 is immediately discharged via D1 and the alarm will begin to sound, R6 prevents IC2a from being destroyed by the pull-down action. This earth is sensed by IC1a and will latch the alarm (providing the exit delay cycle is complete). This input is verified by the RESET/VALIDATE cycle in the manner described above. The main ACTIVATE/DEFEAT switch S1 does not affect this input making it completely independent of the main system.

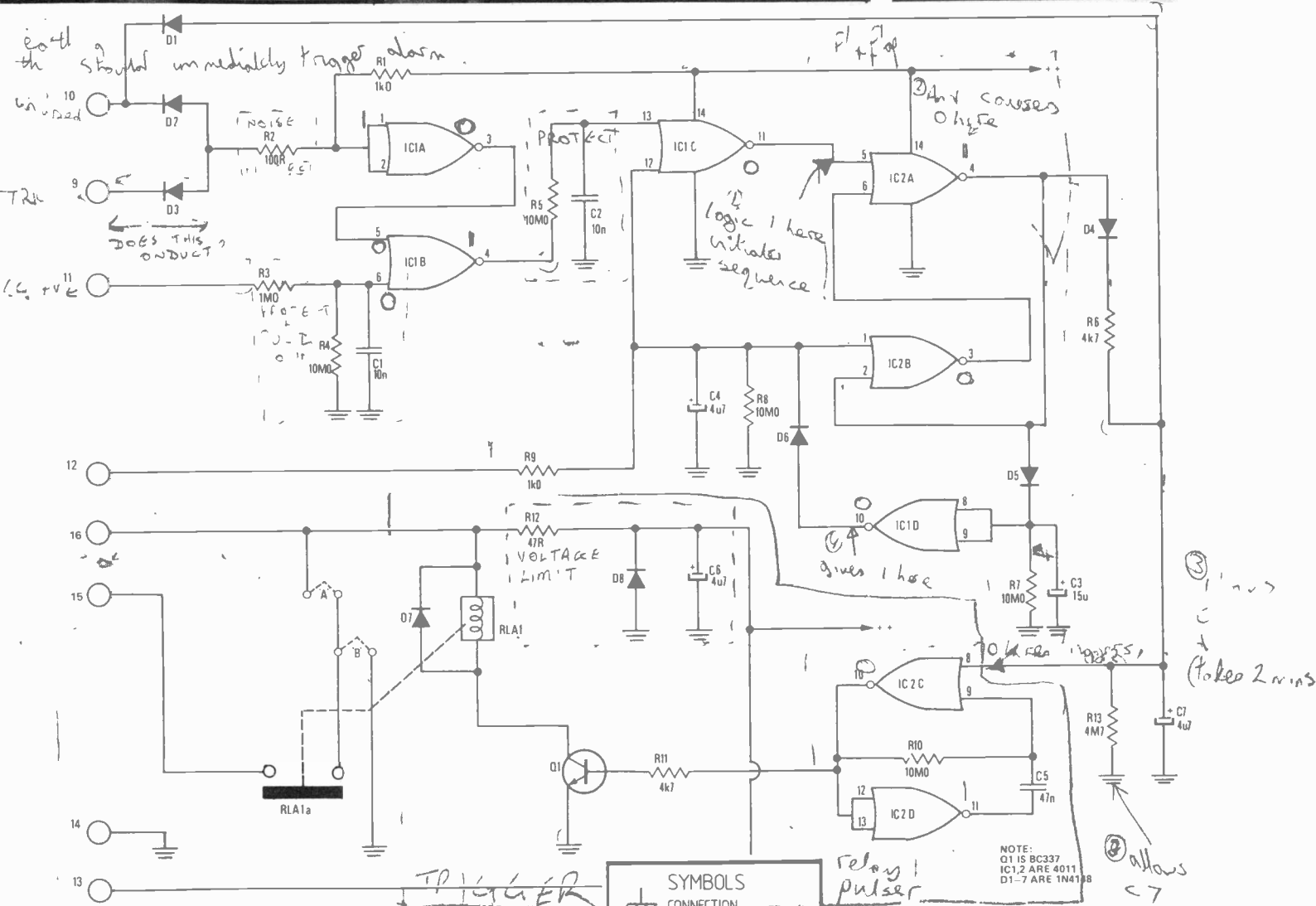
Accessory Protection Module — Theory of Operation

In the quiescent state IC3a output is logic 1 and the output of IC3b is logic 0. Under normal conditions, i.e. no alarms sensed, all inputs to IC3a will logic 0 (sunk to earth via R14, R16, R18, R20 and the sense wires). The input to IC3b will be open or at +12 volts, R23 being the pull-up resistor for an open circuit, R23-C13 are noise suppression components. C8 by-passes any noise present on the supply rail to earth. If any of the sense wires open R15, R17, R19, or R21 will pull the respective input to logic 1. C9 thru C12 in conjunction with R14, R16, R18, R20 form a noise suppression circuit for these inputs. Any logic 1 present at IC3a inputs will result in a logic 0 at the output which is connected via buffer resistor R22 to the unit's output. This is connected through ACTIVATE/DEFEAT switch S2 to the main control unit. S2 has been provided to make the accessory protection system independent of the main system and will normally be activated continuously.

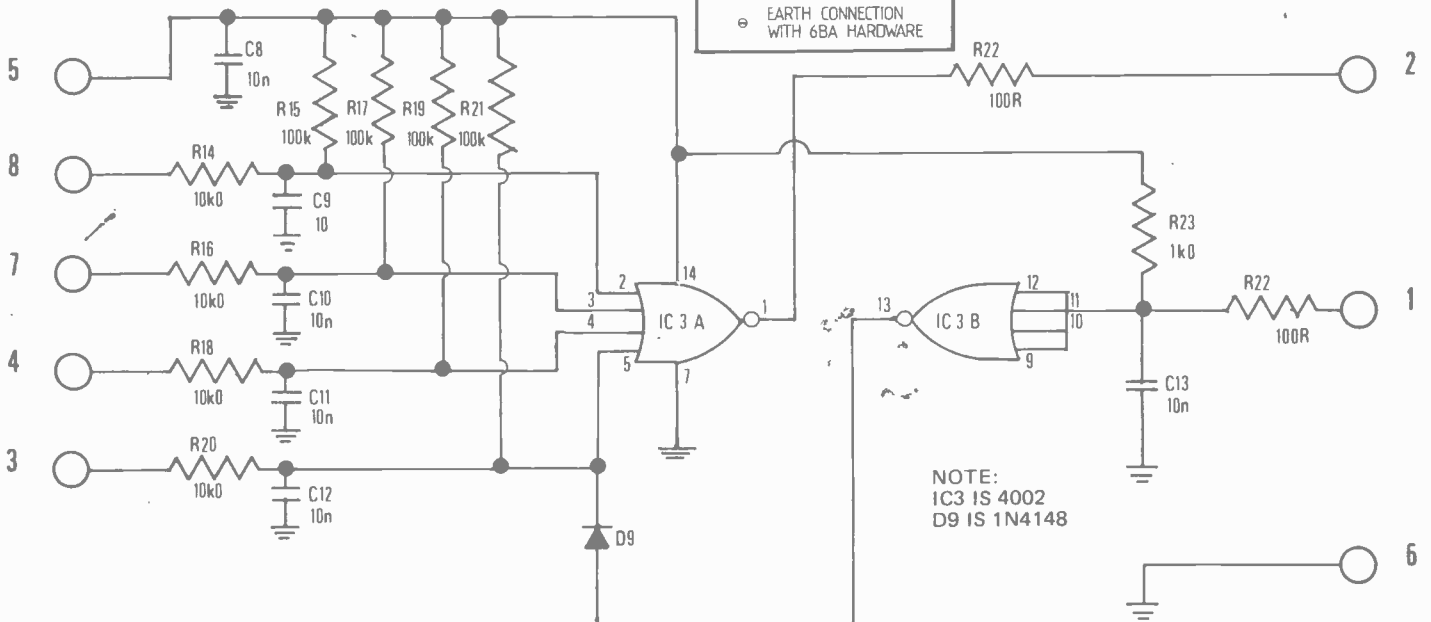
An earth at the active low I/P will force the output of IC3b to logic 1. This logic 1 is coupled via D9 to IC3a forcing pin 5 to logic 1 regardless of the status of the sense wire this will result in a logic 0 at the output of IC3a as explained above. D9 is provided to that IC3b can only force pin 5 of IC3a to logic 1, it cannot force it to Logic 0.

Any time a logic 0 is present at terminal () and S2 is in the activate position the alarm will sound immediately as explained in the description of the main control unit.

PROJECT: Car Alarm



Circuit diagram of the main control unit.



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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.

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4010	58p	4070	20p	4534	614p
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4019	60p	4078	20p	4554	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	75p	4089	150p	4559	388p
4025	17p	4093	50p	4560	218p
4026	180p	4094	100p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
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4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	218p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4586	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	130p	4512	96p		
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7403	14	20	7470	28	24	74133		29	74191	
7404	14	24	7472	28	74	74136	22	40	74192	105
7405	18	26	7473	32	74	74138	60	74	74193	180
7406	38	7474	27	38	74139	60	74194	105	87	137
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7414	51	130	7484	97	74150	99	74253		108	column is not OSTs
7415	30	24	7485	104	99	74151	64	84	74257	
7416	30	24	7486	61	40	74153	64	54	74279	
7417	30	24	7489	205	90	74154	96	110	74283	
7420	16	24	7490	33	90	74155	54	110	74290	
7421	29	24	7491	76	110	74156	80	110	74295	
7422	24	24	7492	38	78	74157	67	55	74298	
7423	27	24	7493	32	99	74159		60	74258	
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7426	36	27	7495A	65	99	74169	210	130	74365	
7427	27	29	7496	58	120	74161	92	78	74366	
7428	35	32	7497	185	74162	92	130	74367	49	43 matching to a max of 6 diodes
7430	17	24	74100	119	74163	92	78	74368	49	per diode (1%)
7432	25	24	74104	63	74164	104	74375	60	74379	
7433	40	32	74105	62	74165	105	74399	130	150	KV1210 275p
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7440	17	24	74110	54	74168			74477	90	BA479 pin 35p
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HOW IT WORKS~ TELEVISION RECEIVERS

Ever wondered just how your TV actually works — all those cunningly interconnected and interrelated bits of high-voltage circuitry? Gordon King takes a good long look in this, the first of a series of How It Works articles based around consumer electronics products.

THIS FIRST ARTICLE in the 'How It Works' series looks at monochrome television based on a recent mains/ battery chassis from Thorn Consumer Electronics. In addition to providing an insight into modern television technology the article is also styled to give a fair impression of how the picture is developed on the screen of the picture tube. The basic principles are common to all receivers except that for the reception of colour there are circuit additions for the decoding of the colour information (and a tricolour tube for display!)

Sound and vision signals are modulated on to two carrier waves, the former using frequency-modulation (FM) and the latter amplitude-modulation (AM). On the prevailing UK 625-line system the signals are transmitted in Bands IV and V which are located in the UHF spectrum. Each channel occupies a width of 8MHz with the sound carrier being 6MHz above the vision carrier. For example, Channel 21 has sound and vision frequencies of 477.25 and 471.25 MHz respectively,

while the frequencies for Channel 68 are 853.25 and 847.25 MHz.

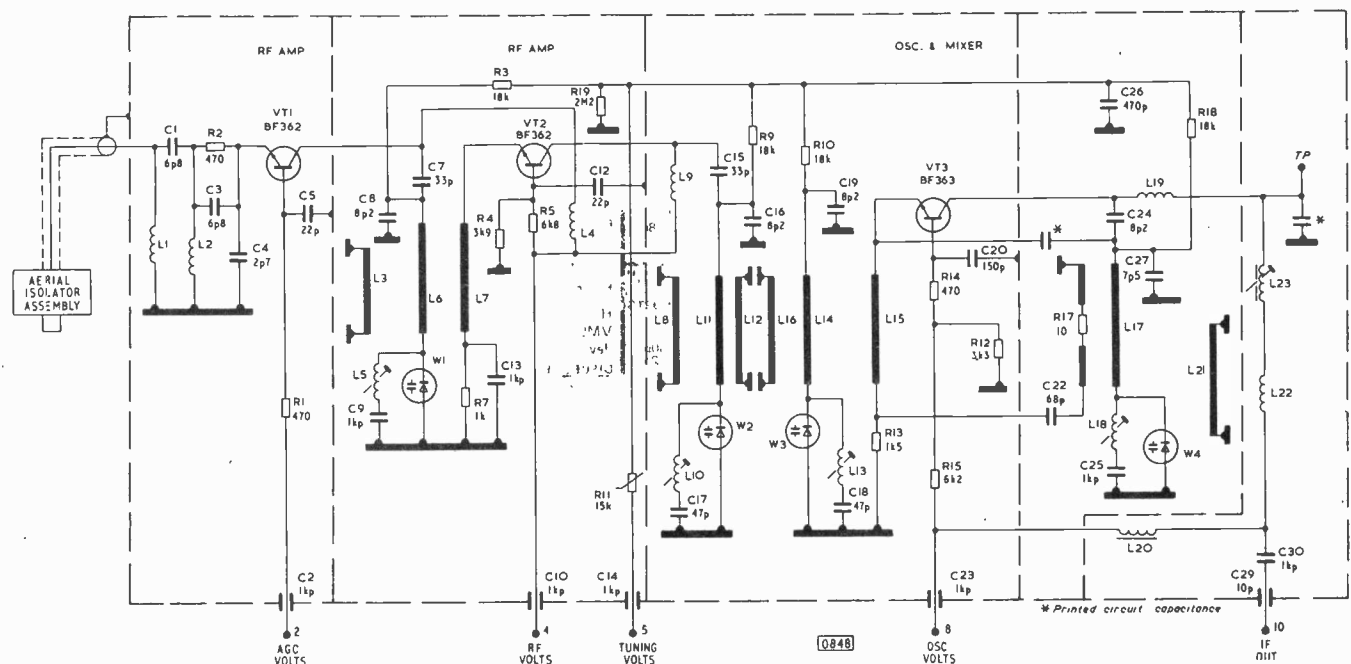
Vision modulation is negative-going (see Fig. 3) and is transmitted in 5.5MHz upper sideband and 1.25MHz lower sideband. Peak FM deviation is 50kHz (as distinct from 75kHz on FM sound radio) based on 50µs pre-emphasis. Ratio of peak vision to peak sound power is 5:1. Further information on the signal is given later.

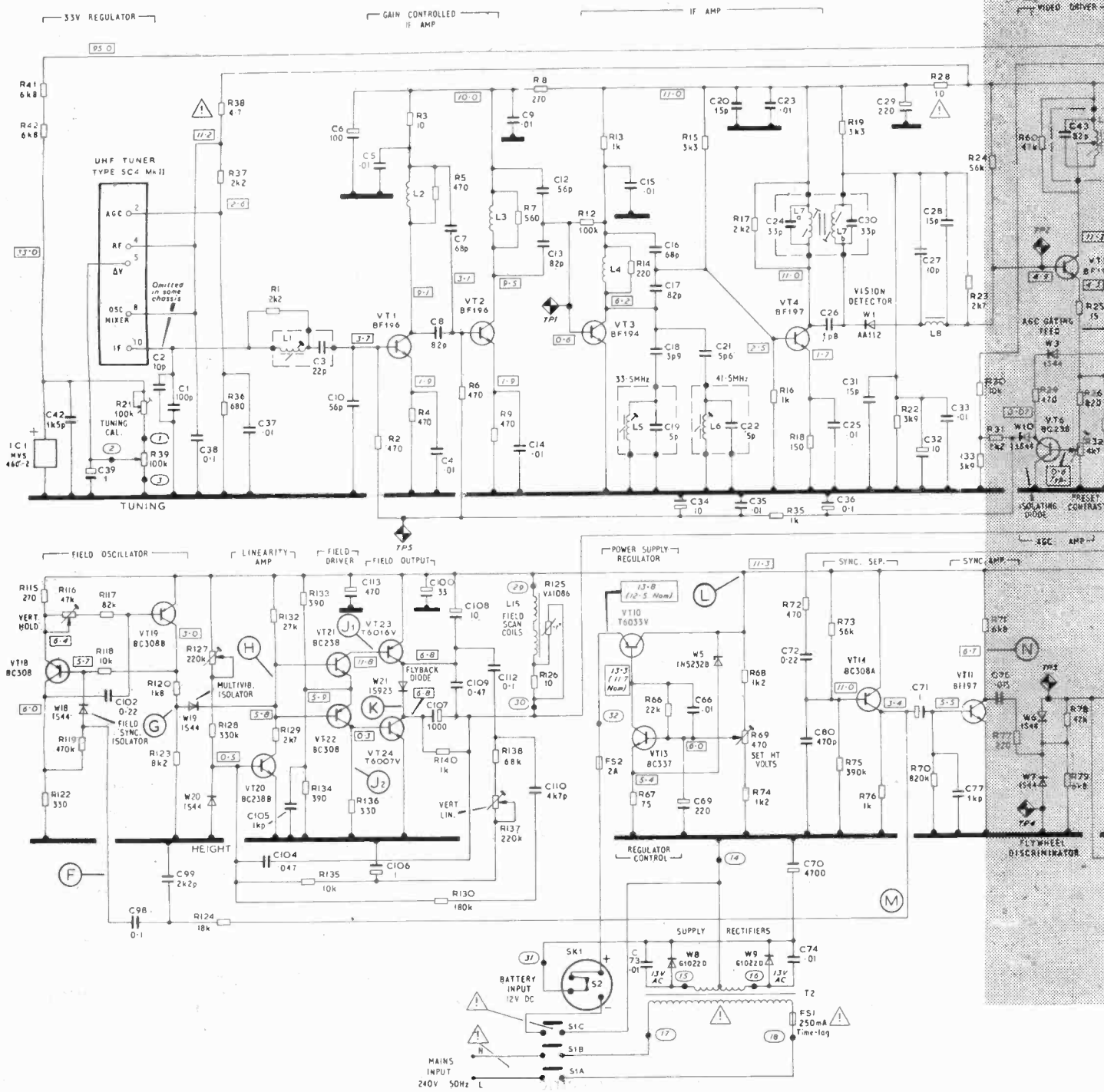
Tuner-Front-End

The start of any television receiver is the 'front-end' or tuner (Fig. 1), whose job it is to select the required channel and to convert the sound and vision carriers to lower frequency ones for subsequent intermediate-frequency (IF) amplification and response tailoring. In Fig. 1 the aerial signals are coupled to an aperiodic RF amplifier, VT1, through an 'isolator' for preventing spurious mains voltages in the receiver from reaching

Fig 1. Circuit diagram of UHF varicap tuner, which uses two RF amplifiers and a mixer stage. Resonant lines tuned by capacitor-

diodes select the required channel and provide the necessary front-end selectivity.





the aerial at lethal power! The transistor is in common-base mode so that the input is applied to the low-impedance emitter. Further input matching is provided by the emitter components and the base is biased either from a constant potential or from an AGC potential (see later).

VT2 is a tuned RF amplifier, also in common-base mode, but the tuning is by resonant lines rather than coils. Any transmission line whose length is adjusted to correspond to a tuned frequency is the equivalent of a tuned LC circuit. An open-circuit line is resonant at $1/2$, $3/2$, $5/2$, etc. wavelength. Excluding velocity factor,

the physical length of a line for, say, Channel 33 would be around 280mm. Happily, it is possible to reduce the physical length while retaining the required electrical length by cutting off the ends of the line and replacing them with capacitance, which reduces the physical length to about 50mm. Moreover, tuning the channels then becomes a question of varying the capacitance at one end.

Looking at line L6 in Fig. 1 shows that the bottom connects to varicap W1 and the top to C8 and VT1 collector capacitance. A varicap is essentially a junction diode. As the reverse bias is increased so the depletion

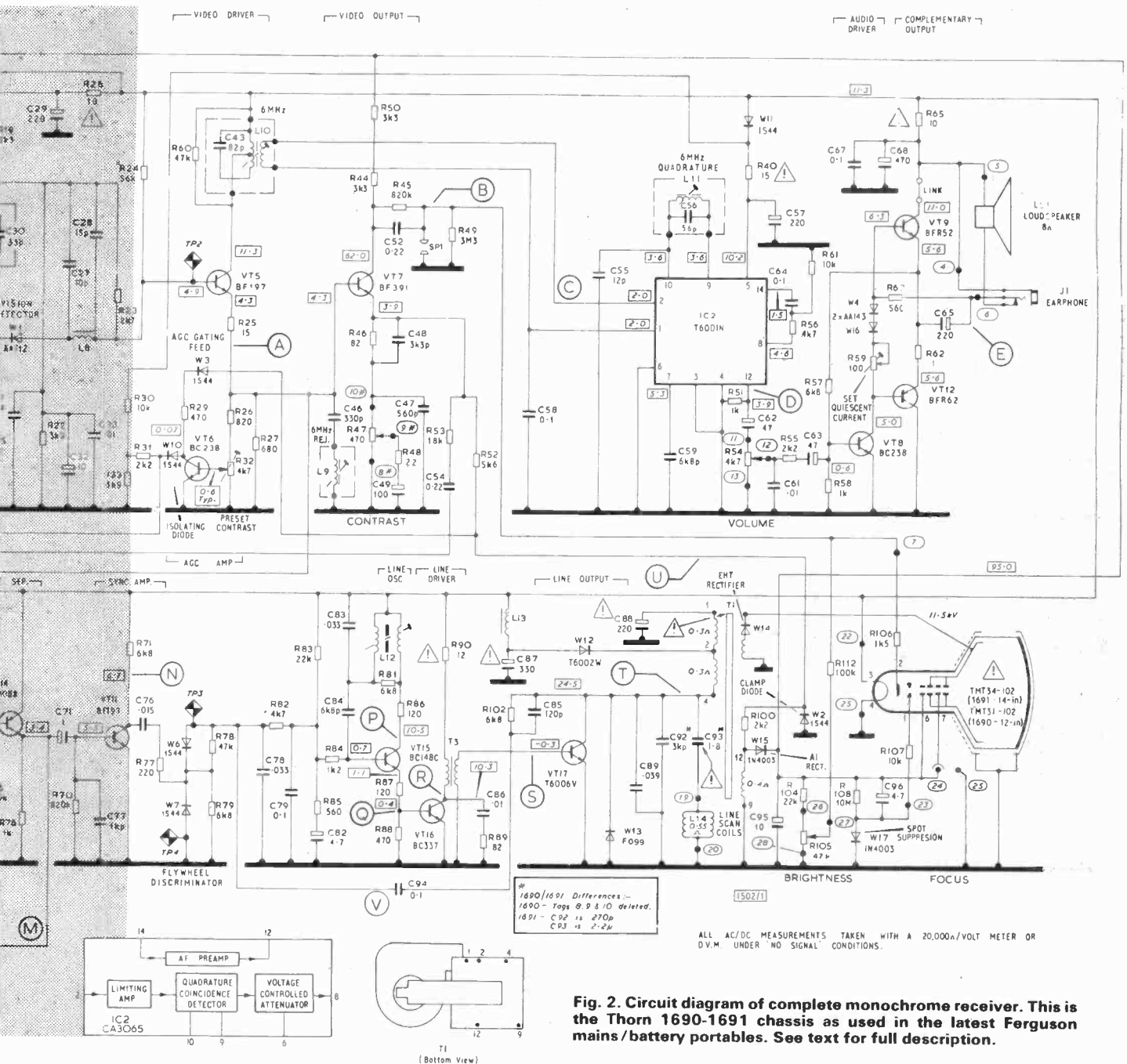


Fig. 2. Circuit diagram of complete monochrome receiver. This is the Thorn 1690-1691 chassis as used in the latest Ferguson mains/battery portables. See text for full description.

region widens, and as this constitutes the dielectric between the n and p regions. The effect is tantamount to the two plates of a capacitor being moved away from each other, with a consequent reduction in capacitance. The four varicaps in Fig. 1 are biased by a positive potential being applied to the 'tuning volts' input. The potential is obtained from a stabilised (by IC1) supply in the main chassis (Fig. 2) via tuning potentiometer R39. Thus as this control is tuned so the resonance frequency of the lines alter in step and tune over the UHF channels.

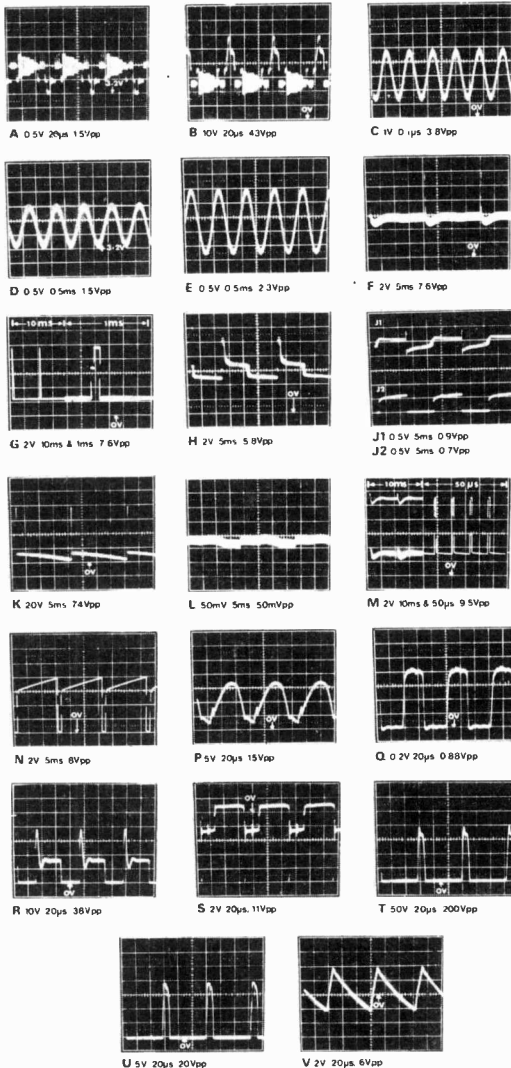
The second RF amplifier stage VT2 starts to give selectivity. Emitter coupling is via low impedance aperiodic line L7. Further selectivity is provided by the bandpass coupling between VT2 collector and VT3 emitter formed by lines L11, L12, L16 and L14, tuned

by varicaps W2 and W3. Common-base VT3 uses collector/emitter feedback for the local oscillator tuned by line L17 and varicap W4. Line L15 couples the RF signal to the oscillator/mixer stage. The circuits are trimmed by L5, L10, L13 and L18 (so they all tune in step), while the closed lines L3, L8 and L21 also assist with the tuning and matching.

The oscillator is arranged to operate at the IF frequency above the input frequency, and additive mixing yields the IF output, which is resonated by L23 and associated components. The IF signal is coupled to the IF input of Fig. 2 via C30. The high degree of selectivity minimises spurious responses such as image, IF, repeat spot, etc., while also providing a good 3rd-order intermodulation rejection ratio. This is further

Oscillograms

These were taken from a typical receiver at the points indicated by corresponding letters in the circuit diagram. The voltage and time figures refer to the sensitivity per division of the graticule. The receiver was set up for normal reception (test card with tone on sound) and the oscillograms were taken via a +10 probe having an input capacitance of 12pF in parallel with 10MΩ. The mixed mode timebase facility was used for G and M.



aided by the nature of the transistor and design of the first stage VT1.

The circuit also reveals various signal coupling, decoupling and isolating components, which are essential for the stable performance of this important part of the receiver. The tuner is built into a fully screened box with feed-through capacitors for the inputs and outputs.

IF Channel

Sound and vision signals of the selected channel undergo amplification with bandpass and selectivity tailoring in the IF channel comprising VT1/2/3/4. Tuner signal is applied to VT1 base from the tuned coupling L1/C3, and the amplified and bandpass defined output is yielded by transformer L7a/b. Gain is controlled automatically (AGC) to suit the level of the

input signal by a bias fed to the bases of VT1 and VT2. The four stages are each in common-emitter mode, and impedance matching at the couplings is achieved essentially by capacitor divide-down.

The bandpass characteristic is provided in the main by L1/C1/C3/C10/R1 at the input and by L7a/b at the output. Additional selectivity is provided by collector inductors L2/L3/L4, while sound and adjacent channel sound rejections are introduced at 33.5MHz by L5/C18/C19MHz and at 41.5MHz by L6/C21/C22.

With the 625 line system (system 'I' is used in the UK) the sound carrier is 6MHz above the vision carrier, but because the local oscillator of the tuner is working at the IF above the signal frequencies, the IF appears at 33.5MHz for sound, which is 6MHz below the 39.5MHz vision IF. The sound and vision signals are handled simultaneously by the IF channel, which is possible because frequency modulation (FM) is used for the sound signal. Vision bandwidth of the 'I' system is 5.5MHz upper sideband, accommodated by the IF bandwidth, and overall channel width 8MHz.

Vision Detector

Sound and vision signals from L7b are coupled to vision detector W1, which yields a changing amplitude output corresponding to the picture information (Fig. 3) and also an output at 6MHz resulting from intermodulation of the sound and vision signals by the diode non-linearity, the difference frequency of the two signals being 6MHz. The intercarrier sound signal (as it is called) retains the FM of the sound signal because this is one of the components from which it is derived.

If the ratio of the levels of the sound and vision signals is incorrect a buzz occurs on sound — called intercarrier buzz. Hence the reason for the 33.5MHz trap, which sets the sound signal level below that of the vision carrier while helping to establish one side of the bandpass. The 41.5MHz trap avoids the sound signal from the next channel causing interference while helping to establish the other side of the bandpass. The vision carrier is set 6dB down the response to equalise for the single side band signal.

Video Channel

Picture and intercarrier signals from W1 are directly coupled to the base of the video driver VT5 via low-pass filter L8/C27/C28, which removes residual IF signal. VT5 collector is loaded into transformer L10 which tunes the 6MHz intercarrier signal and couples it to the sound section for FM demodulation and subsequent pre and power amplification for driving the loudspeaker.

VT5 also serves as an emitter-follower for the video signal with network R26/R27/R32 as the load. The signal across this is directly coupled to the base of the video output transistor VT7, which feeds negative-going picture signal to the cathode of the picture tube from its collector. A series rejector L9/C46 tuned to 6MHz is also active at VT7 base to prevent intercarrier signal from getting into the video output stage, where it would cause picture interference. The level of video signal reaching the tube is adjustable by R47, the contrast control, which is a kind of current feed-back control working by the progressive shunting effect across R47 emitter resistor by R48. C49 is a DC isolator. Video-frequency compensation is also provided by capacitors in the feedback loop.

Automatic Gain Control (AGC)

VT5 base is biased from a resistive divider complex (R24/R33/R22/etc.) from the supply rail. It is also partly biased from rectified IF signal at W1 anode, and since direct-coupling is used an increase in IF signal level results in a reduction in positive bias at VT5 base and hence a fall in potential across VT5 emitter load.

The voltage across R32 (the preset contrast control part of the load) is fed to the base of the AGC amplifier VT6 at a level established by the setting of the control. Because VT6 collector is energised via W3 from positive-going 5Vpp pulses derived from a winding on the line output transformer (bottom right-hand corner of Fig. 2, next to the picture tube), the transistor conducts only during the line sync pulses when there is no picture content which the AGC circuit might otherwise falsely read. The degree of conduction and hence the level of the collector potential are determined by the DC level of the line sync pulses at VT6 base. This is called line-gated AGC.

Thus with increase in input signal level (such as when tuning to a stronger channel) VT6 is turned down and the positive potential at its collector rises. This is reflected via forward conducting W10 to the bases of VT1 and VT2 by way of R2/R6 and the filter consisting of C34/C35/C36/R35, which removes line pulses. The small-signal transistors VT1 and VT2 are the type designed for forward AGC; that is, increased gain reduction resulting from positive-going AGC potential.

The preset contrast control R32 sets the operating range of the AGC. With a test card signal of average strength the control is adjusted for 1.5Vpp picture *plus* sync signal at VT5 base.

Some sets include delayed AGC for the tuner RF amplifier which comes into effect after the gain has been reduced initially on a strong signal by the IF AGC; but for the monochrome portable this is barely necessary as maximum front-end gain is generally necessary for most of the time for the best signal-to-noise ratio when a simple set-top aerial is utilised. It will be seen that the tuner 'block' in Fig. 2 has an AGC input which, in this model, is terminated to a supply potential-divider.

Field Timebase

The electron beam needs to be deflected both vertically and horizontally to build up the raster upon which the picture appears. The vertical deflection is handled by the field timebase which deflects the beam from the top to the bottom (scanning stroke) and then very swiftly back to the top again (retrace) at 50 Hz repetition rate.

This is achieved by a 50Hz sawtooth current passing through the field scan coils (L15) on the tube neck. The oscillatory requirements are provided by the field oscillator VT18/19, which is an RC multivibrator. The retrace is initiated by the arrival of a field sync pulse at VT18 base (see later), while the repetition rate is determined by the vertical hold control R116 with R117/118 and C102.

Consider the circuit during the scanning stroke when a rising voltage (ramp) occurs at the base of high-gain amplifier VT20 owing to C104 charging through R127/128. This turns on VT20, VT22 and VT24, and turns off VT21 and VT23. At the conclusion of the stroke VT24 is fully 'bottomed', at which time a positive-going

pulse from VT19 collector 'hits' the bases of VT21 and VT22 via the multivibrator isolating diode W19. The pulse is initiated from the field sync action. The retrace is thus triggered by VT21 and VT23 turning on, and VT22 and VT24 turning off.

During the retrace, VT24 collector voltage rises at a rate established by the L/R ratio of the scan coils, and when the supply line voltage is exceeded W21 goes into reverse conduction and VT23 is isolated. The rate of rise is then defined by C109. After a peak, the retrace voltage falls until W21 goes into forward conduction again. This allows the remainder of the retrace energy to be fed back into the supply line, after which the scanning stroke recommences.

The resulting rise in current through the field scan coils during the scanning stroke produces a magnetic field such that the electron beam is drawn downwards. To avoid vertical non-linearity for the display the *rate of change of current* must be linear. Owing to resistive losses in the scan coils and circuit non-linearities, a slight correction to the current waveform is required, and this is achieved by a parabola waveform produced by R138/R137/C106 being added to the ramp via the linearity amplifier VT20. The degree of correction is adjustable by the vertical linearity control R137.

When the retrace is initiated the rapid reversal of scan coil current deflects the beam swiftly upwards to start a new downward scan, and during the retrace diode W20 goes hard into forward conduction so that the base of VT20 is clamped to earth.

Line Timebase

Horizontal deflection of the beam is achieved by the line timebase driving a sawtooth current wave through the line scan coils (L14) during the scanning stroke. Deflection is from left to right, and at the end of the scanning stroke a swift reversal of current deflects the beam back to its starting point again. During the retrace a considerable amount of energy stored in the inductive elements of the line output stage is released to provide the extra high tension (EHT) for the final anode and the high voltage for the first anode (A1) of the picture tube. Boosted voltage is also used to energise the line output transistor VT17 once the line oscillator has started.

Line repetition rate of the 625 line system is 15625Hz. Thus the horizontal rate is significantly greater than the vertical rate. We have seen that in the UK the vertical rate is 50Hz. This means, then, that a raster of 312½ lines is produced (15 625/50). For a complete picture there are two vertical scans, each producing a raster of 312½ lines, so that the complete picture is made up of 615 lines and produced every twenty-fifth of a second (in actual fact not all the lines are used for the picture as some occur during the field sync period when the electron beam is cut off).

A complete full-line-picture is achieved because the scanning lines of one field *interlace* in the spaces between the lines of the partnering field. To obtain 625 lines without interlacing the line frequency would need to be increased to 31 250Hz. This in turn would call for a greater rate of change in beam intensity and hence spot brightness to trace out the fine detail over each line, and because a greater rate of change of signal amplitude involves a greater bandwidth, more radio space would be needed to accommodate the picture detail of each

channel. With the 5.5MHz vision bandwidth of the 'I' system good definition is obtained at the 15 625Hz line rate.

Interlacing *could* be avoided without using up extra radio space by reducing the field rate to 25Hz, but then the picture would suffer bad flicker (subjectively apparent up to about 45Hz). Interlacing thus solves the problems of bandwidth and flicker without unduly detracting from the displayed information.

Returning to the circuit in Fig. 2, the line frequency is established by a blocking oscillator incorporating VT15. Forward base bias through R83 turns the transistor on so that the current through the collector winding of L12 rises. The reversed phase of the other winding puts a negative-going pulse on the base which cuts the transistor off. The on/off cycles are timed by L12/C83/C84 with the oscillator in the free-running mode, the frequency being set by L12 core. The oscillator is synchronised to the line pulses of the signal (as will be explained later).

VT16 amplifies and shapes the pulses from VT15 emitter and transformer T3 couples them to the base of output transistor VT17. The pulses switch this transistor on during the scan so that current flows through the upper left-hand windings of the line output transformer (LOT) T1 and scan coils L14. Because the coils are essentially inductive the current rises as a fairly linear ramp. However, because the effective length of the beam changes with scanning stroke owing to the wide scanning-angle and flat screen of a contemporary tube, 'S-correction' is required. This is achieved by C93 which reduces the rate of scan at the start and end of a line with respect to the centre. Further linearity correction and width adjustment are provided by a closed-loop sleeve set under the scan coils. The field produced by the current induced into this counteracts the non-linearity of the field produced by the scan coils themselves.

VT17 switches off at the end of a scan and the swiftly collapsing current through the scan coils and LOT windings returns the beam to its starting point and yields a high voltage pulse owing to the sudden release of the inductively-stored energy. The repetitive pulses are increased in voltage by the overwind at the top right-hand side of T1, rectified by W14 and smoothed by a capacitance formed by the inner and outer conductive layers on the tube flare, the inner connected to the final anode. The result is a potential of 11.5kV for the final anode. After rectification by W15, pulses from the lower right-hand winding charge C95 to yield a 95V line for the tube first and third anodes, video output VT7 (to provide about 50V video swing for the tube) and varicap tuning.

Oscillatory energy is rectified by the booster diode W12 conducting during the retrace to charge C87/C88. This not only damps the unwanted energy which would otherwise cause vertical lines at the left of the picture, but the potential developed from it is used to energise VT17 collector, and contribute to the line scan, thereby improving the efficiency of the line output stage. The stage also adopts 3rd harmonic tuning of the pulses. This tends to flatten the tops of the pulses, which leads to improved EHT regulation. The tuning capacitor is C89 in parallel with a low-inductance disc capacitor C92 providing flashover protection.

Sync Stages

Video signal at VT5 emitter is coupled to the base of the sync separator transistor VT14 through R72/C72. On the 625 line system the picture signal is negative-going (modulation level falling with increasing brightness), and at the end of each line a line sync pulse occurs whose tip reaches 100% amplitude, as shown in Fig. 3 a.

Composite video (picture plus sync) from VT5 emitter is fed to the base of VT14 (sync separator) which is biased to conduct only during the sync pulses so that they resolve free from picture signal at the collector. For line sync, coupling is to VT11 (sync amplifier/inverter), whose output drives 'flywheel' discriminator W6/W7 etc. The discriminator is also fed positive-going line pulses from the LOT via C94 which, after RC integration,

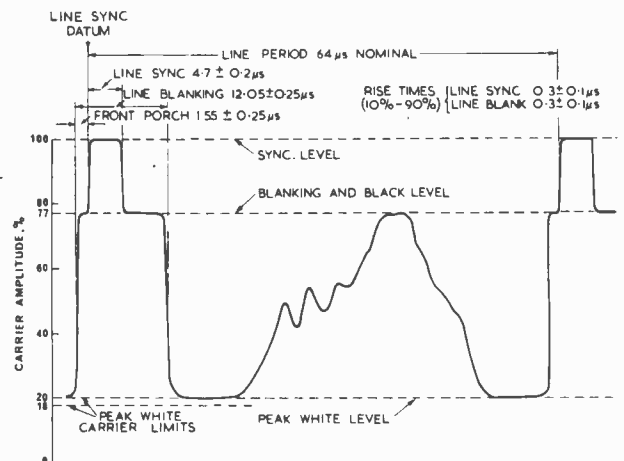
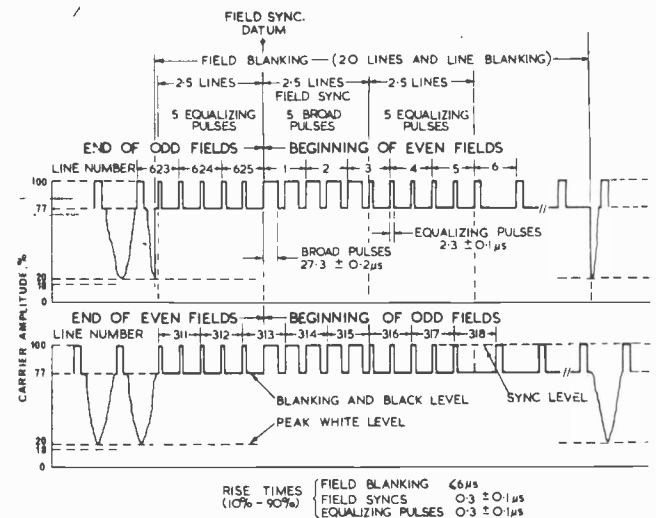


Fig. 3. BBC 625-line television signals. (a) One line of signal showing sync pulses. These keep the line scan in step with that at the transmitter, while the picture signal causes the deflected scanning spot on the face of the picture tube to change in brightness at a rate determined by the detail of the transmitted picture and by an amount governed by the brightness of the transmitted scene at any instant. (b) Pulses transmitted during the synchronising period at the end of one field scan and the start of the next (upper end of odd fields and beginning of even ones, and lower end of even fields and beginning of odd ones). The pulses provide correct interlacing while keeping the line timebase in sync during the field synchronising period (see text).



form a ramp whose phase is compared with that of the line sync pulses. Phase error results in a potential at the top of R78 which, after being filtered by C78/C79/R82 to remove pulse residual, is applied to the line oscillator. As this is a VCO, frequency correction and hence line synchronisation are achieved.

From the end of one field scan to the start of the next one, five narrow equalising pulses are followed by five broad field sync pulses and then by another five equalising pulses. The width and spacing of the pulses keep the line synchronised during the field sync period, while the equalising pulses ensure equal blanking on both even and odd fields, and also identify the two fields for accurate interlacing by cutting off the picture half way through a line at the end of odd fields and starting it after a line is half over at the beginning of even fields, as shown in Fig. 3 (b).

It is worth noticing that test signals and certain teletext data are transmitted on blank lines — the latter at a bit rate of 7 megabits per second. The 1.55 and 5.8 μ s front and back porches to the line sync pulses provide time for the line retrace, and it is the 5.8 μ s porch which carries colour burst signal.

The positive-going field sync pulses at VT14 collector are integrated by C99/R124 and applied to VT18 base through W18. The integration builds up a composite pulse for triggering the field retrace and attenuates line pulses.

Tube Biasing and Video Feed

During normal working the tube grid is held at chassis potential by W17. When the set is switched off W17 is reverse-biased and the charge held by C96 drives the grid negative, thereby suppressing the beam, while the supply voltages collapse.

Beaming current cut-off is set by R105 (brightness control) which merely adjusts the tube cathode potential. Video signal from VT7 collector is also applied to the cathode, and as the signal is negative-going the beam current increases with increasing picture brightness. Beam cut-off or black-level is set by the brightness control so that the sync pulses drive the tube below black.

Sound Channel

Intercarrier signal from L10 is fed to IC2 which incorporates a 6MHz limiting amplifier; quadrature coincidence detector tuned by L11; voltage-controlled attenuator operated by the volume control R54 and an audio preamplifier for driving the class B push-pull output transistors VT9/VT12 via driver VT8. The bases of the output transistors are driven together from VT8 collector, which is possible because VT9 is NPN and VT12 PNP (a complementary pair). Quiescent current is set by R59 at 8mA. Negative feedback is from the emitters of the output pair via R57 to VT8 base. Since the mains supply is isolated by transformer T2 it is possible to use a headphone set or earphone connected to jack J1.

For those not familiar with the quadrature FM detector the following brief description may help. After passing through the limiting amplifier chain, the intercarrier signal is changed to squarewave and the signal fed two ways. one way to a synchronous detector and

the other way to a 90-degree phase shift circuit and thence to the synchronous detector. The synchronous or coincidence detector combines the two inputs vectorially so that the output consists of the vector sum which, relative to the fixed 90-degree phase shift, changes with the FM deviation. The result is a variable width squarewave (pulse width modulation) which, after integration, yields the audio signal.

Power Supplies

The receiver can be operated from a 12V car battery or the mains supply. On mains, isolation is provided by transformer T2 and full-wave rectification by W8/W9, with C70 the reservoir. The supply is fed to the emitter of series regulator VT10. VT13 is the error amplifier which compares a ratio of the collector output voltage with a reference potential provided by zener W5. Starting current is provided by R66 and the base potentiometer R69 sets the output voltage for the correct value of EHT voltage. Stabilisation is effective over a mains input of 220-264V. The high V_{be} rating of VT10 provides automatic protection against reversed battery polarity.

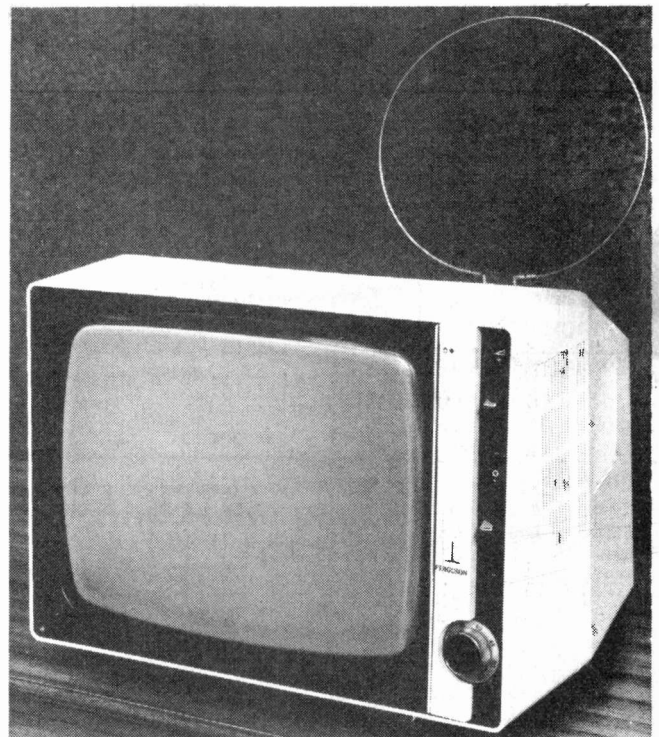
Final Points

Finally, one or two minor points: SP1 at VT7 collector is a spark gap which liberates energy in the event of a flashover inside the tube, directing current away from VT7 collector. The tube is a quick-heat type whose heater is energised from the 11.3V line and one which is happy with a relatively low focus electrode voltage.

Acknowledgement

I would like to thank Thorn Consumer Electronics and Mr. R. V. Arnaboldi and Mr. D. A. Pike of this Company for permission to use the circuit of the 1690-1691 chassis in this article.

ETI



DIODES/ZENERS				SOCKETS/BRIDGES				TRANSISTORS, LEDS, etc.				
1N914	100v	10mA	.05	8-pin	pcb	.20	ww	.35	2N2222	NPN (2N2222 Plastic)	.10	.15
1N4005	600v	1A	.08	14-pin	pcb	.20	ww	.40	2N2907	PNP		.15
1N4007	1000v	1A	.15	16-pin	pcb	.20	ww	.40	2N3906	PNP (Plastic - Unmarked)		.10
1N4148	75v	10mA	.05	18-pin	pcb	.25	ww	.75	2N3904	NPN (Plastic - Unmarked)		.10
1N4733	5.1v	1 W Zener	.25	22-pin	pcb	.35	ww	.95	2N3054	NPN		.35
1N753A	6.2v	500 mW Zener	.25	24-pin	pcb	.35	ww	.95	2N3055	NPN 15A 60v		.50
1N758A	10v	"	.25	28-pin	pcb	.45	ww	1.25	T1P125	PNP Darlington		.35
1N759A	12v	"	.25	40-pin	pcb	.50	ww	1.25	LED Green, Red, Clear, Yellow			.15
1N5243	13v	"	.25	Molex pins .01	To-3 Sockets	.25			D.L.747	7 seg 5/8" High com-anode		1.95
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1N5245B	15v	"	.25	25 Amp Bridge	200-prv	1.95			MAN3610	7 seg com-anode (Orange)		1.25
									MAN82A	7 seg com-anode (Yellow)		1.25
									MAN74A	7 seg com-cathode (Red)		1.50
									FND359	7 seg com-cathode (Red)		1.25

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

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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
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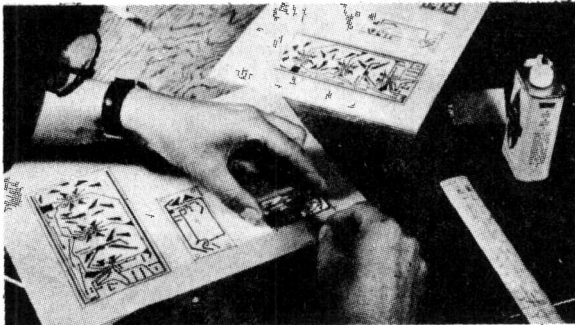
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HOW IT WORKS



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!

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	Clock B	Dec 77
003	Race Track Game	Jan 78
	Hammer Throw	Jan 78
	Freezer Alarm	Dec 77
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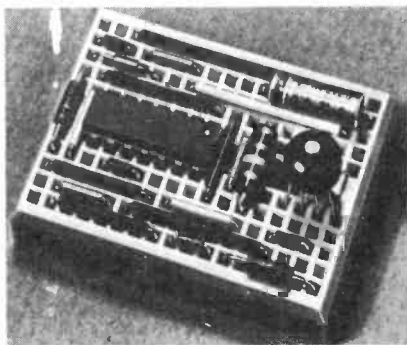
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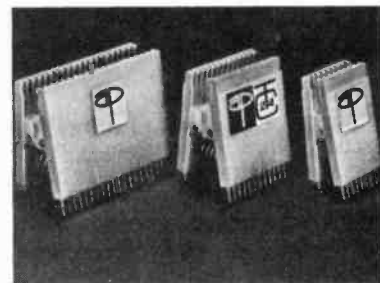
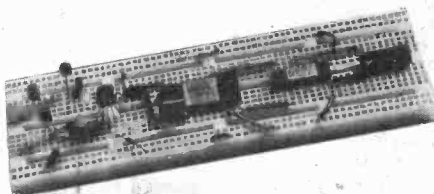
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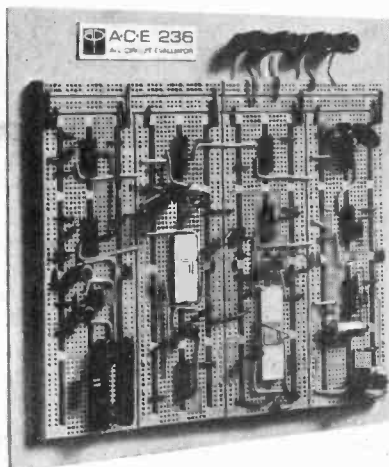
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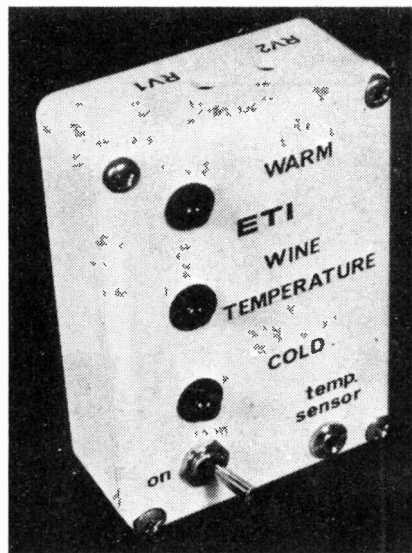
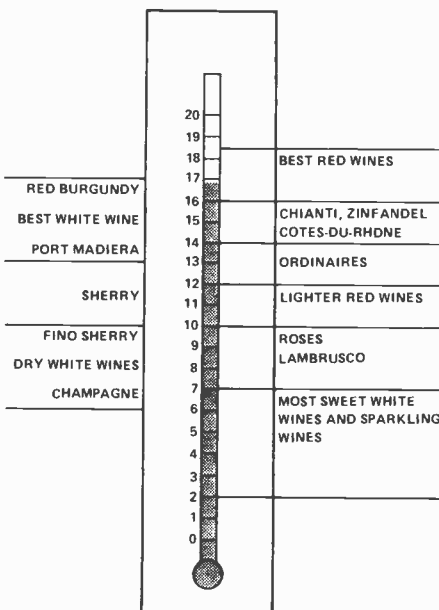
SEE LEKTROKIT ON STANDS D8 AND D9 AT BREADBOARD '78!

WINE TEMPERATURE METER

Ensure your wine is at the correct temperature with this little idea from our project team

WINE, WOMEN AND SNOG — no not another misprint but ETI's updated version of that phrase that so aptly describes that which a young man's fancy turns to in spring, or any other time of year for that matter. We at ETI can't do much about the provision of the above items but this project will at least ensure that when you get your hands on one of them it will be in perfect condition. Before going any further let's make it clear that its the wine we're talking about in this connection.

In use the wine temperature meter's sensor is clipped to the plunk of your choice and the condition of the booze, with regard to temperature, read off from the three LEDs on the meter's front panel. To set up the instrument consult our table showing the range of temperatures considered acceptable



Above, the complete unit while below the sensor, a bicycle clip painted black with the sensor epoxied to it.

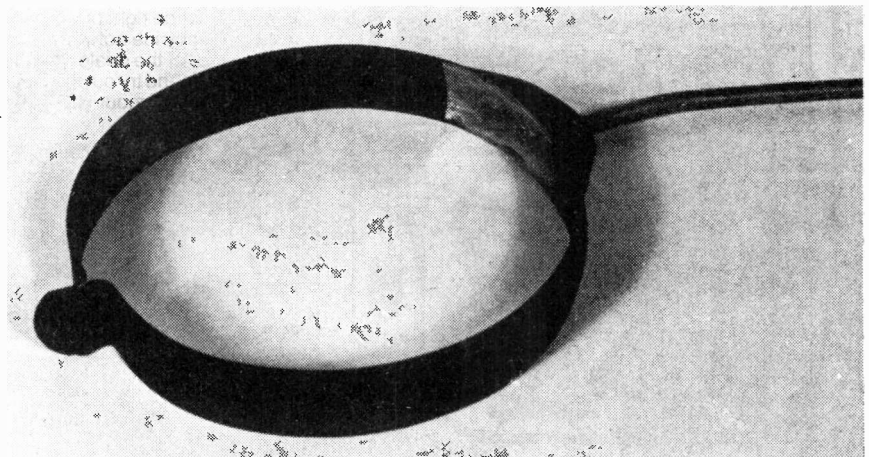
for the various types of wines. Turn RV2 fully anticlockwise and bring the sensor to a temperature that is in the middle of the desired range. Adjust RV1 until the centre LED just lights

Next lower the temperature of the sensor until it is at the lower temperature limit. Adjust RV2 until the lower LED is just extinguished.

Construction of the project is quite straightforward. Assemble all the components according to the overlay shown. Space is at a premium if the case chosen for our prototype is used so keep everything tidy.

Our sensor was made from a bicycle clip. The thermistor was epoxied to the clip — we smeared a small amount of silicon grease on the clip before mounting the sensor — this provides a good thermal contact. We coated the sensor in a layer of black paint when it was complete leaving the area under the sensor as bare metal.

Insert the battery and start getting your grapes as they should be enjoyed.



HOW IT WORKS

The project is based on the TCA965 window discriminator IC. This device can be used in a number of different modes, the one selected for this application allows the potentiometers RV1 and RV2 to set up a "window height" and "window width" respectively.

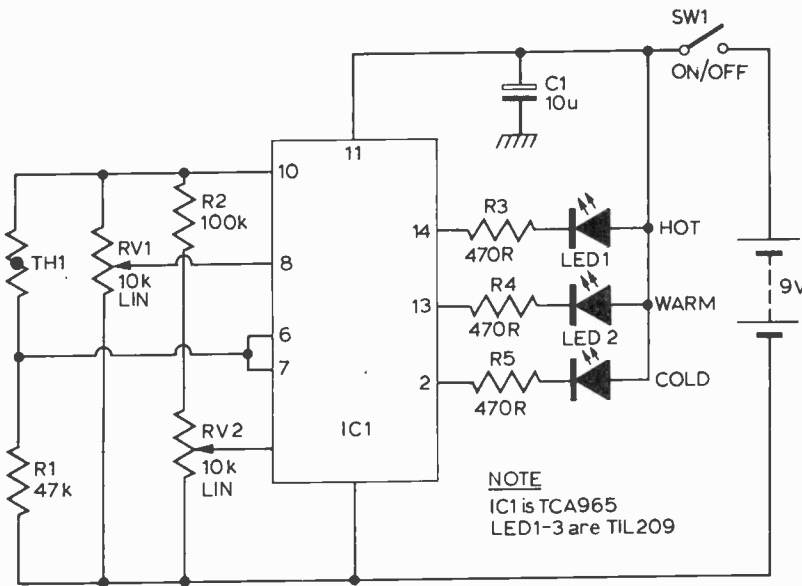
R1 and thermistor TH1 for a potential divider connected across the supply lines. The value of R1 is chosen such that at ambient temperature the voltage at the junction of these two components will be approximately half supply.

As the temperature of the sensor changes so the voltage will change and it is the temperature dependent voltage that is input to IC1.

RV1 will set the point which corresponds to the centre voltage of a window the width of which is set by RV2. The switching points of the IC feature a Schmitt characteristic with low hysteresis.

The outputs of IC1 indicate whether the input voltage is within the window or outside by virtue of being either too high or too low..

The outputs of IC1 are all open collectors capable of providing up to 50mA. In our circuit however they are only required to drive a LED via a current limiting resistor.



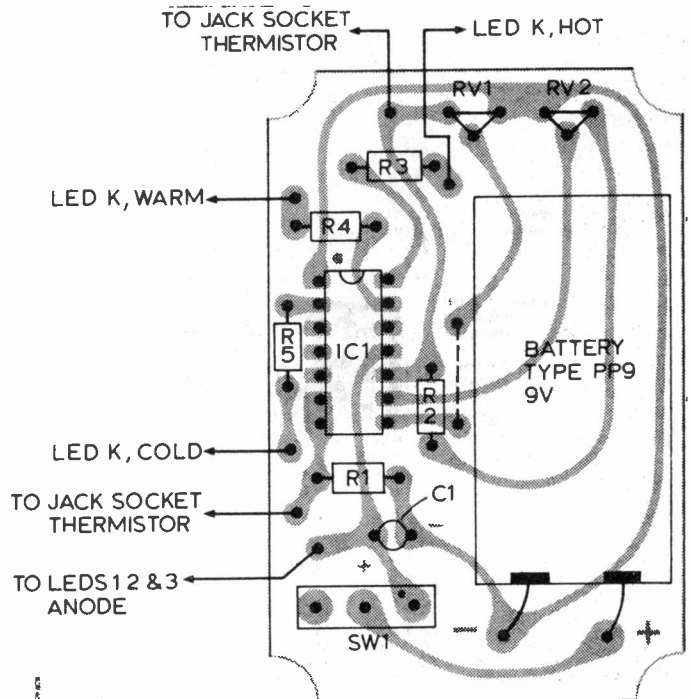
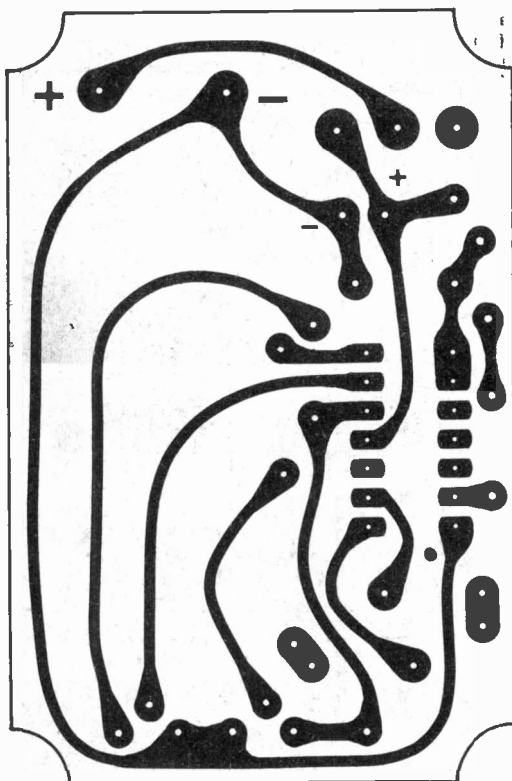
NOTE
IC1 is TCA965
LED1-3 are TIL209

Circuit diagram of the wine temperature meter.

BUYLINES

All the components for this project should be available from most local shops — no problems.

Foil pattern of the wine temperature meter.



PARTS LIST

RESISTORS

R1 47k
R2 100k
R3, 4, 5 470R

POTENTIOMETERS

RV1, 2 10k sub. min. preset

CAPACITORS

C1 10u 10V tantalum

SEMICONDUCTORS

IC1 TCA965
LEDs1-3 TIL209

SWITCH

SW1 SPDT

MISCELLANEOUS

PCB as pattern, Vero potting box, 2.5mm jack socket, battery wire, wire etc.

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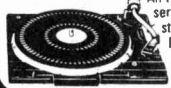
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0.9-0.9	500 500	207	2.35	.55
0.8-9, 0.8-9	1A 1A	208	3.50	.55
0.15-0.15	200 200	236	1.95	.40
0.20-0.20	300 300	214	2.35	.70
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0.15-20, 0.15-20	1A 1A	206	4.20	.85
0.15-27, 0.15-27	500 500	203	3.65	.70
0.15-27, 0.15-27	1A 1A	204	4.75	.85

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6.0	107	14.95	1.50
8.0	108	15.75	1.50
10.0	109	20.50	2.00

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Amps	Ref. No.	Price £	P&P
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1.0	126	4.65	.85
2.0	127	6.50	1.00
3.0	125	9.15	1.00
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5.0	40	11.80	1.30
6.0	120	14.75	1.40

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2.0	3	4.80	.85
3.0	20	5.80	1.00
4.0	21	6.85	1.00
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6.0	117	9.50	1.00
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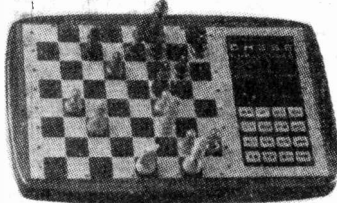
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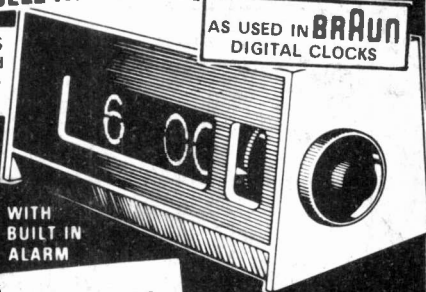
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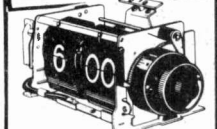
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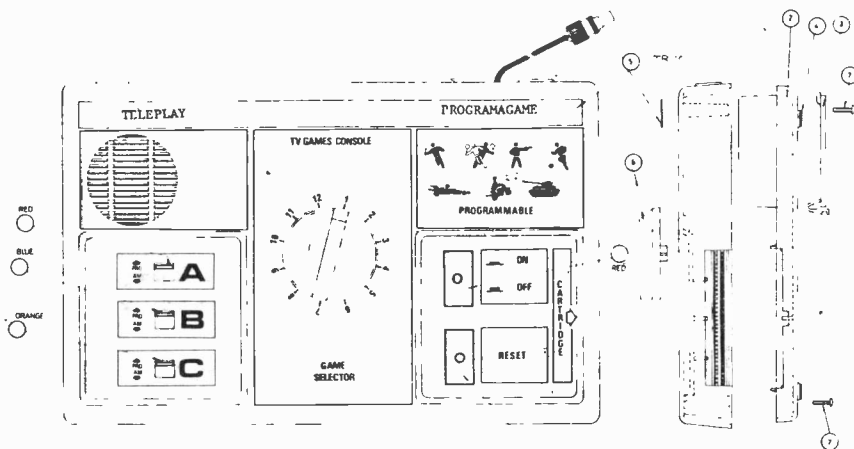
Video games have only been around for a short period of time. The original units were developed by the Magnavox Corporation in America, with these early units you could play any game — as long as it was Tennis! Besides being reasonably boring, they were built from dozens of separate logic devices and cost a small fortune.

The first major breakthrough, in cost and versatility, came from General Instruments — with their introduction of the AY-8500 game chip. The now famous (and obsolete) AY-8500, allowed you to play up to six games and also produced sound effects.

Since the days of the AY-8500 General Instruments have produced several other dedicated devices, allowing you to race a motorbike, command a tank and even drive a Formula One racing car (to name just a few). By continually introducing new and exciting products General Instruments have become the major T.V. game device manufacturer in the World.

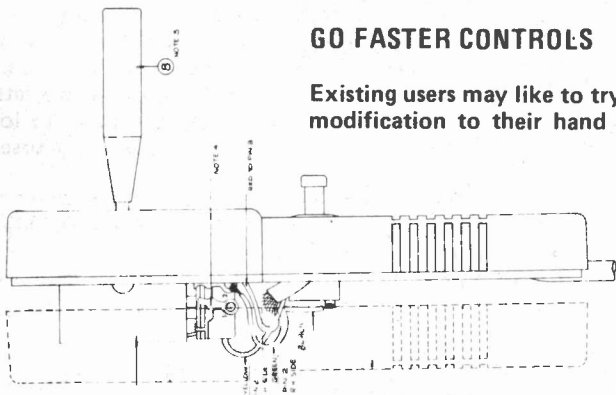
Every time a new game is launched the electronic magazines publish a D.I.Y. version, but you always need a new case and U.H.F. modulator. By the time you have paid for all the bits & pieces, the £10 chip has turned into a £30 project — and probably used up a lot of time.

Teleplay have developed the Programgame as the answer to the D.I.Y. enthusiasts need — for an inexpensive, easy to construct, up-to-the-moment, professional looking, full colour T.V. game system.



GO FASTER CONTROLS

Existing users may like to try this simple modification to their hand controllers.



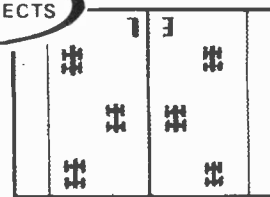
Remove the 220k resistor and 470p capacitor from each controller. Then set both joysticks to the bottom right position. Set the PRO/AM switch to give small bats, then adjust the cartridge preset until both bats are just on the bottom boundary.

This modification gives a much better feel to the controllers. You can also give the plastic sleeves a sharp tap, with a

blunt instrument (the wrong end of your screwdriver), to make them fit closer to the case - this also improves the feel of the controllers.

If you want to use the Road Race after making the modification, you will need to fit the two 470p capacitors inside the cartridge. They go between pins 10 & Earth and 14 & Earth.

REALISTIC
SOUND EFFECTS

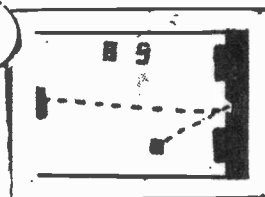


ROAD
RACE

£12.90

Road race has two different games inside it. The first is a two player version, with a switchable handicap on the left-hand track. The second game is you against the machine, see if you can score 15 laps without crashing! Uses the normal Joystick.

NEW



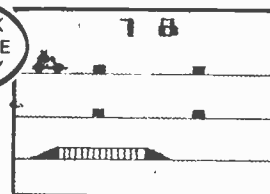
WIPEOUT
SIX GAMES

£13.90

The latest game from General Instruments, brought to you by Teleplay first! Based on the popular arcade game Breakout, the cartridge has 6 games built into it. On each of the games there are 3 variables - bat size, ball size and ball speed. The device type is an AY-3-8606.

The games are single and double Wipeout, single and double Breakout, two player Wipeout with barrier, and solo Wipeout (not the same as single).

EX-STOCK
IMMEDIATE
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Switches.

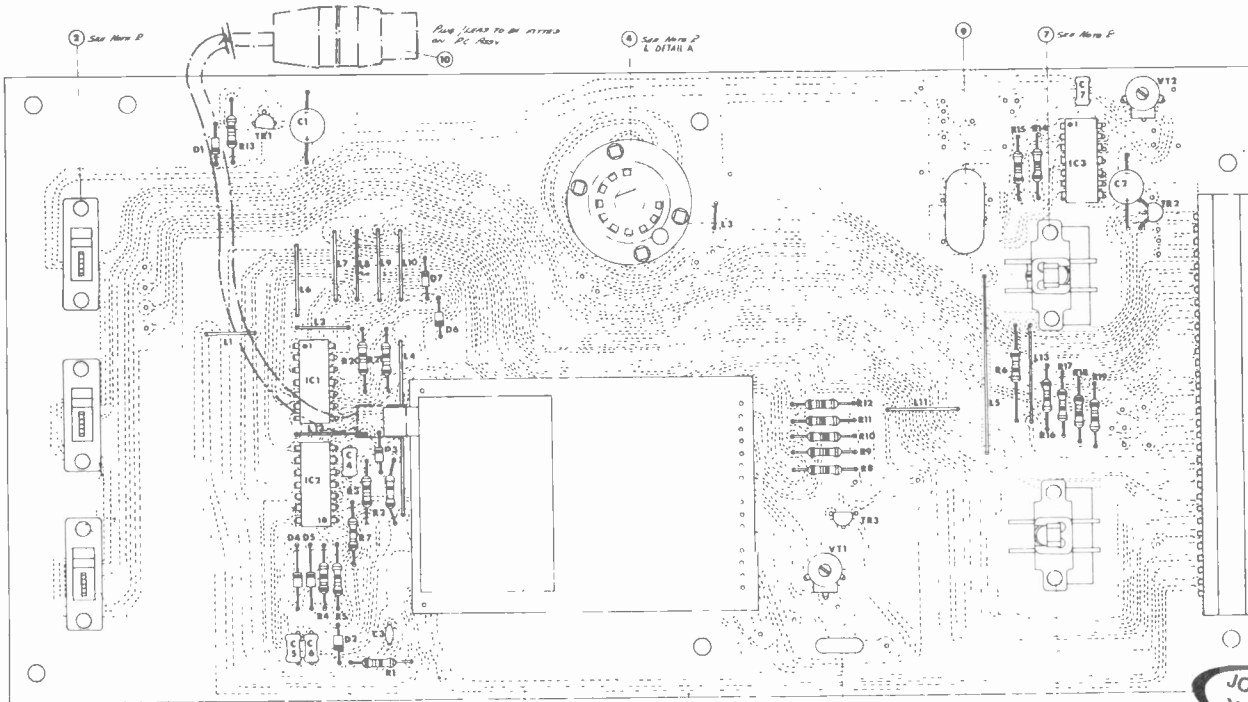


TANK
BATTLE

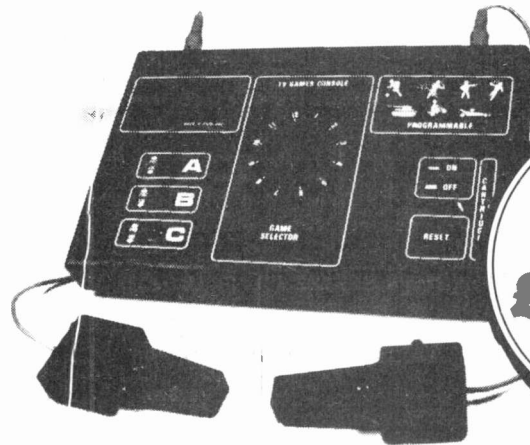
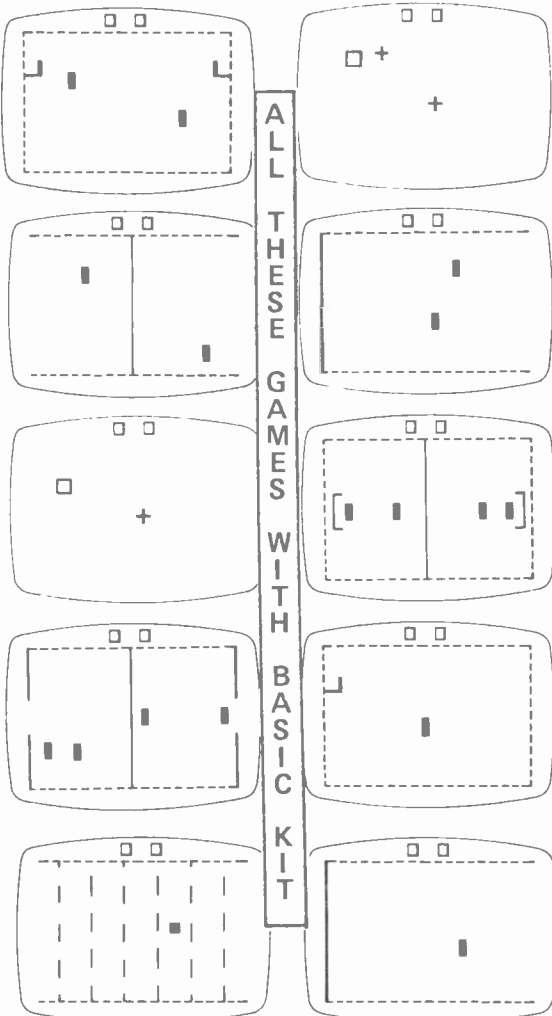
£13.90*

Complete with special hand controls but without the Tank chip. Due to extreme supply difficulties we are unable to provide any Tank chips at present. If you have one of these AY-3-8710 in your workshop why not take advantage of this £6 off offer.

COLOUR PROGRAMAGAME



On the left is the main circuit for the console. All the colour encoder circuitry is inside the large square in the centre, which is a ready made module. The various game cartridges slot into the 32 way connector on the right hand side. All the switches are mounted on the PCB itself.



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impedance for the motor, thirdly a delayed action can be switched in and out so that the controlled inertia of a heavy train can be simulated together with brake levers; and lastly it's short-circuitproof by virtue of heavy duty transistors and an overload trip. The last is indeed essential because short-circuits abound on the model railroad!

Though the circuit I've shown uses two darlington transistors, commercial versions are available, particularly from the USA, using op amps, SCR control or pulse width modulation. Even the renowned Heathkit has introduced a version. The most important feature is probably that superimposed pulse, for if it's too small in amplitude or too high in frequency, it is not effective; but if it goes too far in the opposite direction, the resulting buzz or rattle from the motor becomes objectionable. Anyway, you electronic fans with a dusty train set in your attic, dig it out, build a momentum-pulse-throttle and you just might pick-up an extra hobby!

In terms of current rating, the power pack shown should be capable of about 2A5 at 12V. This is adequate for any HO scale models, which scale 1:87, even with double heading locomotives. As you'd anticipate, the current requirements decrease with scale size—the second most popular scale is 1:160 (n for Nine mm, which is the track width) scale. Going up as size to O scale (1:48) many motors will need the full 2A5. By the way, in case you home computer builders are thinking "why waste money on electronics for toys" some of these "toy" locomotives retail for over £500 apiece and lately have been appreciating in value at well over 20%.

Signals

A natural for digital IC application is signaling. Model signals in two (red and green) or three aspect (red, yellow, green) with operating miniature 12V 60mA lamps are available. Until recently, relays were widely used by modellers to operate these lamps in controlled sequence and often automatically disconnected a section of track ahead of a red signal for automatic train control. The relays used were typically low resistance coils in series with the power supply to the track. When the locomotive entered a particular track section, the relay contacts closed. All model railroads use track sections from 2 to 20 feet long insulated from each other and switchable to alternate power packs. This facilitates the operation of multiple trains.

Complete model railroads still exist using these series relays for automatic control and signalling; but they're a maintenance nightmare for their intermittently proud owners. Up to date techniques use TTL gates driving red, yellow and green LED's for signals.

Relay driver ICs can be added to drive the small 12 V signal lamps if preferred and also to operate good solid 12 V relays for automatic stops and starts.

The interface between train and TTL is a little more tricky; you've noticed, of course, that the track has only two rails which are required to conduct power (in either direction) to the locomotive. The requirement to detect locomotive presence led a few years back to a widely used detector circuit known as a "Twin-T".

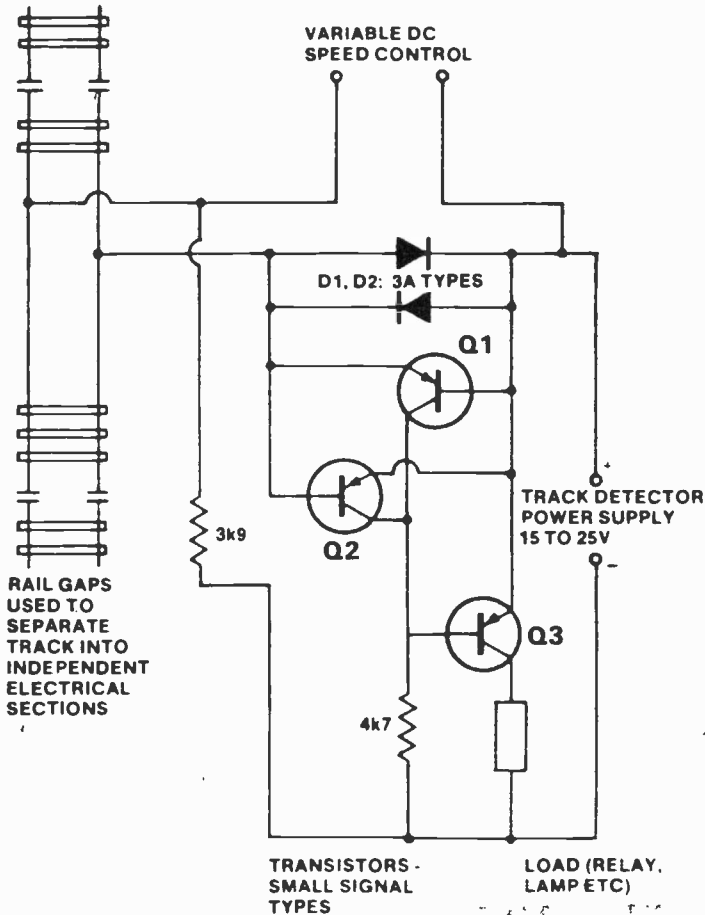
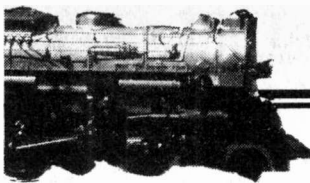


Fig. 2. Widely used "Twin T" track detector circuit. Q3's load de-energises whenever a resistance appears across track in the section being detected, regardless of whether power is connected to that track section. Consequently presence of any train or item of rolling stock can be sensed remotely.

The simple circuit is shown in Fig. 2. The circuit detects resistance between the rails as high as 50k, but is insensitive to the connection of the power supply in the circuit, so it will respond only to the presence of a locomotive motor or any rolling stock with a 10k to 4.7k resistor wired between its wheels. Other less subtle interfaces are magnetic reed switches between the track, triggered by disc magnets under rolling stock—ideal for JK flip-flop operations, or opto-electronics, where ambient light can be interrupted by the movement of rolling stock to trigger or detrigger a light activated SCR, for example.

With a light activated system, the light source and the opto detector must be angled to the track to avoid gaps between moving rolling stock causing light modulation.

All three track detection systems are, of course, suitable input interface for microprocessor control of signals . . . and track voltage, polarity, etc.

Turnout Control

Turnouts, (switches, or points) control train routing. Remote control of these, on the models as on the prototype has nearly always been electric. The usual method is the use of a solenoid motor (Fig. 5). A soft iron armature can be moved into either of two high flux

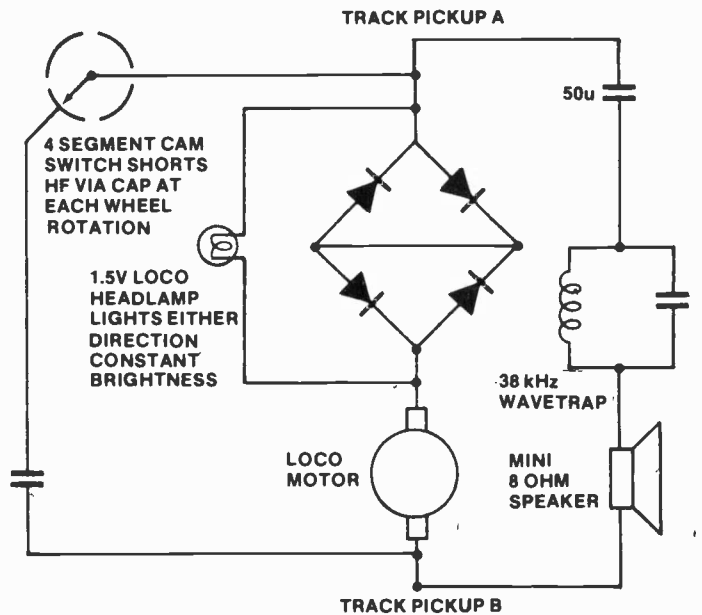


Fig. 3. These components, mounted in locomotive tender reproduces audio signals superimposed on DC motor voltage. Cam switch signals synchronization of "chuff" sound to trackside audio generator.

copper wound coils, depending on which is energised — using 16 Volt AC or DC. The armature is linked mechanically to the movable track section to control the train's alternate paths. These coils of necessity are about 2 to 4 ohms resistance and hence can draw a 4 A: if left connected to the supply for more than a second or so, the 50 W of heat show—rapidly. So recently the electronically minded modeller adopted capacitor discharge.

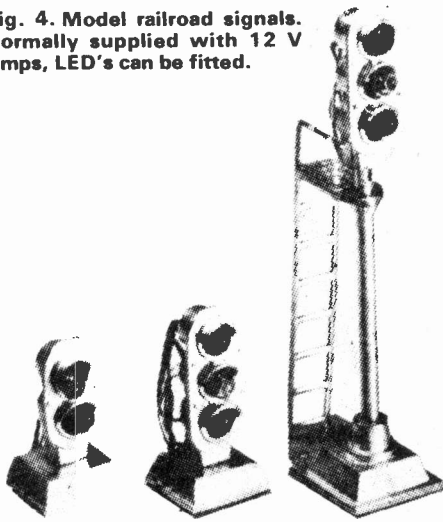
Typically a 220 u capacitor, charged to 25 V stores enough energy to operate a couple of the low resistance coils and as you can see from the circuit, there's no fire hazard if the power is left on. Also a small transformer can be used. Also shown is a method of discharging the capacitor into the coil via an SCR, which permits the controlling push button to carry only the low SCR gate current, instead of a contact-blowing multi-ampere current.

Again, this basic control circuit is adaptable to TTL control.

Sound

Now you hi-fi fans know it's impossible to reproduce the sound of a gigantic steam locomotive without a 100 W amp and a 4 cubic foot bass reflex enclosure. Except those model railroad nuts don't believe you! Quite expensive, at about US \$350, is a Pacific Fast Mail sound unit that transmits sound and motor power through just those two rails. The sound is synchronized to the piston position, that is for a two cylinder steam engine there are four "chuffs" per driver wheel revolution. Plus bell sound and the required wailing steam chime can also be sent from the trackside to be nicely reproduced in a miniature speaker located in the locomotive tender.

Fig. 4. Model railroad signals. Normally supplied with 12 V lamps, LED's can be fitted.



The PFM unit synchronizes the "chuff" sounds by transmitting a 2 V 38 kHz (approx.) signal superimposed on the DC motor voltage going to the track. The DC voltage source (a transistorized circuit, which is a simplified version of the circuit shown in Fig. 1) has a low resistance choke in series with its output: this prevents the 38 kHz and the audio tones from disappearing into the speed circuitry. When the 38 kHz reaches the locomotive, it is intermittently shorted out in a capacitor (see Fig. 3). The capacitor is grounded four times per drive wheel revolution via a phosphor-bronze contact, which rubs on the inside of a drive wheel equipped with insulated quarter sections. As the 38 kHz signal shorts out, a relay operates in the track-side unit, sending out transistorized hiss to the locomotive-borne speaker. Being highly inductive, the locomotive motor bypasses neither the 38 kHz nor hiss—nor bell nor steam chime sounds, all of which are solid-state generated in the PFM box with full operator control. And even though the speaker is less than 2 inches in diameter, the sound is very effective.

Another electronic gimmick in the PFM system is the bridge rectifier of Fig. 3. There's a constant voltage drop of 1V4 across the bridge, since it's in series with the motor—regardless of the motor/voltage polarity. Connect a miniature 1V5 headlamp across the bridge and presto—constant brightness, regardless of motor speed.

A California based firm — Modeltronics, produces sound systems that are completely contained in the model — also synchronized for "chuff". The supply voltage for the noise generator and miniature amplifier is derived from the track voltage much as the PFM "constant lighting section". Of course, the Modeltronics system does not offer bell or chime — yet.

LED Hazard Flashers

Pop a 3mm red or yellow LED into the cabin roof of a model diesel, drive it from an internal LM3909 flasher integrated circuit, oscillating at 0.3 Hz, powered up from 0V5-3V, and you've duplicated real life on the "Atchafalaya Topeka and the Santa Fe".

Grade crossing flashers in model form are available ready made, with miniature 12 V lamps, just like signals. To flash, take on 555 IC timer, put one pair of lamps from IC output to + rail, another pair from output to-rail, apply 12 V, time at 20/minute and grade flashers are in business.

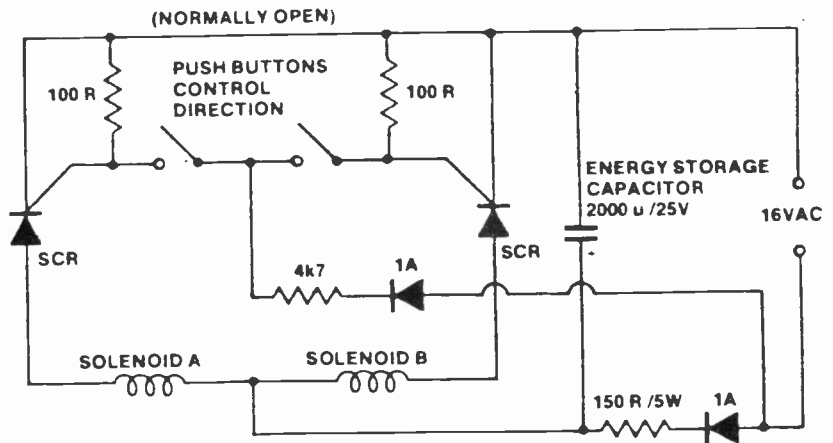


Fig. 5. Capacitor discharge system enables solenoids to be thrown with small average energy. System also prevents solenoid burnup if accidentally left powered-up. SCR switch control enables small current push buttons to switch heavy current. The SCR's automatically switch off when capacitor stored charge zeroes.

Lighting

Whole passenger trains can be lit up using a super-sonic generator at around 25-40 kHz. This can be fairly easily constructed using a 10 W audio power amplifier with the conventional negative feedback rephased to positive. Connected in parallel with the train motor power, with a blocking choke between the two, constant lighting can give a superb visual effect with artificial twilight on a layout. Switch off the generator — and the lights go out. Each train group of lights uses a 220nF capacitor in series to block the otherwise additive lighting power from the DC motor voltage.

Radio Control and Carrier Control

As a purely personal observation, I feel the next and imminent step in electronics with model railroads is radio control. At least one experimental, but practical circuit has already been published. Taken to the ultimate, needed are very low current motors powered by rechargeable NiCd batteries together with the radio receiver, variable speed and direction controls, and sound generator circuit plus amplifier. Of necessity the concept requires extreme miniaturization because for HO scale (the most widely used size), the space available for everything is hardly more than 5 or 6 cubic inches. The entire receiver and motor drive circuit can easily be derived from model aircraft RC designs, particularly if the new Signetics NE544 motor/servo driver chip is employed. On-board sound — for example a diesel horn sound, can use a 556 IC in the self-oscillating mode generating two tones, each around 250 Hz, amplified by an LM380 audio chip.

Individual function control is practical using 555 tone generators in the transmitter with phase lock loop decoders in the receiver. The advantage of this type of control is that the modeller has become free of the power-to-the-rails restriction.

In summary, I hope this overview shows how another hobby can adapt techniques of electronics in order to add to the fun. Maybe I've tempted you to pop round to your nearest Model Railroad emporium.

ETI

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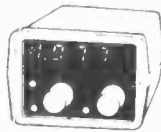
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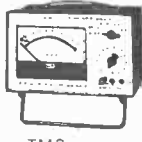
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SOUND~TO~LIGHT UNIT

Designed by Richard Bekker of Powertran, especially for ETI, this superb light show can act as strobe, linear five channel sound-to-light or random switching unit and can be digitally controlled!

OVER THE YEARS several lighting control units have appeared, some performing switching and others performing modulation of the light output according to the musical input. The Chromatheque combines both of these functions in a most original way. It is capable of controlling five banks of lamps — of up to 500 watts each in either analogue or digital mode. By being a five channel controller not only is the sound to light modulation made more exciting than three or four channel systems by virtue of the extra colours, but linear and random sequencing between the channels gives a tantalizing effect which could not occur with a smaller number of channels.

Singled Out

Being conceived as a single board design wiring is minimal and construction very simple. All components are cheap, readily available items but a complete kit is being made available by Powertran of Andover, including metalwork.

Modes

In the analogue mode the audio signal first passes through an amplifier stage with automatic gain control. This ensures that sound to light modulation occurs smoothly even when the overall sound level changes. After this the signal is split into active filter bands the outputs of which are used to phase control triacs which determine the current in the lamps.

By doing this channel 1 (red) responds to the lowest frequencies varying the light in time with the bass notes in the music. Channel 5 (blue) responds to the highest frequencies. The other 3 channels handle the intermediate frequency bands. separate light level control is provided for each channel to allow for intensity adjustment to personal taste to suit different types of music.

Fingers and Digits

In the digital mode TTL integrated circuits are used to

selectively switch either all the lamps in strobe fashion or alternatively one lamp at a time either sequentially or randomly. The speed at which the switching is carried out is controlled either manually with a potentiometer on the front panel or automatically. In this case the switching rate increases with the level of the audio signal. This is particularly effective in the sequential or random switch positions — a crescendo sets the lights racing whilst they freeze when the music stops.

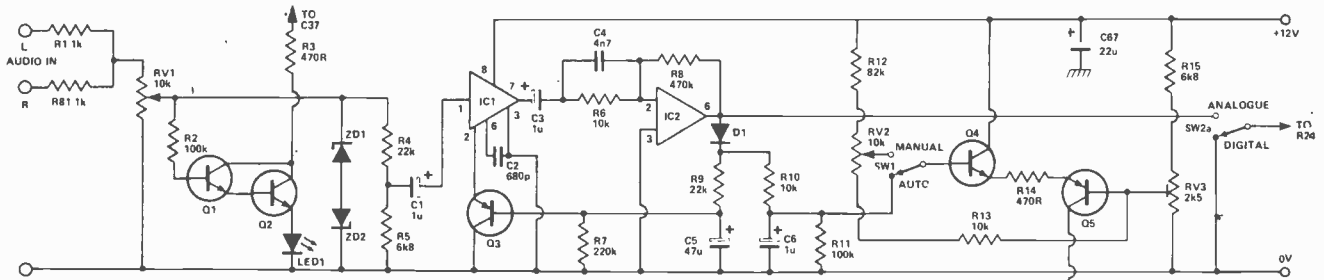
On music with a heavy beat the lights will step round one position on each beat.

Because of the light level controls, the lamps can be turned just partially on to suit the mood of the occasion.

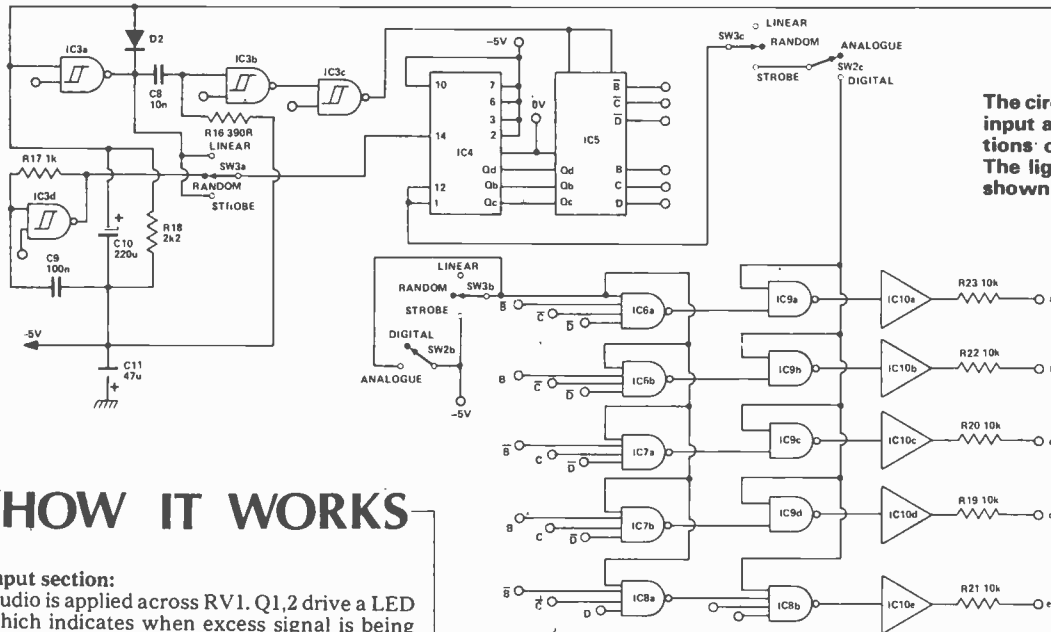
Construction

Start by assembling the board. This is entirely straightforward — just follow the overlay. All the potentiometers mount directly on the board though the switches are hardwired.





The circuit diagram for the audio input and digital switching sections of the lightshow circuit. The light drivers and filters are shown overleaf.



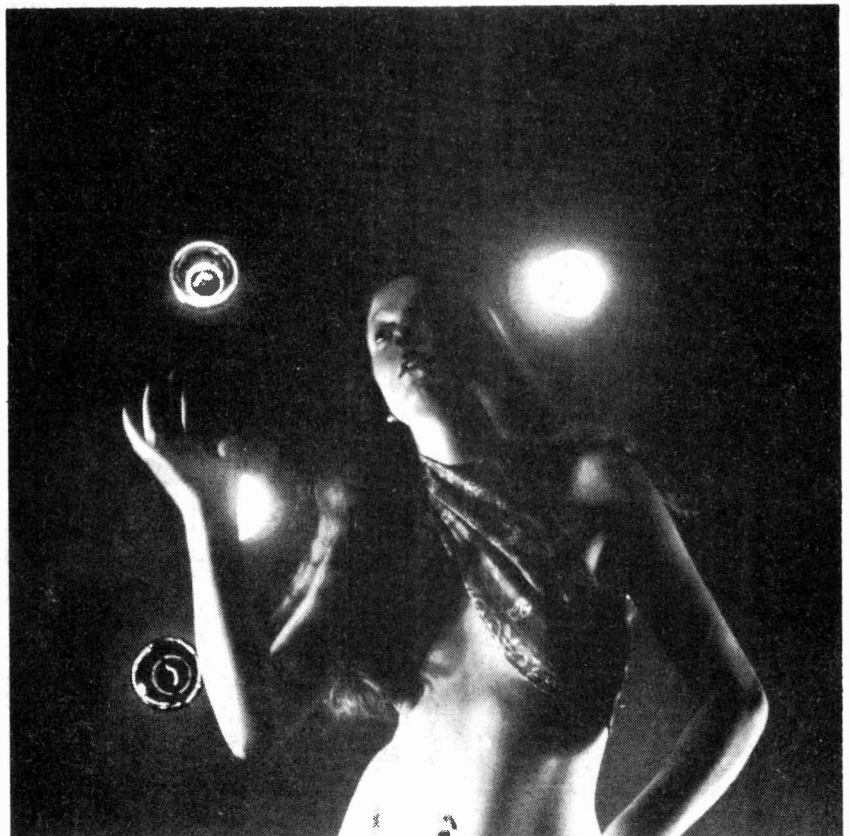
HOW IT WORKS

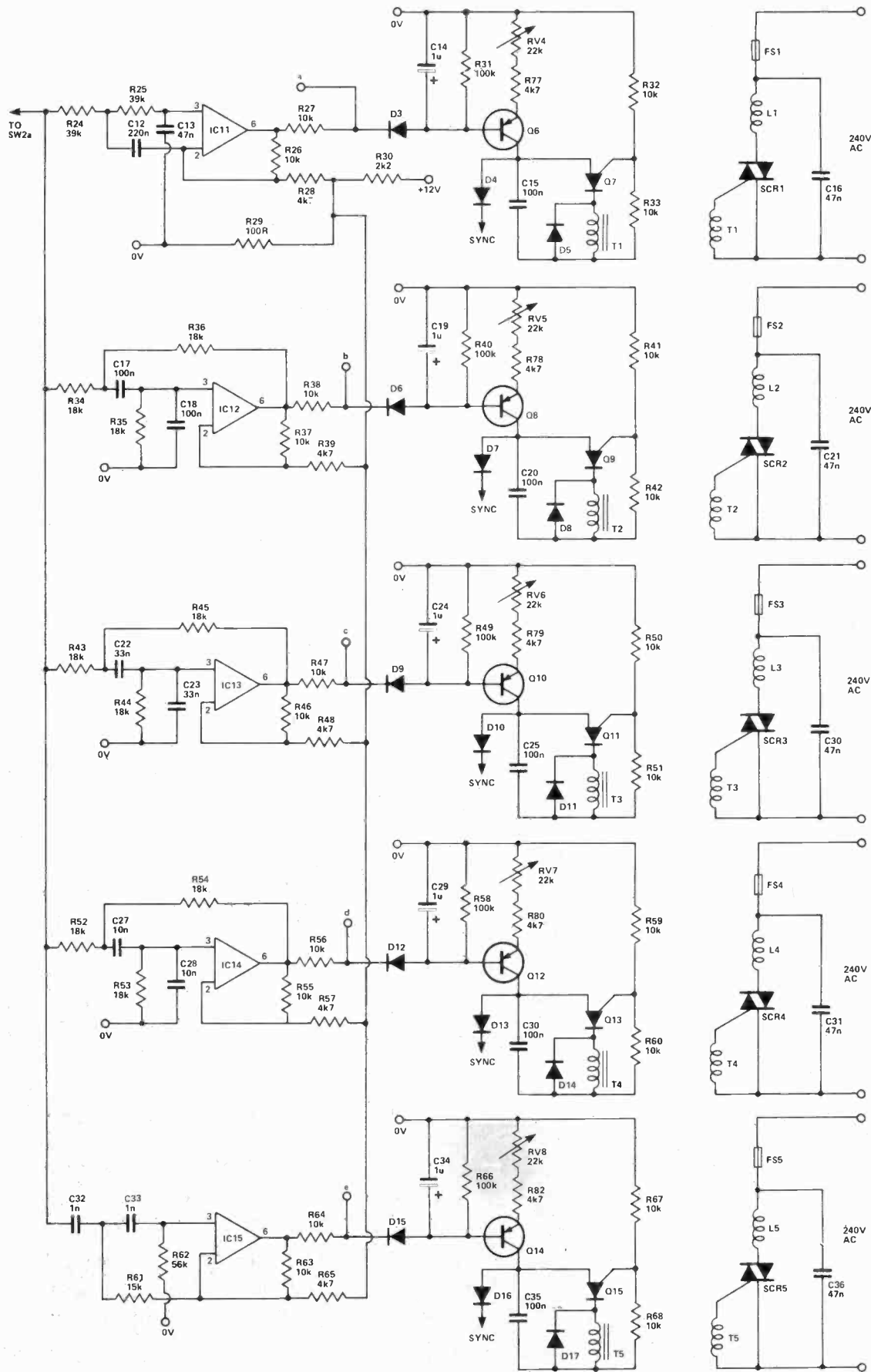
Input section:

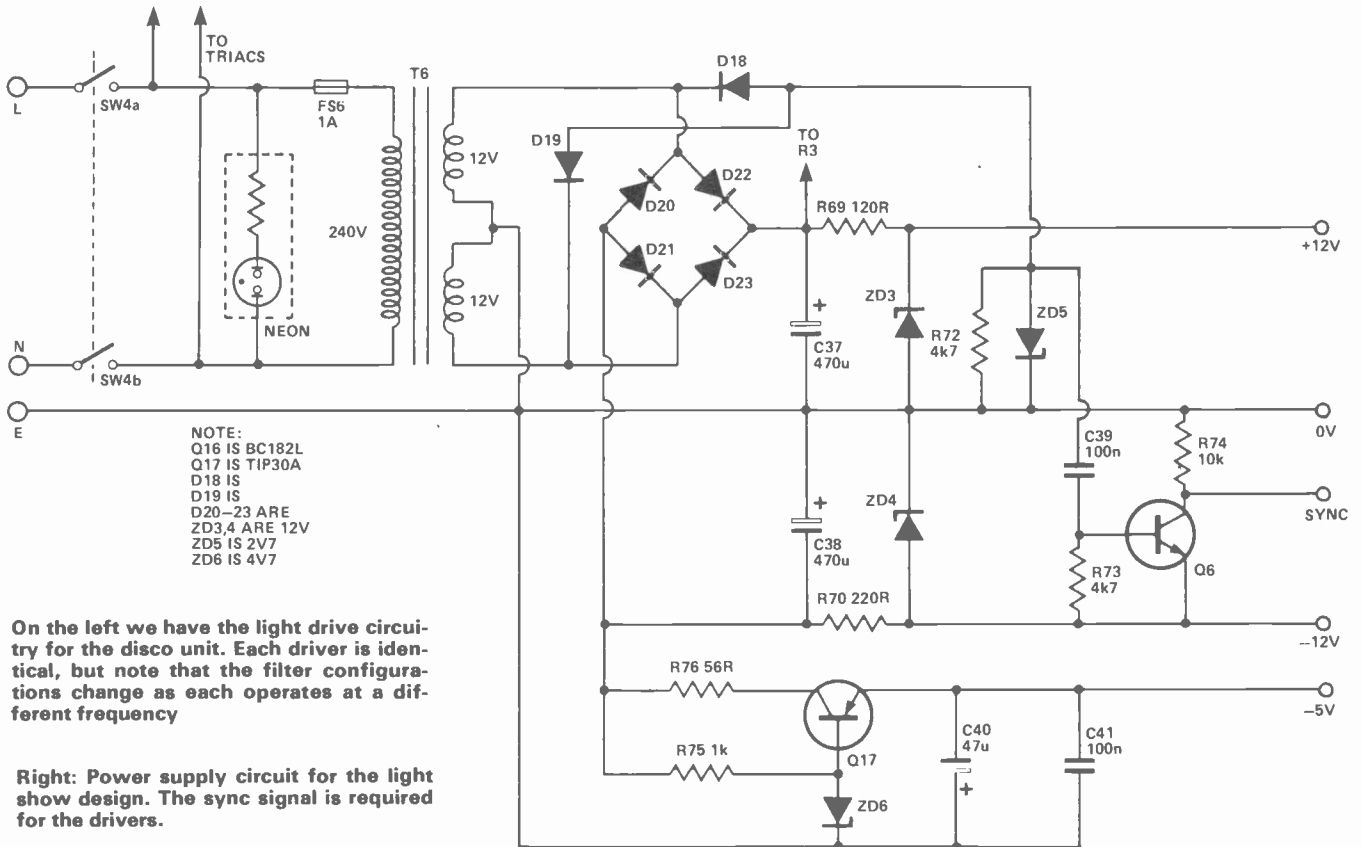
Audio is applied across RV1. Q1,2 drive a LED which indicates when excess signal is being taken off RV1. ZD1,2 clip the signal in cases of gross overload. IC1 is a variable attenuator, the output of which is amplified by IC2. This feeds a 'diode' pump' setting up a voltage on C5 which rises as the output increases. This voltage is used to control Q3 which in turn controls the attenuation of IC1.

Digital section:

IC3 is a block of 4 Schmitt triggers two of which are used to form oscillators. C9,R17 determine the speed of the fast oscillator and fast clock pulses are produced at pin 8. The slow oscillator rate is determined by the rate at which C10 is charged via Q5, the current through which is either varied by RV2 or else the signal on C6, depending on the position of S1. D2 is a germanium type for the benefit of its low turn-on voltage. In the linear sequencing or strobe mode the low speed clock is applied to IC4 which is a +2, +5 counter, the outputs of which are applied to decoding ICs 6,7,8 via 4 bit latch IC5. The outputs of IC6,7,8 are taken via gates in IC9 and half of IC8 to inverters in IC10 to provide negative turn voltages to the triac driver stages. In the linear mode only one of the inverter outputs a,b,c,d,e is negative at any instant whilst in the strobe mode all the outputs are at 0V. In the random mode the fast clock is applied to the counter, the output of which is sampled at a low rate by means of the slow clock being applied to IC5. C8 and two trigger sections of IC3 convert the slow clock into narrow pulses suitable for this sampling. As the two clocks are independent the sampling will be at a totally random point of the count by IC4 thereby making the lamp selection truly random.







HOW IT WORKS

Filter section:

The output of IC2 is taken to 5 active filters based round IC11-15. IC11 is the low pass filter, IC15 the high pass and IC12-14 band-pass. The cut-off and centre frequencies are 40 Hz, 120 Hz, 400 Hz, 1200 Hz, 4 KHz. R29,30 are used to bias the filters to give a small negative offset voltage at the outputs which are applied to the triac driving stages. This means that the series diodes are biased on and control of the lamp can start even when the signal level is very low thereby improving the smoothness of the modulation.

Triac drivers:

All 5 stages are identical so only the low frequency one will be considered. Signal from IC11 charges C4 via R27,D3. The voltage

across C4 causes Q6 to conduct and charge C15. When this reaches about 6 volts PUT Q7 suddenly conducts discharging C15 through transformer T1 generating a pulse to turn on the triac SCR1. At the zero voltage point of the 50 Hz mains cycle a sync. pulse is generated which discharges C15 via D4. For a given charging, current C15 will always reach 6 V at the same point in the mains cycle. We therefore have phase control which is dependent on the audio signal level and the setting of RV4. Phase control is used in preference to burst control because of its superiority in producing smooth flicker free modulation of the lamps. Filtering of the switching surges is performed, most effec-

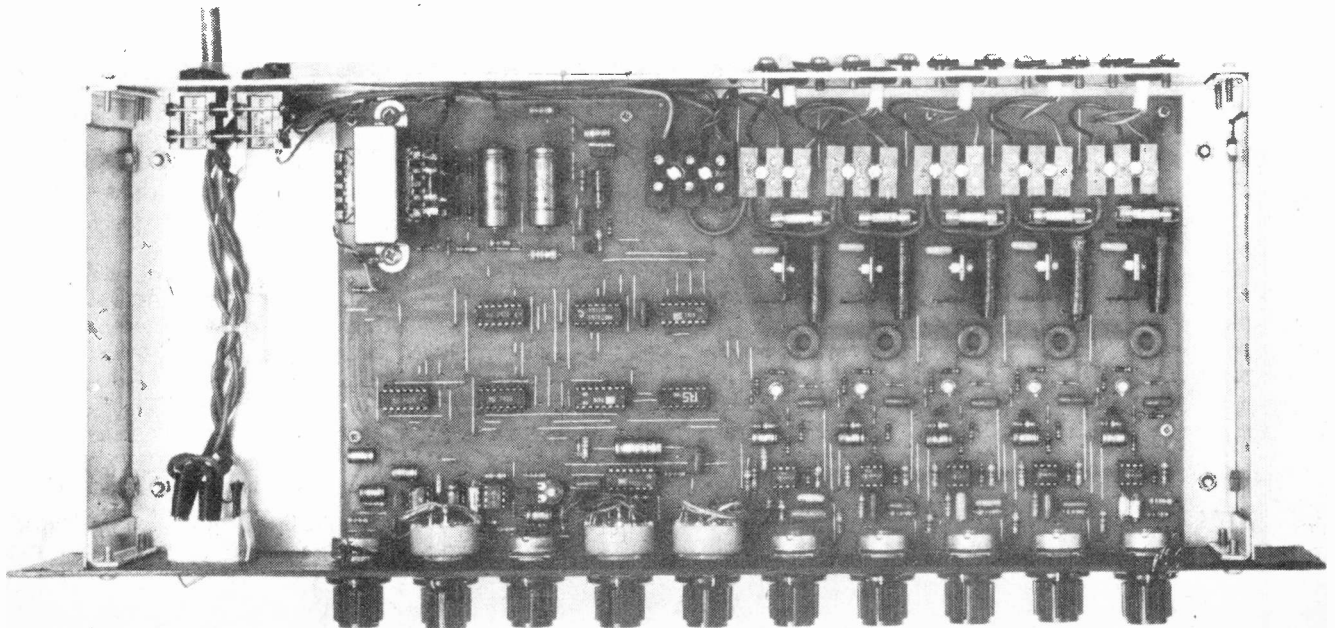
tively by C16,L1 and the RF interference generated is substantially less than that from a domestic light dimmer.

Syncing:

To generate the 100 Hz sync pulses the 12 V. AC output of T6 is full wave rectified by D18, 19 and without smoothing is applied to ZD5 across which is produced a spiky waveform. This is then applied via C39 to Q16 which is sufficiently turned on by the spikes to sink the charge on C15,C20 etc.

Power supply:

Highly stable voltages are unnecessary and the 12 V lines for the op. amps are taken off simple zener regulators whilst the TTL-5 V line is regulated by a single series transistor Q17.



PARTS LIST

RESISTORS 1/4W 5% except where stated

R1, 17, 71, 74, 81	1k
R2, 11, 31, 40, 49, 58, 66	100k
R3, 14	470R
R4, 9	22k
R5, 15	6k8
R6, 10, 13, 19-23, 26, 27, 32, 33, 37, 38, 41, 42, 46, 47, 50, 51, 55, 56, 59, 60, 63, 64, 67, 68, 73	10k
R7	220k
R8	470k
R12	82k
R16	390R
R18, 30	2k2
R24, 25	39k
R28, 39, 48, 57, 65, 72, 76-80	4k7
R29	100R
R34-36, 43-45, 52-54	18k
R61	15k
R62	56k
R69	120R 1/2W
R70	220R 1/2W
R75	56R 1W

POTENTIOMETERS

RV1	10k log " "
RV2	10k lin PCB mounting
RV3	2k5 preset " "
RV4-8	22k lin " "

CAPACITORS

C1, 3, 6, 14, 19, 24, 29, 34	1u 63V electrolytic
C2	680p polystyrene or ceramic
C4	4n7 polystyrene
C5, 11, 40	47u 10V electrolytic
C7	22u 25V electrolytic
C8, 27, 28	10n polycarbonate
C9, 15, 17, 18, 20, 25, 30, 35, 39, 41	100n polycarbonate
C10	220u 4V electrolytic
C12	220n polycarbonate
C13	47n polycarbonate
C16, 21, 26, 31, 36	47n 400V polycarbonate
C22, 23	33n polycarbonate
C32, 33	1n polystyrene
C37, 38	470u 25V electrolytic

SEMICONDUCTORS

Q1, 2, 4 16
Q3, 5, 6, 8, 10, 12, 14
Q7, 9, 11, 13, 15
Q17
SCR1-5
IC1
IC2, 11-15
IC3
IC4
IC5
IC6-8
IC9
IC10
D1, 3-19
D2
D20-23
ZD1, 2, 6
ZD3, 4
ZD5

SWITCHES

SW1-3	4p 3w adjustable stop rotary illuminated mains switch DPDT 10 Amp
SW4	

TRANSFORMERS

T1-5	FX3008 with 10 turns 35g for both windings
T6	240V to 15V-0-15V at 200mA

INDUCTORS

L1-5	FX1089 with 40 turns 25g
------	--------------------------

FUSES

F1-5	2A fast
F6	1A anti surge

MISCELLANEOUS

Two 1/4" mono jack sockets, 5 cooling clips, 13A mains cable, cable clamps, five 3 terminal 5A connector blocks, 3 terminal 10A connector block, fibre glass ready drilled PCB, metalwork to suit ten knobs, grommets, spacers, nuts, bolts etc.

BC182L
BC212L
BRY39
TIP30A
8A Triac
MC3340p
741
74132
7490
7475
7420
7400
7405
IN4148 or IN4151
OA95
IN4002
4V7 zener
12V zener
2V7 zener

Use 3" lengths of coloured wire for these. The switches supplied in Powertrain kits are of the adjustable stop variety. The tag on the stop plate goes in the hole stamped 2 for two way switches and the hole stamped 3 for the 3 way switch.

Mains transformer T6 is bolted onto the board and the 15 V windings connected to the board by means of short wire links from the tags down to the holes directly beneath them.

Pulse transformer T1-5 you wind yourself. Wrap round the ferrite rings 10 turns of 35g wire for both the primary and secondary. It doesn't matter which you call the start or the finish of the windings as the circuit operates with them either way round. The wire supplied in the kits is self fluxing polyurethane covered and can be soldered directly to the board.

Wind coils L1-5 with about 35 turns of 25g wire. A smear of glue on the windings will help them stay in place before

fitting and reduce buzzing when in use. The triacs are kept cool by means of a finned tab bolted to each of them. The outputs to the lamps are taken from the board via connector blocks screwed to the board and linked to it with short lengths of 18g wire.

Testing and Setting Up

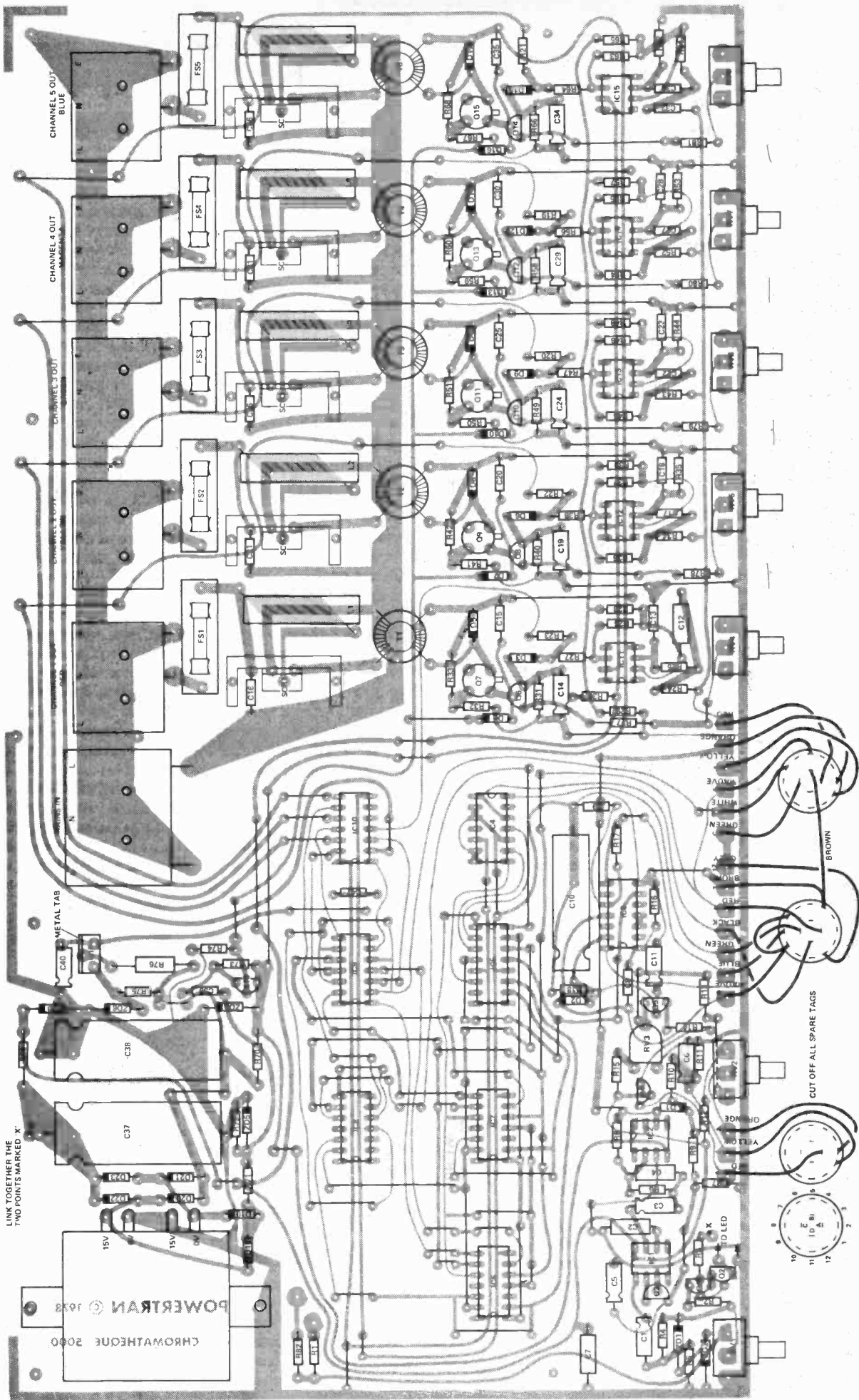
Plug in the unit between your amplifier and speakers, wire in the lamps securing the cables with the clamps on the rear panel, turn all controls anticlockwise, switch on and set auto level to where the LED only comes on occasionally. Switch SW2 to A and turn up the level controls and watch the lamps operate smoothly in time with the different frequency bands in the music. Switch SW2 to D, SW3 to S, SW1 to A, adjust the level controls for the lamps to be equally turned on by the strobing and set the one and only pre-set (RV3) for a strobe rate as fast as the lamps will follow.

ETI

BUYLINES

A complete kit of parts including metalwork is to be made available by Powertran Electronics. Address from the inside front cover. The PCB will be available only from them as it is their design. All components are available separately.

Below: Component Overlay for the lightshow



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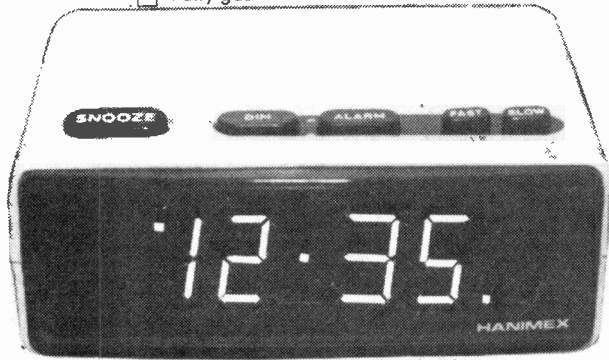
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- Silent operation, all electronic
- Space age technology L.S.I. circuitry
- Alarm and 9 minute snooze repeater
- P.M. indicator
- Seconds Display
- Size 100mm x 130mm x 60mm high
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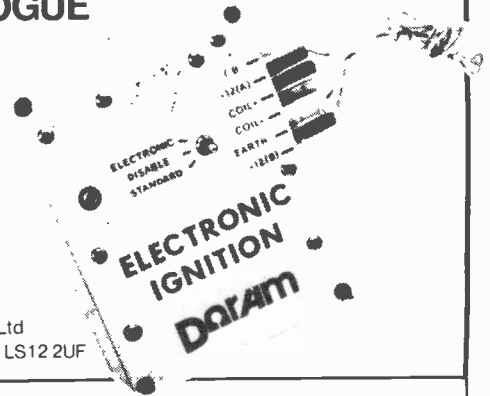


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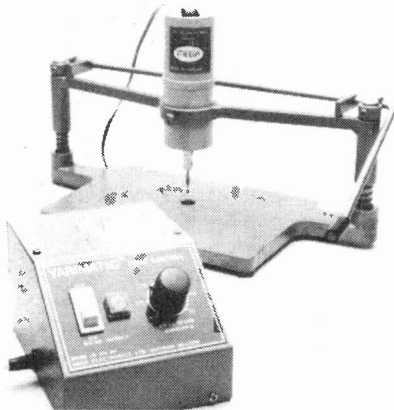
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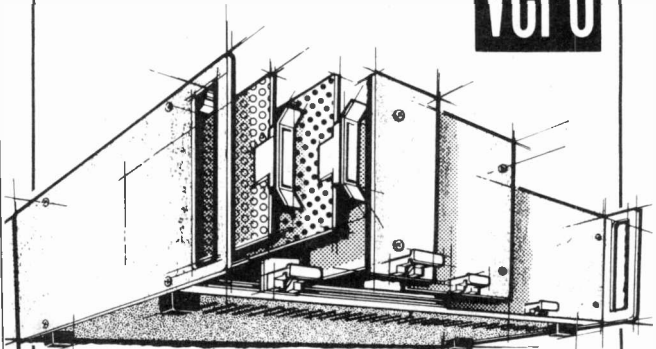


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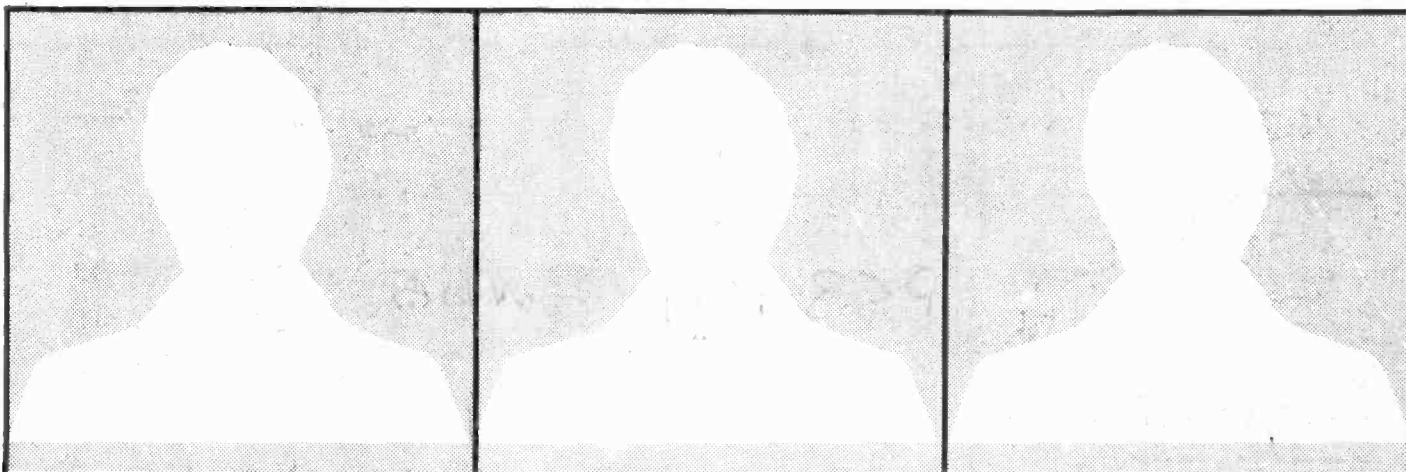
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HELP!

ETI NEEDS YOU!

Last month we advertised for someone to fill the position of Editorial Assistant, and we are still receiving applications for that. However our expansion plans now mean we need three additional recruits!



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.

Editorial Assistant (Home Computing):— in order to complement and add to our existing staff skills we are looking for someone with a real knowledge of this ever-expanding field. Everyone here at ETI is fascinated by the field — PET nearly stopped the magazine dead — but we feel we need a person who has a broad overall knowledge of the systems around today and the principles behind them, in order to assist with the magazine generally and our 'Computing Today' supplement in particular.

Salary in the range £3,700-£4,100.
Age flexible.

Project Engineer:— the person who fills this position will be able to design and build up projects to the standard of finish ETI readers are used to seeing in their magazine. This calls for someone with a good knowledge of circuit design, and with the patience to carry the design through to a finished state. Existing staff are available to assist in all aspects of design work. The easiest part of the job will be writing up the project once it is completed. None of the present ETI staff were journalists previous to joining, and no-one has found the writing a difficult task.

One again we have no preconceived notions of age required, and salary will be negotiable upwards from £4,000.

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TRANSISTORS																													
2N696	0.39	2N2218	0.35	2N3393	0.17	2N4637	0.60	2N5192	0.80	2N6124	0.45	BC108A	0.16	BC1789	0.35	BC307	0.20	BD240A	0.49	BF160	0.33	BF79	0.30	ME4001	0.16	TIP30C	0.70		
2N697	0.31	2N2218A	0.38	2N3394	0.19	2N4638	0.22	2N5193	0.75	2N6125	0.47	BC108B	0.16	BC1790	0.25	BC308	0.23	BD240C	0.59	BF161	0.65	BF80	0.30	ME4002	0.16	TIP31A	0.54		
2N698	0.49	2N2219	0.30	2N3396	0.19	2N4640	0.22	2N5196	0.97	40362	0.55	BC109	0.16	BC1790C	0.25	BC213B	0.17	BC547A	0.13	BD241C	0.65	BF173	0.37	BF81	0.30	ME4003	0.16	TIP31C	0.72
2N699	0.58	2N2219A	0.39	2N3397	0.19	2N4641	0.19	2N5245	0.37	40363	1.45	BC109B	0.17	BC1792	0.26	BC213C	0.17	BC547B	0.13	BD242A	0.55	BF177	0.27	BF83	0.34	ME4102	0.11	TIP32C	0.82
2N706	0.30	2N2220	0.39	2N3438	0.85	2N4662	0.20	2N5246	0.38	40408	0.82	BC109C	0.18	BC182	0.12	BC214	0.17	BC548	0.13	BD242C	0.62	BF178	0.27	BF84	0.30	ME4103	0.11	TIP41A	0.76
2N706A	0.30	2N2221	0.25	2N3440	0.75	2N4664	1.35	2N5247	0.44	40409	0.82	BC140	0.30	BC182A	0.12	BC214A	0.17	BC549	0.14	BD243A	0.65	BF179	0.33	BF85	0.38	ME4104	0.11	TIP41B	0.76
2N708	0.30	2N221A	0.25	2N3441	0.92	2N4674	2.65	2N5248	0.44	40410	0.82	BC141	0.32	BC182B	0.13	BC214C	0.17	BC549A	0.14	BD243C	0.65	BF180	0.37	BF86	0.30	ME4105	0.22	TIP42A	0.86
2N710	0.30	2N2222	0.25	2N3442	1.45	2N4711	0.27	2N5294	0.44	40411	3.10	BC147	0.13	BC182C	0.15	BC214D	0.18	BC551	0.14	BD244C	0.67	BF182	0.37	BF88	0.30	ME4106	0.22	TIP42B	1.08
2N718A	0.54	2N2224	0.25	2N3636	0.17	2N4722	0.27	2N5295	0.44	40594	0.87	BC147B	0.13	BC182D	0.15	BC214E	0.18	BC552	0.14	BD244D	0.65	BF183	0.44	BF90	0.30	ME4107	0.16	TIP42C	0.86
2N720A	0.85	2N2225	0.27	2N3638A	0.17	2N4723	0.19	2N5296	0.44	40595	0.98	BC148	0.13	BC182E	0.15	BC214F	0.18	BC553	0.14	BD244E	0.69	BF183A	0.44	BF91	0.30	ME4108	0.16	TIP42D	0.70
2N722	0.45	2N2269A	0.27	2N3702	0.14	2N4724	0.19	2N5298	0.44	40673	0.80	BC148B	0.13	BC183	0.12	BC237B	0.15	BC559	0.15	BD245C	0.85	BF184	0.41	BF92	0.27	ME4109	0.62	TIP34	1.05
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2N916	0.33	2N2903	1.60	2N3705	0.14	2N4728	0.38	2N5449	0.20	40671	0.48	BC149C	0.15	BC183C	0.13	BC238C	0.16	BD115	0.88	BD44	0.44	BF195	0.16	BF91	1.35	ME4120	0.70	TIP90	0.22
2N917	0.38	2N2904	0.31	2N3707	0.14	2N4728	0.22	2N5458	0.35	40672	0.48	BC151A	0.15	BC183D	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N918	0.45	2N2904A	0.31	2N3707	0.14	2N4728	0.22	2N5458	0.35	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N923	0.37	2N2905	0.31	2N3708	0.12	2N4728	0.22	2N5459	0.32	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N929A	0.37	2N2905A	0.31	2N3709	0.12	2N4729	0.22	2N5460	0.35	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N930	0.37	2N2906	0.25	2N3721	2.16	2N4731	2.20	2N5484	0.37	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N930A	0.95	2N2906A	0.25	2N3722	2.20	2N4732	2.65	2N5485	0.40	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N1711	0.30	2N3207	0.25	2N3727	0.36	2N4919	0.70	2N5490	0.64	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N1889	0.30	2N3207A	0.25	2N3819	0.25	2N4919	0.70	2N5490	0.64	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N1890	0.30	2N3223	0.17	2N3820	0.39	2N4920	0.83	2N5492	0.64	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N1893	0.30	2N2924	0.17	2N3820	0.39	2N4920	0.83	2N5492	0.64	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2102	0.50	2N2925	0.19	2N3900	0.28	2N4922	0.60	2N5496	0.67	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2192	0.58	2N2926	0.17	2N3901	0.30	2N4923	0.75	2N5627	0.64	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2193	0.50	2N3251	0.25	2N3902	0.20	2N4924	1.15	2N6107	0.95	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2193A	0.52	2N3254	0.72	2N3904	0.18	2N4926	0.30	2N6108	0.55	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2194	0.42	2N3055	0.75	2N3905	0.18	2N4927	0.30	2N6109	0.55	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2194A	0.45	2N3930	0.50	2N3906	0.18	2N4928	0.30	2N6111	0.49	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2194B	0.40	2N3931	0.40	2N4031	0.55	2N4929	0.30	2N6121	0.41	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2195A	0.40	2N3931A	0.45	2N4032	0.65	2N4930	0.65	2N6122	0.44	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33
2N2217	0.55	2N4032	0.72	2N4033	0.72	2N4931	0.75	2N6123	0.48	40673	0.48	BC151B	0.15	BC183E	0.13	BC239E	0.17	BD131	0.55	BD45	0.46	BF197	0.18	BF93B	0.55	ME4121	0.51	TIP92	0.33

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4012	0.22	4037	1.20	4067	4.85	4097	4.65
4013	0.52	4040	0.85	4068	0.27	4098	1.00
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4016	0.52	4044	1.00	4071B	0.24	4516	2.10
4017B	1.05	4045	1.76	4072	0.27	4518B	1.20
4018	1.05	4046B	1.50	4073B	0.24		
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INDEX 78

INTRODUCTION

IT WAS APRIL last year when we last provided an index of our own efforts. That one went right back to our first issue in April 1972. This month's brings us once more up to date. In future these listings will appear each December issue (there's long-term planning!).

Producing a definitive index is not simply a matter of reading from the contents pages and rearranging to nice neat alphabetical order. There will be some items which can be classified in several ways, and which are usually

entered more than once as a result. All articles here are included just once for simplicity.

All articles, except Tech-Tips and the news features, are included in the index. Projects are simply listed consecutively, whilst the features are divided into categories for ease of reference.

Computing Today is a separate entity from ETI, and articles appearing within it are not eligible for inclusion in our index.

Projects

A			G		
ALARM ALARM	JUL 77	p.29	GAS MONITOR	APR 78	p.32
ASC II KEYBOARD	APR 77	p.25	GRAPHIC EQUALISER	SEP 77	p.27
AUDIO AMPLIFIER (200W)	APR 78	p.43	GSR MONITOR	JUL 77	p.11
AUTOCHORD			H		
Pt 1	NOV 78	p.57	HAMMER THROW GAME	JAN 78	p.29
Pt 2	DEC 78	p.80	HELPING HAND	MAY 78	p.16
B			I		
BASS ENHANCER	JUN 77	p.53	IB METAL LOCATOR	FEB 78	p.32
BELL EXTENDER	OCT 78	p.65	INJECTOR-TRACER	MAY 77	p.37
BENCH SUPPLY	APR 77	p.47	L		
BURGLAR ALARM SYSTEM	APR 77	p.57	LED PENDANT	NOV 77	p.41
BURGLAR ALARM (CMOS)	JAN 78	p.16	LCD MULTIMETER	AUG 78	p.23
C			LCD PANEL METER	MAR 78	p.26
CAR ALARM	DEC 78	p.16	LIGHT DIMMER	MAR 78	p.55
CLOCK (LED)	NOV 77	p.23	LIGHT SHOW	DEC 78	p.44
CLOCK (Fluorescent)	DEC 77	p.19	LOUDHAILER	SEP 77	p.56
COMPUTER (Triton)	NOV 78	p.16	LOUDSPEAKERS (ER II)	MAY 77	p.31
COMPANDER	NOV 77	p.11	M		
CONTINUITY TESTER	SEP 77	p.38	MASTERMIND	JUN 77	p.41
CROSSHATCH GENERATOR	SEP 78	p.33	METRONOME (Accentuated)	FEB 78	p.17
CURVE TRACER	DEC 78	p.73	METRONOME	MAY 77	p.39
D			MICROAMP	JUL 77	p.30
DRUNKEN SAILOR PUZZLE	JAN 78	p.46	MOISTURE INDICATOR (Soil)	AUG 77	p.19
E			O		
EGG TIMER	AUG 77	p.26	OSCILLATOR (Sweep)	AUG 77	p.10
ELECTRONIC BONGOS	AUG 77	p.24	OSCILLATOR (LCD)	NOV 78	p.71
ELECTRONIC IGNITION	MAY 78	p.41	OSCILLATOR (Wide range)	JUN 78	p.90
F			P		
FM/AM RADIO	JUN 78	p.79	PHASER (CCD)	MAY 78	p.57
FM TUNER (Digital)	SEP 78	p.21	PHASER		
FREEZER ALARM	DEC 77	p.41	PLANT WATERER (Auto)	AUG 78	p.61
FREQUENCY METER (Digital)	JUN 77	p.19			
FREQUENCY SHIFTER	MAR 78	p.40			
FUZZ BOX	APR 77	p.48			

PORCH LIGHT	FEB 78	p.28
POWER BULGE	OCT 78	p.41
POWER METER (R.F.)	OCT 78	p.30
POWER SUPPLY	AUG 78	p.75
PROXIMITY SWITCH	OCT 78	p.75

R

RACE TRACK GAME	JAN 78	p.36
RAIN ALARM	APR 78	p.62
REV MONITOR	DEC 77	p.37

S

SHUTTER TIMER	FEB 78	p.57
SKEET GAME	NOV 77	p.34
STAC TIMER	SEP 78	p.71
STAR TREK RADIO	MAY 78	p.62
STARS & DOTS	JUN 78	p.17
STEREO SIMULATOR	SEP 77	p.16
SOUND GENERATOR	OCT 78	p.17
SPECTRUM ANALYSER	JUN 78	p.27
SPIRIT LEVEL	OCT 77	p.28
SYNTHESISER (Transcendent)	JUL 78	p.38
	and AUG 78	p.45

SYSTEM 68

PSU	MAY 77	p.55
VDU	JUN 77	p.33
	and JUL 77	p.54
BUS STRUCTURE	AUG 77	p.45
CPU CARD	SEP 77	p.22
	and OCT 77	p.63
TTY	NOV 77	p.45
INTERFACING	DEC 77	p.59
CUTS CARD	JAN 78	p.61
	and FEB 78	p.45
ETIBUG	MAR 78	p.59

T

TACHOMETER	JUL 77	p.32
TANK BATTLE	MAY 78	p.50
TEMPERATURE METER	JUL 78	p.21
THERMOMETER (Digital)	OCT 77	p.20
tone CONTROL (3-channel)	OCT 77	p.34
TORCH FINDER	JUL 78	p.31
TV CHESS		
PT 1	OCT 78	p.48
PT 2	NOV 78	p.44

U

UFO DETECTOR	JUL 78	p.63
ULTRASONIC SWITCH	FEB 78	p.62

V

VOLTMETER (True RMS)	MAR 78	p.13
----------------------	--------	------

W

WATCHDOG	OCT 77	p.10
WHEEL OF FORTUNE	SEP 78	p.61
WHITE LINE FOLLOWER	APR 78	p.23
WINE TEMP METER	DEC 78	p.31

FEATURES

Audio

AM STEREO	OCT 77	p.25
CLASS G AMPS	DEC 77	p.34
ELECTRETS IN AUDIO	DEC 77	p.24
NOISE REDUCTION	NOV 77	p.16
SWITCH IN LINE	NOV 78	p.51
PICKUP PRINCIPLES	AUG 77	p.56
PIRATE RECORDINGS	OCT 78	p.45
ROCK SOUND	SEP 78	p.15
VALVE SOUND	JUN 77	p.57
VALVE SOUND ON THE REBOUND	JUL 77	p.34
VOCODERS	AUG 77	p.34
(See also AUDIOPHILE)		

Circuit design

ACTIVE FILTER		
Pt 1	JUL 77	p.23
Pt 2	AUG 77	p.36
Pt 3	SEP 77	p.52
AUDIO AMPS	JUN 78	p.21

DIGITAL ELECTRONICS BY EXPERIMENT

Pt 1	OCT 77	p.49
Pt 2	NOV 77	p.58
Pt 3	DEC 77	p.76
Pt 4	JAN 78	p.67
Pt 5	FEB 78	p.78
Pt 6	MAR 78	p.66
Pt 7	APR 78	p.38
Pt 8	MAY 78	p.74
Pt 9	JUN 78	p.98

GAIN CONTROL

Pt 1	OCT 78	p.22
Pt 2	NOV 78	p.65

HOW IT WORKS — TELEVISION RECEIVERS HI-EST FI AMPS

Pt 1	AUG 78	p.15
Pt 2	SEP 78	p.39

OSCILLATORS OP AMPS

Pt 1	FEB 78	p.22
Pt 2	MAR 78	p.49
Pt 3	APR 78	p.29
Pt 4	MAY 78	p.69

OP AMP (741) SUPPLEMENT

	APR 77	p.10
--	-------------------	------

Components

BATTERIES EXPLAINED	DEC 77	p.65
CASINGS SURVEY	APR 78	p.67
CCD-	SEP 77	p.10
COMPONENTS		

Pt 9	APR 77	p.53
Pt 10	MAY 77	p.60
Pt 11	JUL 77	p.59
Pt 12	AUG 77	p.52
Pt 13	SEP 77	p.47

INSIDE VCT	MAR 78	p.19
LCD-DISPLAYS	JUN 77	p.13
MOSFETS	JUN 78	p.41
TRANSFORMERS	SEP 77	p.18
V-FETS FOR EVERYONE		
Pt 1	JUL 78	p.25
Pt 2	AUG 78	p.67

Computing

GAMES	JUN 78	p.73
GLOSSARY	JUN 78	p.76
HIGH LEVEL LANGUAGES	JUN 78	p.57
MEMORIES	JUN 78	p.63
ONE ARMED MPU	OCT 77	p.15
PERIPHERALS	JUN 78	p.69

SOFTWARE GAMES	JAN 78	p.56
SOFTWARE TECHNIQUES	JUL 77	p.18
SYSTEM SURVEY	JUN 78	p.53
SYSTEM 68 UPDATE	JUN 78	p.95
(See also 'MICROFILE')		

General

DANGERS OF LIGHTNING	FEB 78	p.50
----------------------	--------	------

ELECTRONICS—IT'S EASY!		
Pt 38	APR 77	p.65
Pt 39	MAY 77	p.64
Pt 40	JUN 77	p.64
Pt 41	JUL 77	p.64
Pt 42	AUG 77	p.64
Pt 43	SEP 77	p.62

ELECTRONICS IN PHOTOGRAPHY	AUG 77	p.28
ELECTRONICS IN SURVEYING	JAN 78	p.24
ELECTRONICS 2000	MAY 77	p.25
ELECTRONICS ON TAP	FEB 78	p.38
ELECTRONICS IN MODEL		
RAILWAYS	DEC 78	p.36
ELECTRONICS IN MOTORING	AUG 78	p.33
ELECTRONIC NEWS GATHERING	DEC 77	p.14

IONOSPHERE	DEC 78	p.61
PL EXPLAINED	MAY 77	p.18

KENNEDY SPACE CENTRE	JUN 77	p.25
LASER LIGHTSHOWS	SEP 77	p.34
QUARKS	JUN 78	p.34
RACE FOR THE BOMB	JUL 78	p.69
ROCKWELL SPACE SHUTTLE	SEP 78	p.50
ROBOTS	MAY 78	p.22

SOLDERING IRON SURVEY	OCT 77	p.52
ULTRASONICS IN MEDICINE	NOV 78	p.79
VENUS PROBE	NOV 78	p.37

Reviews

AIWA AD 6800	JAN 78	p.72
BATTLE OF THE KEYS	NOV 77	p.28
CAMBRIDGE PROGRAMABLE	JUL 77	p.15
CRIMSON CPR1	NOV 78	p.85
COMMODORE PET	APR 78	p.13

GARRARD MRM 101	OCT 78	p.70
GOLDRING G900SE-2	AUG 78	p.79
HITACHI SR 903	DEC 77	p.34
HITACHI HMA 750	JUN 78	p.41
HP 67 CALCULATOR	JUN 77	p.30
KOSS ESP10	MAR 78	p.63

MK 14 KIT	SEP 78	p.27
SCRUMPI 3 KIT	OCT 78	p.35
SOUND GUARD	JAN 78	p.71
T159 CALCULATOR	JUN 78	p.85
TRS 80 COMPUTER	AUG 78	p.39
VIDEOCRAFT TELETXT	AUG 77	p.18
WIRELESS SHOW	JAN 78	p.50

Data Sheet

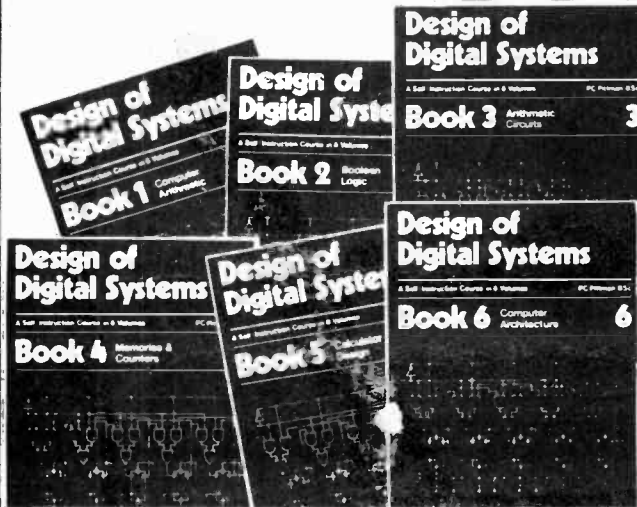
HD0165 ENCODER	APR 77	p.40
ICL 8038 VCO	JUL 77	p.50
ICM 7205 STOPWATCH	JUL 77	p.52
L911 COMPARATOR	JUN 78	p.97
LM1812 TRANSCEIVER	MAY 77	p.48
LM 1830 FLUID DETECTOR	AUG 77	p.62
LM 2907/17 CONVERTORS	AUG 77	p.60
LM 3919 TEMP SENSORS	SEP 77	p.59

MC14490 BOUNCE ELIMINATOR	JUN 77	p.49
MC14433 A-D CONVERTOR	SEP 77	p.60
MK50362N CLOCK	APR 77	p.38
MM57160 TIMER	SEP 78	p.65
MM5837 NOISE SOURCE	FEB 78	p.71
NE570/1 COMPANDER	OCT 77	p.59
NSL 4944 LED	NOV 77	p.55

3-TERMINAL REGULATORS	JUN 77	p.50
TDA 1023 DELAY LINE	MAY 77	p.49
TGS 812 GAS SENSOR	APR 78	p.57
TL080 OP AMPS	JAN 78	p.53
2102 RAM	JUL 78	p.51
2112 RAM	JUL 78	p.52
2107 RAM	JUL 78	p.54
5204 EPROM	JUL 78	p.56
7208 COUNTER/DECODER	AUG 78	p.57

Understanding Digital Electronics

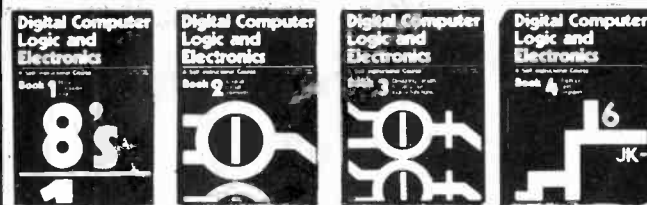
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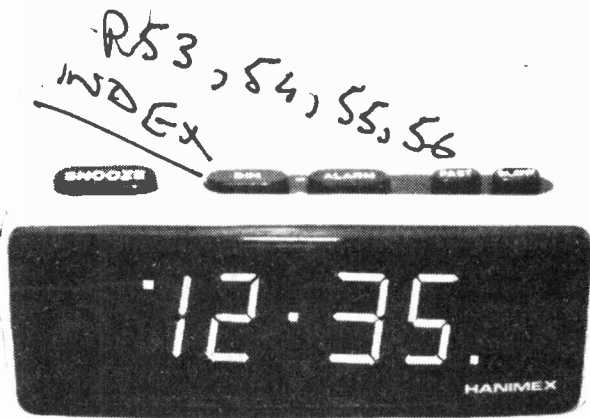
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The Hanimex HC-1100 is designed for mains operation only (240V/50Hz) with a 12 hour display, AM/PM and Alarm Set indicators incorporated in the large display. A switch on the top controls a Dim/Bright display function.

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.

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.

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

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

ELECTROVALUE Buying Guide

Section 1

If you have bought before from Electrovalue, you will know just how large and varied our stocks are. Those who have yet to know are finding our series of monthly ads to give up-to-date information and prices on the most important items we carry. BY DETACHING AND SAVING THESE PAGES, YOU WILL BUILD UP A VALUABLE AND COMPREHENSIVE MONEY-SAVING CATALOGUE. All goods brand new and to published specifications.

Transistors/Zeners

IN914	5p
IN9142	7p
IN916	6p
IN4007	8p
IN4148	5p
IN5402	16p
IN5407	20p
IS920	10p
IS940	5p
2N697	38p
2N706	22p
2N930	21p
2N1132	24p
2N1302	48p
2N1303	48p
2N1304	52p
2N1305	52p
2N1306	56p
2N1307	56p
2N1308	60p
2N1309	60p
2N1599—SCR	88p
2N1613	23p
2N1711	22p
2N1893	35p
2N2218	24p
2N2218A	24p
2N2219	24p
2N2219A	24p
2N2270	75p
2N2369A	22p
2N2484	26p
2N2646	69p
2N2904	22p
2N2904A	22p
2N2905	22p
2N2905A	22p
2N2924*	25p
2N2925*	25p
2N2926*	25p
2N3053	26p
2N3054	73p
2N3055	70p
2N3391A*	41p
2N3405*	64p
2N3663*	52p
2N3702*	11p
2N3703*	10p
2N3704*	11p
2N3705*	10p
2N3706*	9p
2N3707*	12p
2N3708*	8p
2N3709*	12p
2N3710*	12p
2N3711*	12p
2N3794*	21p
2N3819*	28p
2N3820*	56p
2N3823E*	24p
2N3904*	24p
2N3906*	28p
2N4036	68p
2N4058*	12p
2N4059*	12p
2N4060*	12p
2N4061*	12p
2N4062*	12p
2N4124*	22p
2N4126*	27p
2N4286*	18p
2N4289*	23p
2N4291*	24p
2N4292*	21p
2N4303*	30p
2N4410*	39p
2N4443	£1.14
2N4444	£1.50
2N4906	£1.00
2N4915	£1.00
2N4991	80p
2N5062*	45p
2N5163*—SCR	24p

2N5192	85p
2N5195	99p
2N5457*	39p
2N5458*	39p
2N5459*	39p
6F40	£1.46
16F40	£1.65
40HF10	£1.64
40HF40	£2.28
40250	95p
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40406	40p
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40602	75p
40636	£1.80
40673	86p
A9903	44p
AA113	9p
AA116	9p
AA117	9p
AA118	10p
AA119	9p
AC126	30p
AC127	48p
AC128	28p
AC151R	53p
AC153	40p
AC153K	40p
AC176	58p
AC176K	40p
AC187K	70p
AC188K	70p
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ACY18	91p
ACY19	99p
ACY20	70p
ACY21	85p
ACY22	50p
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AD142*	90p
AD149	80p
AD161	96p
AD162	96p
AF114	27p
AF115	30p
AF116	30p
AF117	34p
AF124	25p
AF125	32p
AF126	25p
AF127	36p
AF139	32p
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AF239	89p
AF279	30p
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AFY16	£2.69
AFY18D	£5.74
AFY18E	£6.15
AFY42	£2.91
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ASY26	£1.39
ASY27	£1.39
ASY28	£1.39
ASY29	£1.39
AU111	£2.25
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AUY22	£10.95
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BO140	35p
BO226	35p
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B1906	38p
B1912	38p

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8AX13	5p
8B103B	37p
8B103G	37p
8B104G*	53p
8B105B	28p
8B109G*	37p
BC107A	14p
BC107B	14p
BC108A	14p
BC108B	14p
BC108C	14p
BC109B	14p
BC109C	14p
BC121W	20p
BC122Y	61p
BC125*	20p
BC126*	20p
BC140	43p
BC147A*	21p
BC147B*	21p
BC148A*	21p
BC148B*	21p
BC148C*	21p
BC148C*	21p
BC149C*	21p
BC154*	16p
BC157A*	21p
BC157B*	21p
BC158B*	21p
BC159B*	21p
BC160	49p
BC167A*	8p
BC167B*	12p
BC168A*	8p
BC168B*	12p
BC168C*	8p
BC169C*	8p
BC177A	18p
BC177B	20p
BC178A	16p
BC178B	17p
BC179B	20p
BC182L*	12p
BC182*	12p
BC183L*	12p
BC183*	12p
BC184L*	12p
BC184*	12p
BC202Y	75p
BC212L*	12p
BC212*	12p
BC213L*	12p
BC213*	12p
BC214L*	12p
BC214*	12p
BC238B*	8p
BC238C*	8p
BC239C*	12p
BC257A*	8p
BC257B*	8p
BC258A*	8p
BC258B*	8p
BC259B*	8p
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BF459*	40p
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(1.5W are metal cased)	
20W 7.5V—75V	£1.25 each

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Micro processor Evaluation Kit (for M. 680 Microcomputer)
£175.87 + VAT (net)

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electronics today

international

What to look for in the January issue: On sale Dec 1st

CLICK! ELIMINATOR

Fed up with low quality records? Had a hard day and dropped your favourite LP? Kiddies used Bach for target practice?

We can help — do not despair.

Next month we present a design to remove the clicks and scratches from records. The system works in a novel manner, and the system can be built at a fraction of the cost of commercial units.

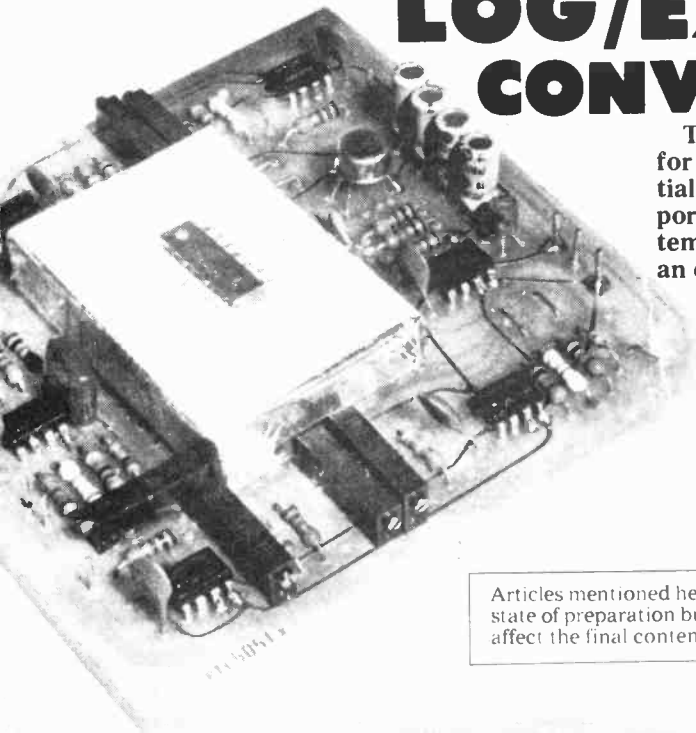


DIGITAL TACHO

Compact, easy to build, 10 rev resolution, fast response due to PLL technique and a range to 9999 rpm. With all that going for it how can you afford to miss it? Suitable for standard, CDI, and transistor assisted ignition systems.

LOG/EXP CONVERTER

This design can be set up for either log or exponential conversion, and incorporates a neat heater for temperature stability. Has an eight octave range.



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

LOUDSPEAKERS PRINCIPLES



An article to explain what goes on behind the grilles on those large wooden boxes dominating the living room. All the major types will be covered, moving coil electrostatic piezo-electric etc, as well as explanations of 'loading' the units to do their job better.

computing today no 3

NEWBEAR'S BEARGAGS are an economical way of adding extra power to any small system. Next month we take a look at a typical bag — the petitevid VDU II kit.



BASIC II

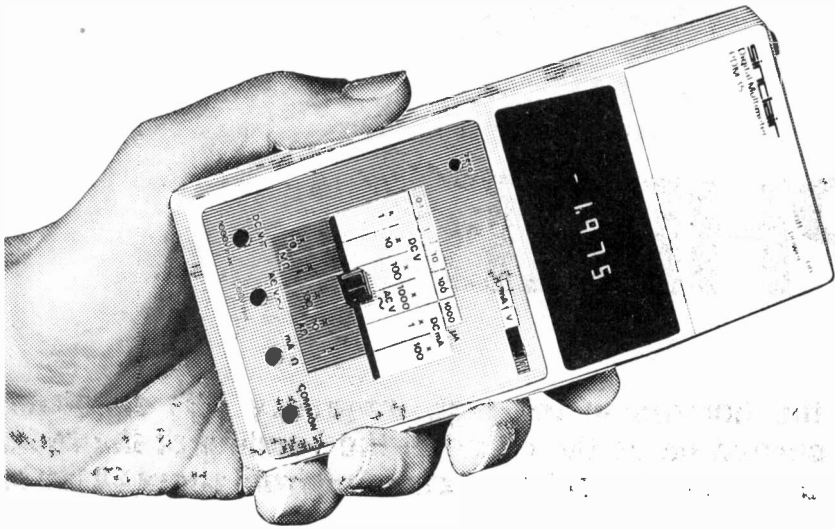
Tandy's level two BASIC upgrade for TRS-80 machines is now available in this country — what extra power does this conversion provide?

COMPUTERS IN BUSINESS. A look at how one small businessman uses a microcomputer at work.

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 (0.0001 μA).

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)

@ £32.35 (incl. VAT) each.....£..... Name.....

_____ (qty) De-Luxe carrying cases

@ £3.24 (incl. VAT) each.....£..... Address.....

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

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

Post and packing (please add).....£0.65

I enclose cheque/PO made payable

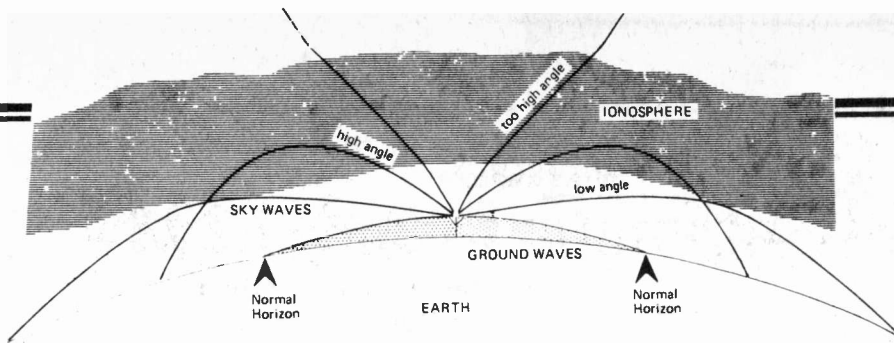
to Sinclair Radionics Ltd for

(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



IONOSPHERE

Radio communications beyond the horizon in the high frequency (HF) spectrum between 3 MHz and 30 MHz are carried on as the result of the bending of the radio waves in the ionosphere, that region of our atmosphere extending from about 60 km to about 1000 km above the earth.

THE IONOSPHERE CAN bend radio waves so that they return to earth from hundreds of kilometres to many thousands of kilometres distant.

Without the existence of the ionosphere, long distance radio communications, shortwave broadcasting, amateur radio 'DX' etc. would not be possible — and one G. Marconi would probably have died an unknown pauper!

The ionosphere enables shortwave radio stations such as Radio Peking, The Voice of America etc to broadcast programmes across the world. It enables radiotelephone communications to ships at sea and contact with international aircraft.

The Solar Prime Mover

The sun, which dominates almost every phase of our lives, influences all HF radio communications beyond the horizon. The sun generates the ionosphere; solar activity has a considerable influence on this area of our atmosphere and thus affects propagation of HF radio waves.

Ionisation of the upper atmosphere is brought about largely by ultraviolet radiation from the sun, along with solar X-ray radiation. This solar radiation strips electrons from the atoms of the rarified atmospheric gases existing in our upper atmosphere.

The result is not a single, thick region of 'band' ionisation, as you may suppose. The ionosphere separates into several readily defined regions having varying densities, located in layers at different heights.

Each layer has a relatively dense region, called the *peak* of the layer, the ionisation tapering off above and below this region. The peak is not necessarily located in the centre of the layer, nor does the ionisation always disappear completely between layers.

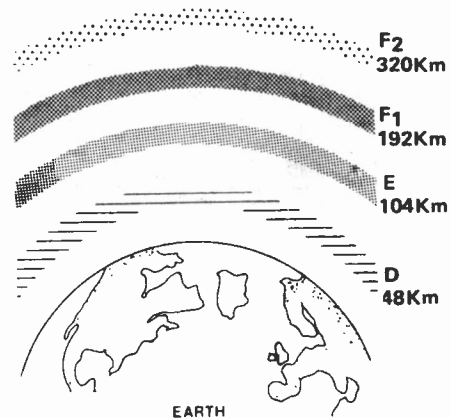


Figure 1. The ionosphere divides into readily defined regions which have been designated as illustrated here. The amount of ionisation in each layer varies diurnally (i.e.: throughout the day), seasonally (through the year) and through the 11-year sunspot cycle. Disturbances on the sun have a variety of effects on the ionosphere and thus on radio communications.

Spotting Good Propagation

The sun's UV radiation output varies over an approximately 11-year cycle, greatly influencing the behaviour of the ionosphere. For many years this cyclic behaviour of the sun has been monitored by means of sunspots - dark areas which appear on the face of the sun, and over the last two decades, by measurement of the *solar flux* (RF noise radiation) at 2800 MHz (10.7 cm wavelength).

Sunspots are enormous areas on the sun's surface which are cooler, and thus do not appear as bright as the surrounding area. Hence they look like 'spots' on the face of the sun. Their size can range from several hundred kilometres across to greater than 100,000 km. By comparison, the earth's diameter is only 13,000 km.

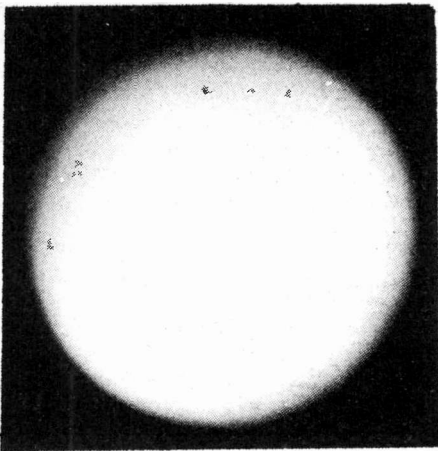


Figure 2. The sun as viewed in the visible light region showing several small spots, a relatively large spot and sunspot groups. (Photo courtesy of the Ionospheric Prediction Service.)

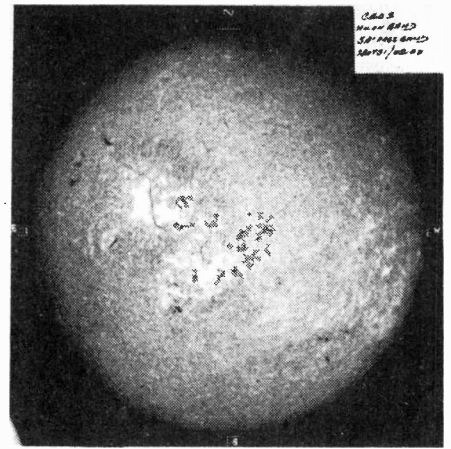


Figure 3. The sun as viewed in the red wavelength region emitted by hydrogen — H-alpha emission. Two large active regions can be seen along with associated 'filaments'. (Photo courtesy of the Ionospheric Prediction Service.)

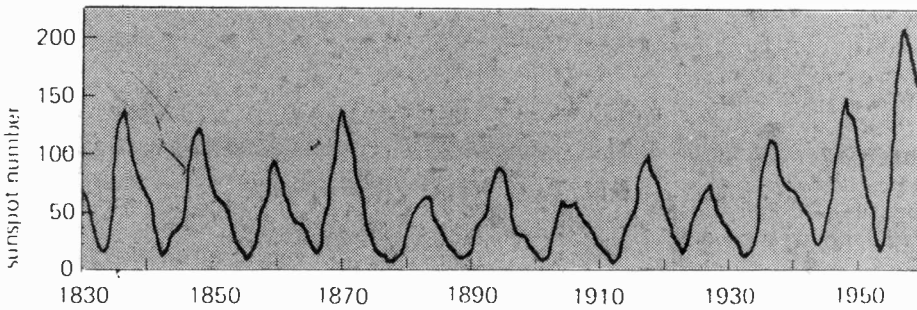
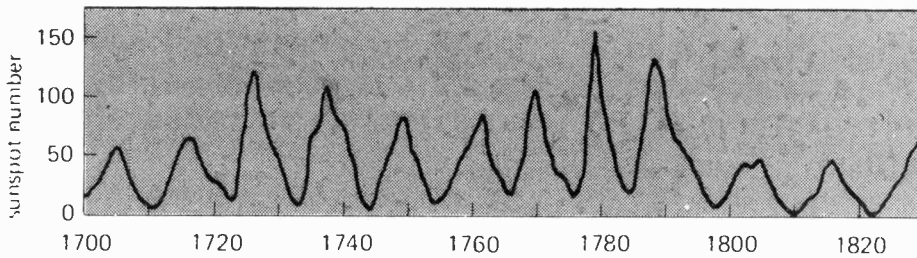


Figure 4. The 11-year solar cycle is clearly evident from this plot of the Sunspot Number from 1700 to 1960.

Rate of production of electrons

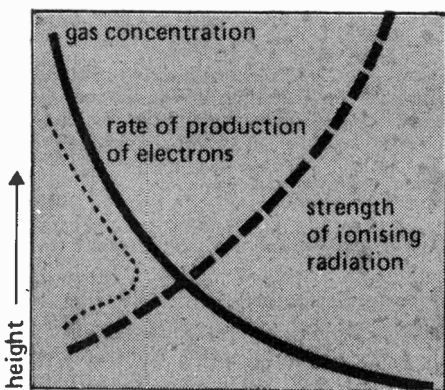


Fig. 5. How a layer of electrons is produced when ionising radiation comes from above the atmosphere. The gas concentration increases with decreasing height while the radiation strength decreases. Peak production of electrons occurs at the height where the curves cross.

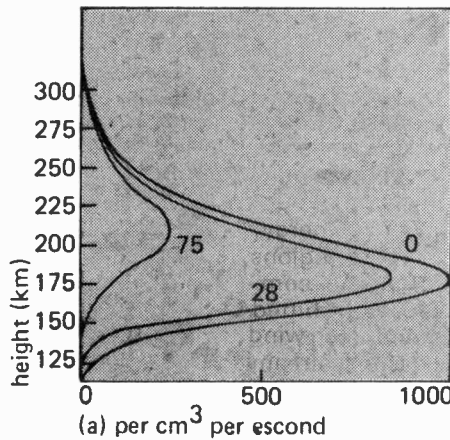
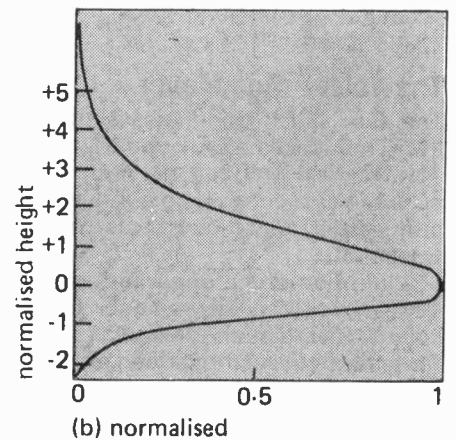


Fig 6. (a) Theoretical 'Chapman' layers showing how electron production is affected by the angle of the sun's rays — best when sun is overhead (0° zenith angle).



(b) If all curves are 'normalised' about peak height, regardless of the sun's zenith angle, they all have the same shape.

Records of systematic sunspot observations date back some 300 years. However, reasonably reliable data is only available since about 1850.

The sun is monitored continuously from a number of observatories around the world. Sunspot observations are statistically smoothed to provide a continuous record — this is termed the Zurich Sunspot Number, which is a statistical 'fudge factor' on which ionospheric propagation predictions are based. More of this later.

On the Spot

Sunspot Number does not mean 'numbers of sunspots'. It is a statistical term which allows comparison with past figures and provides an index of sunspot activity.

The sunspot number has a cyclical variation with a mean period of 11 years. Periods between sunspot peaks have been as short as nine years and as long as 13 years. The sunspot number between the peaks and minimums of the cycles also vary greatly. The sunspot cycles have been 'numbered', for the convenience of reference, back for 200 years. Cycle 18 peaked in 1947, cycle 19—the biggest on record — peaked in 1957 with a sunspot number in excess of 200. Cycle 20 peaked in 1969 reaching a sunspot number of about 120, which is about average intensity.

If you thought the DX wasn't anything spectacular in 1969-70, you should have been around in 1907 when the sunspot number barely reached 60 during the peak!

Sunspot cycle minimums don't always reach zero levels. Some minimums however have shown little or no activity for many months.

The sunspot cycle, while having an 11-year mean period as observed between peaks, has been identified in recent years as actually being a roughly 22-year period based on the magnetic field variations of the sun. Alternate sunspot cycles show a pole reversal in the solar magnetic field.

Solar Disturbances

On occasions, the surface of the sun is disturbed by sudden 'storms'. These disturbances are not normally visible but are readily detected when the sun is viewed at a particular red light wavelength, known as H-alpha, emitted by hydrogen.

These very intense, localised outbursts increase very rapidly to a peak taking a minute or less, and then the intensity of the H-alpha emission decreases to its normal value in about half an hour or so.

This phenomenon is called a *solar flare*, usually occurring near, or associated with, a sunspot.

Solar flares generate enormous amounts of energy, and increased solar X-ray radiation from these regions cause disturbances to the ionosphere and to communications. Electrons and protons are also emitted from solar flares, and these travel through solar wind towards the earth. The particles are emitted in a stream and are much more numerous and move at greater velocities than those particles contained in the normal solar wind.

Upon reaching the region near the earth these particles have a considerable influence on the earth's ionosphere and magnetic field, producing sudden and dramatic changes as well as precipitating other events — such as aurorae — which will be described in more detail later.

Apart from flares, disturbances not associated with sunspots also cause disturbances to the ionosphere and the earth's magnetic field. *Hot Spots* — which are of longer duration than flares, are emitting regions on the sun's surface that expel streams of particles which affect the ionosphere. These, and other areas on the sun's surface which emit persistent streams of particles, have longer durations than flares but the effects of the particles emitted is less severe.

Formation of the Ionosphere

As mentioned previously, the ionosphere is produced principally by ultraviolet radiation from the sun. The amount of ionisation produced is almost wholly dependent on the strength of the UV radiation and its wavelength. Different wavelengths of the radiation ionise different gases.

The process of ionisation absorbs energy from the UV wave, and as the radiation proceeds down through the atmosphere, it is almost completely absorbed in this way.

This process of creation of ions and free electrons in the ionosphere is offset by recombination which is continually taking place between the two to form neutral atoms once again.

In the lower atmosphere, the molecular density is so great that recombination occurs almost immediately after ionisation, the rate of recombination is very rapid. However, in the upper atmosphere, where the number of molecules is very much smaller, the chances of a free electron meeting up with an ion is very much less. Hence, recombination occurs at a much slower rate.

These two opposing mechanisms result in regions in the upper atmosphere where a large amount of ionisation is present, the amount being determined by the balancing forces between the rate of ion production and the recombination rate.

The gases of the upper atmosphere which the solar UV radiation meets first are very rarified, hence little ionisation results and little of the radiation energy is lost. As the radiation penetrates further, the molecular density of the gases increases and hence the ionisation increases.

Height Maximum

More and more energy is extracted from the ionising radiation as it penetrates further and at some stage the amount of ionisation which the radiation can produce begins to decrease. There is thus a certain height at which ionisation is maximised. The region around this height is known as an ionisation layer.

This is how the ionosphere comes to derive its name. It is the region of the upper atmosphere where appreciable ionisation can take place.

The lower limit of the ionosphere is about 50 km and it extends to beyond 1000 km.

Sydney Chapman, a British scientist, investigated the production of ionisation in the early 1930s and showed that the rate of production of ionisation would vary with height as shown in figure 6. The corresponding layers of electrons have been called Chapman layers.

The height of the 'peak' is determined by the concentration at particular heights of the atmospheric gas and by the ability of the gas to absorb the solar radiation. The less easily absorbed wavelengths of the radiation penetrate lower in the atmosphere before forming a layer of electrons. The *height* of the layer does *not*

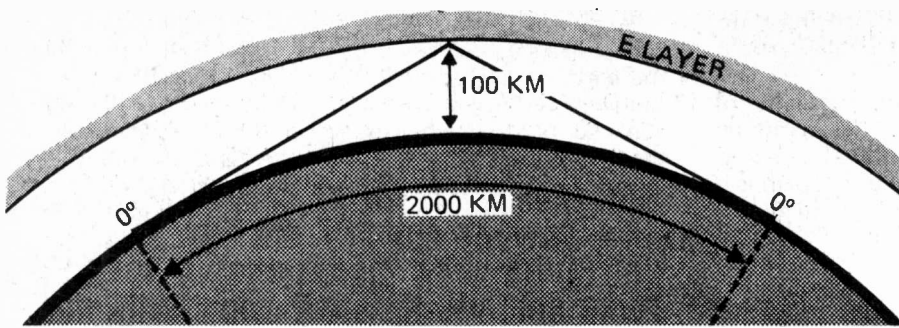
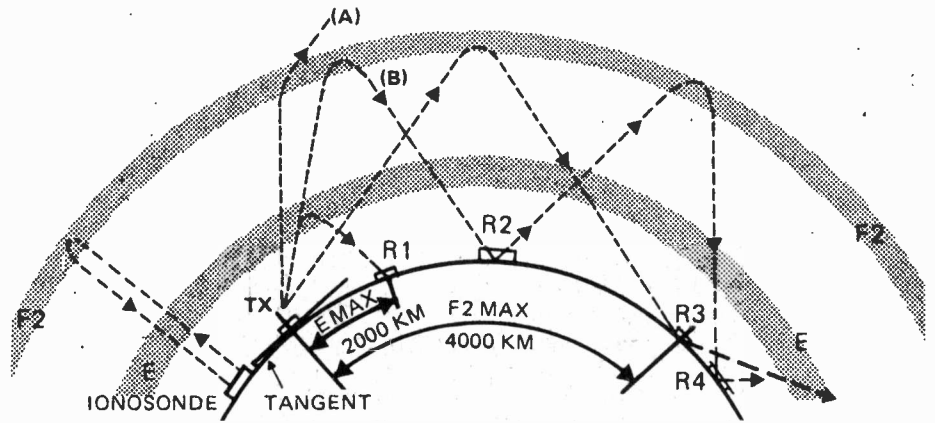


Fig. 7. Geometry of E-layer propagation. As the layer height is about 100 km, low angle radiation from a transmitter will reach distances of about 2000 km maximum.

Fig. 8. The transmitter (TX) radiating RF at several different angles illustrates how signals are propagated by the various layers. A wave radiated at a high angle will be deviated by one or both of the layers, but unless the layer is dense enough, will pass through (A). A ray at a lower angle (B) will skip a relatively short distance and may do so several times (R2-R4 etc). A low angle ray from TX will skip a maximum of 4000 km from the F2 layer (TX to R3) and subsequently further. The ionosonde measures the heights and critical penetration frequencies of the layers vertically.



depend on the strength of the ionising radiation.

The production rate of electrons at the peak of the layer depends on the strength of the ionising radiation and on its direction of arrival. When the radiation is vertically incident on the layer, ionisation is maximum, less when it arrives at an angle.

When curves representing the production rate of electrons of all possible shapes are 'normalised' with respect to the layer peak, they all look the same.

The Three Regions

There are three main regions of the ionosphere. They are designated by the symbols 'D', 'E', and 'F.' The F-layer actually divides into two layers, F₁ and F₂, which I will go into shortly.

The structure of the ionosphere varies widely over the earth's surface as the strength of the sun's radiation will obviously vary with geographical latitude.

The D-layer

This is a region of low ionisation density which does not show the well-defined 'peak' of maximum ionisation density associated with the other layers.

The D-layer only appears during daylight hours and extends rather diffusely from about 50 km to about 90 km. The density of electrons in the D region is generally insufficient to cause appreciable bending of radio waves but they do suffer considerable attenuation in passing through this region.

Solar X-ray radiation with wavelengths less than about 20 Angstroms contributes to some of the ionisation in the D-layer. This radiation can ionise all the gases present at these heights in the atmosphere, but this alone does not account for the level of free electrons found in this region.

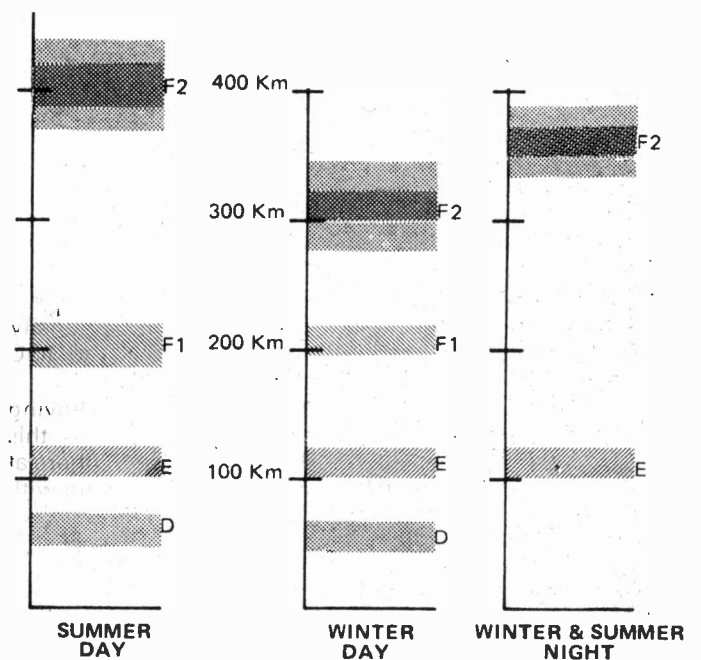


Fig. 9. Illustrating the diurnal and seasonal variations in the various layers.

Nitric oxide (NO) is formed at heights between 60 and 90 km by a photochemical process that diffuses atomic nitrogen down from the E-layer above 100 km. This nitric oxide is ionised by UV radiation from the sun having a wavelength of 1216 Angstroms — the Lyman-Alpha wavelength.

Hydrogen in the sun radiates very strongly at this wavelength which coincides almost exactly with a 'spectral window' in the atmosphere which allows this radiation to penetrate to very low levels in the atmosphere with little attenuation.

Because it penetrates down to where the nitric oxide is produced there is an abundant supply of electrons which contribute to the general ionisation of the D-layer at a height of around 75 km. Solar X-ray and Lyman-Alpha radiation contribute in roughly equal proportions to the ionisation of the D region. However, the strength of the X-rays varies by a large factor both daily and through the solar cycle as well as with solar disturbances. There is no appreciable change in the strength of the Lyman-Alpha radiation.

Up the X-rays

Increased X-ray radiation associated with solar flares can increase the ionisation of the D layer thus causing increased absorption of radio waves travelling through the D region. These solar disturbances can be the cause of a complete 'radio blackout' at times.

As cosmic rays are deviated by the earth's magnetic field ionisation of the lower D region is greater near the magnetic poles than it is near the equator.

Since the D-layer absorbs radio waves it affects the propagation of radio signals. During the day signals below about 5 MHz are almost completely absorbed. Only signals radiated at a very high angle, and above a critical frequency where all signals are absorbed, manage to pass through the layer, being subsequently reflected by the E-layer.

Communication during daylight hours on the lowest frequencies of the HF spectrum from 3 MHz to about 5 MHz or so is thus limited to short distances, not much beyond ground-wave coverage.

Low angle radiation on these frequencies during the day travels a long way through the D-region and is thus absorbed.

The D-layer of course affects higher frequencies but its attenuation affect lessens as the frequency is increased.

The E-layer

This occurs during daylight hours, the maximum density or peak of the layer lying between about 100 and 150 km. It remains weakly ionised at night.

E-layer ionisation is produced jointly by X-rays having wavelengths less than about 100 Angstroms — this ionising oxygen and nitrogen in the upper atmosphere at heights close to 100 km — as well as UV radiation with wavelengths near 100 Angstroms which ionise oxygen.

The atmosphere in the E-region is still dense enough for recombination to take place fairly rapidly. As a consequence, the E-layer can only maintain its signal reflecting ability when it is continuously in sunlight.

Ionisation is generally the best around noon, disappearing rapidly some time after local sunset. (The sun sets on the ionosphere at a height of 100 km about half an hour after local sunset.)

The F-layer

The F-layer is that region of the ionosphere above about 150 km extending up to 800 km and beyond.

During daylight hours, two distinct layers appear in the F-region of the ionosphere — the lower is known as the F₁ layer, the upper as the F₂ layer.

The F₁ layer generally occurs around a height of 200 km and does not vary greatly in height. Its ionisation density is lower in winter than in summer.

As one would expect, the F₂ layer, being the uppermost has the considerable variations in density and height.

There is only one layer during the night in the F-region which is likewise dependant on atmospheric temperature. The height and density of the nighttime F-layer is also very variable owing to a number of factors.

The principal ionising agent of the F-layer is the extreme ultra-violet region (EUV). Solar UV with wavelength between about 200 and 800 Angstroms does most of the work in this respect. Radiation at these wavelengths ionises molecular nitrogen and atomic oxygen at heights between about 150 and 180 km.

The resulting electronic distribution with height does not always show a peak at this level — when there is a peak it is usually that of the F₁ layer.

The shape of the F₂ layer electron distribution, and thus the height of the peak, is largely determined by the variation with height of the loss process and by diffusion of the electronics to other regions. Ions and electronics diffuse above the peak of the layer, the production and loss of electronics (by recombination, etc) below the peak determine both the position of the peak and the shape of the layer. The peak then occurs at a height where the effects of diffusion and loss of electrons reaches an equilibrium.

The F-layer will provide communications out to a range of 4000 km on a single 'hop,' multi-hop propagation being used for distances greater than this.

The F₁ layer will provide communications up to about 9 or 10 MHz during the day. The F₂ layer will support propagation beyond 30 MHz under favourable conditions, even higher in frequency and for longer durations at lower frequencies, during a sunspot maximum.

The maximum usable frequency of the F-layer varies seasonally, being greater during summer than during winter.

Summary So Far

The *daytime* ionosphere consists of an absorbing region — the D-region — with three reflecting ionised layers above that — the E, F₁ and F₂ layers.

The night-time ionosphere consists almost entirely of the F-layer.

It should be noted that the allocation of the letters of these layers above that — the E, F₁₋₅₂ and F₂ layers.

The night-time ionosphere consists almost entirely of the F-layer.

It should be noted that the allocation of the letters of these layers was made by Sir Edward Appleton. It was he who did most of the early investigative work on the ionosphere. The F-layer, which he discovered, is also known as the "Appleton Layer." The E-layer was originally named the "Kennelly-Heaviside Layer" (or just the Heaviside Layer) after the two gentlemen who discovered its existence.

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

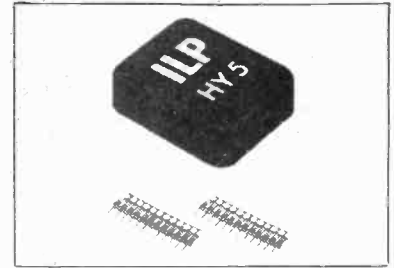
ACTIVE TONE CONTROLS: Treble \pm 12dB at 10kHz, Bass \pm at 100Hz.

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OVERLOAD: 38dB on Magnetic Pick-up. **SUPPLY VOLTAGE:** \pm 16.50V

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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.

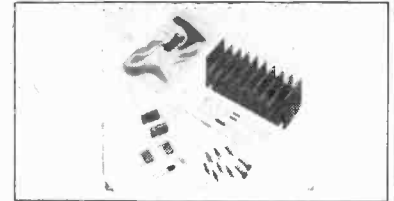
SPECIFICATIONS:

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

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HY50 25 Watts into 8 Ω

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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, 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:

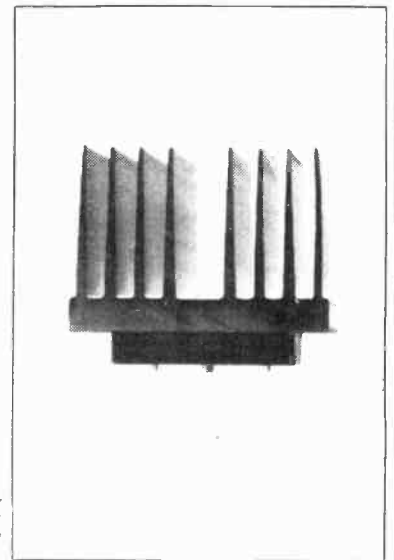
INPUT SENSITIVITY: 500mV

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.

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HY200 120 Watts into 8 Ω

The HY200, now improved to give an output of 120 Watts, has been designed to stand the most rigorous 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.

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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.

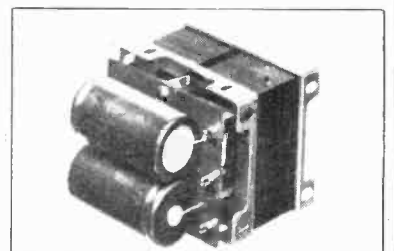
SPECIFICATIONS:

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

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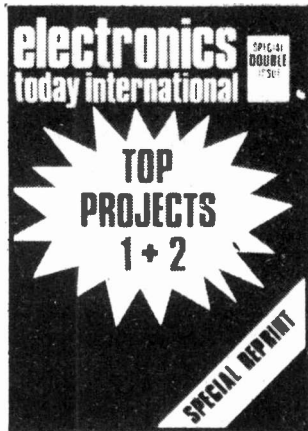
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Type	Voltage	Current	£	p/p	Type	Voltage	Current	£	p/p
08FE06	6+6	0.5A each	1.50	50p	08FE24	24+24	0.15A each	1.80	50p
08FE06	6+6	0.5A each	1.80	50p	12FE24	24+24	0.2A each	2.00	60p
12FE06	6+6	1A each	2.00	60p	20FE24	24+24	0.4A each	2.60	70p
20FE06	6+6	1.6A each	2.60	70p	50FE24	24+24	0.8A each	3.10	70p
50FE06	6+6	3A each	3.10	70p	80FE24	24+24	1.2A each	3.60	85p
60FE06	6+6	4A each	3.60	85p	80FE24	24+24	1.5A each	4.50	1.00
08FE09	9+9	0.3A each	1.50	50p	50FE28	28+28	0.75A each	3.10	70p
08FE09	9+9	0.5A each	1.80	50p	60FE28	28+28	1.1A each	3.60	85p
12FE09	9+9	0.75A each	2.00	60p	80FE28	28+28	1.4A each	4.50	1.00
20FE09	9+9	1A each	2.60	70p	20FE30	30+30	0.35A each	2.60	70p
50FE09	9+9	2.5A each	3.10	70p	50FE30	30+30	0.75A each	3.10	70p
60FE09	9+9	3A each	3.60	85p	60FE30	30+30	1A each	3.60	85p
08FE12	12+12	0.25A each	1.50	50p	80FE30	30+30	1.2A each	4.50	1.00
08FE12	12+12	0.3A each	1.80	60p	Multi-Tap Range. Voltage Available 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 12-0-12 CR 15, 0-15 0-12-15				
12FE12	12+12	0.5A each	2.00	70p					
20FE12	12+12	0.8A each	2.60	70p	30FE30	24+30	1A	3.40	70p
50FE12	12+12	2A each	3.10	70p	60FE30	24+30	2A	3.70	85p
60FE12	12+12	2.5A each	3.60	85p	80FE30	24+30	3A	4.50	1.00
80FE12	12+12	3A each	4.50	1.00	100FE30	24+30	4A	5.60	1.15
08FE15	15+15	0.2A each	1.50	50p	Centre Tap Secondary				
08FE15	15+15	0.25A each	1.80	60p					
12FE15	15+15	0.4A each	2.00	70p	FE06	6-0-6	1A each	2.00	60p
20FE15	15+15	0.6A each	2.60	70p	FE09	9-0-9	1A each	2.60	70p
50FE15	15+15	1.6A each	3.10	70p	FE12	12-0-12	1A each	2.60	70p
60FE15	15+15	2A each	3.60	85p	FE15	15-0-15	1A each	3.10	70p
80FE15	15+15	3A each	4.50	1.00	FE20	20-0-20	1A each	3.10	70p
08FE20	20+20	0.15A each	1.50	50p	60FE28	26-0-26	1A each	3.60	1.00
08FE20	20+20	0.2A each	1.80	60p	60FE28	28-0-29	1A each	3.60	1.00
12FE20	20+20	0.25A each	2.00	70p	60FE30	30-0-30	1A each	3.60	1.00
20FE20	20+20	0.5A each	2.60	70p	100FE26	26-0-26	2A each	5.15	1.15
50FE20	20+20	1.2A each	3.10	70p	100FE30	30-0-30	2A each	5.15	1.15
60FE20	20+20	1.5A each	3.60	85p	100FE36	36-0-36	2A each	5.15	1.15
80FE20	20+20	2A each	4.50	1.00	Air cored Audio Cross Over Coils				
Charger Transformer									
48FE12	0-6-12	4A	3.19	70p	FE01	0.1mH		0.26	20p
66FE12	0-6-12	5A	3.64	85p	FE03	0.3mH		0.26	20p
70FE12	0-6-12	6A	4.86	1.00	FE05	0.5mH		0.30	20p

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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

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data sheet

LH0063/LH0063C DAMN FAST BUFFER

NATIONAL

TYPICAL APPLICATIONS

The LH0063/LH0063C is a high speed, FET input, voltage follower/buffer designed to provide high current drive at frequencies from DC to over 100MHz. It will source or sink 250 mA into 50 ohm loads (500 mA peak) at slew rates of up to 6000V/ μ s. In addition, it exhibits excellent phase linearity up to 20 MHz.

It is intended to fulfil a wide range of buffer applications such as high speed line drivers, video impedance transformation and high impedance input buffers for high speed A to Ds and comparators.

It can also be used as a diddle yoke driver for high resolution CRT displays*.

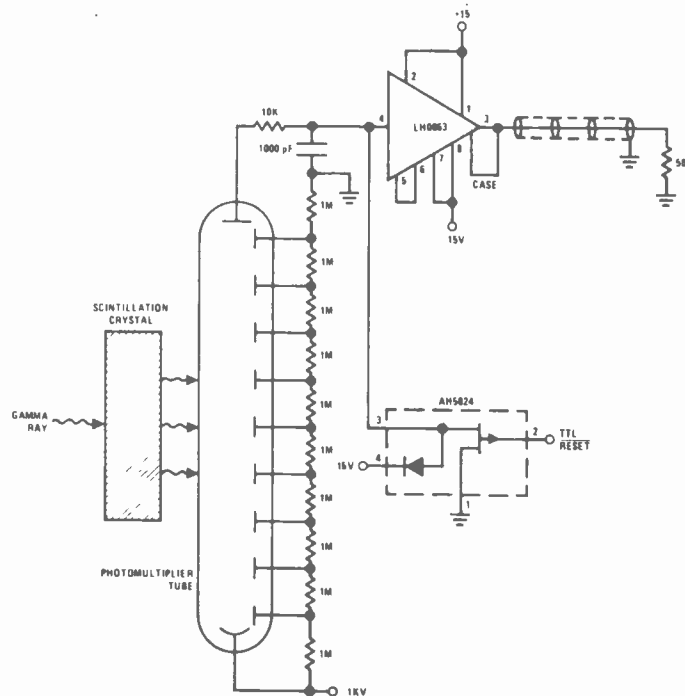
FEATURES

- Damn fast **6000V/ μ s**
- Wide power bandwidth
DC to 100 MHz
- High output drive
+ or - 10 V with 50 ohm load
- Low phase non-linearity
2 degrees
- Fast rise times **2 ns**
- High current gain **120dB**
- High input impedance
10 000 M

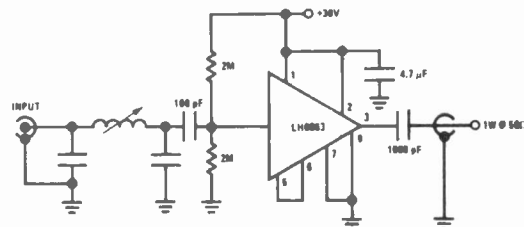
These devices are constructed using specially selected junction FETs and active laser trimming to achieve guaranteed performance specification. The LH0063 is specified for operation from -55 to $+125$ C, while the LH0063C is specified from -25 to $+85$ C. Both are available in a 5W 8-pin TO-3 package.

*NOTE. In VDUs where the basis of operation is for the beam to be pointed at the start of the character and then 'diddled' by means of a separate set of coils in order to form the shape of the character on the screen, the beam being switched on and off as required.

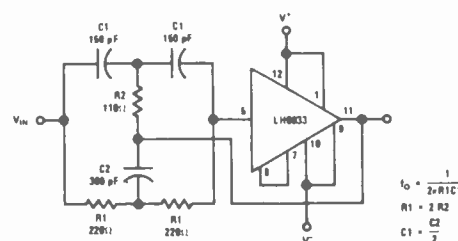
Gamma Ray Pulse Integrator



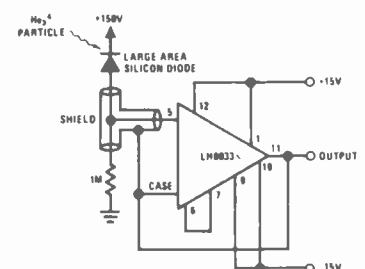
1W CW Final Amplifier



4.5 MHz Notch Filter



Nuclear Particle Detector



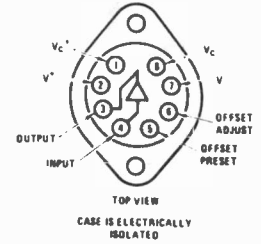
LH0063/LH0063C DAMN FAST BUFFER

NATIONAL

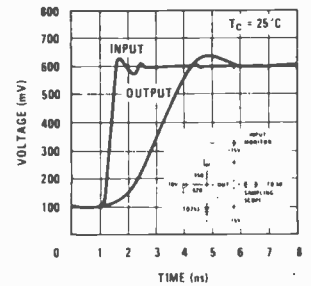
DC ELECTRICAL CHARACTERISTICS

LH0063/LH0063C (Note 1)

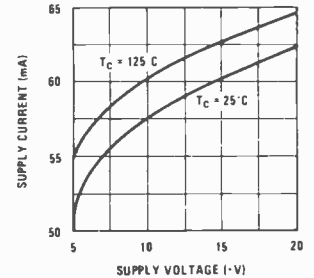
PARAMETER	CONDITIONS	LIMITS						UNITS
		LH0063			LH0063C			
		MIN	TYP	MAX	MIN	TYP	MAX	
Output Offset Voltage	$R_S \leq 100 \text{ k}\Omega$, $T_C = 25^\circ\text{C}$ $R_S \leq 100 \text{ k}\Omega$		10	25		10	50	mV
Average Temperature Coefficient of Output Offset Voltage	$R_S \leq 100 \text{ k}\Omega$		300			300		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$T_C = 25^\circ\text{C}$		.1	.2		.1	.2	nA
Voltage Gain	$V_{IN} = \pm 10\text{V}$, $R_S \leq 100 \text{ k}\Omega$, $R_L = 1 \text{ k}\Omega$	.96	.98	1	.96	.98	1	V/V
Voltage Gain	$V_{IN} = \pm 10\text{V}$, $R_S \leq 100 \text{ k}\Omega$, $R_L = 50\Omega$, $T_C = 25^\circ\text{C}$	.94	.96	.98	.92	.96	.98	V/V
Input Resistance		10^{10}	10^{11}		10^{10}	10^{11}		Ω
Input Capacitance	Case Shorted to Output		8			8		pF
Output Impedance	$V_{OUT} = \pm 10\text{V}$, $R_S = 100 \text{ k}\Omega$		1	4		1	4	Ω
Output Current Swing	$V_{IN} = \pm 10\text{V}$, $R_S \leq 100 \text{ k}\Omega$	.2	.25		.2	.25		Amps
Output Voltage Swing	$R_L = 50\Omega$	± 10	± 13		± 10	± 13		V
Output Voltage Swing	$V_S = \pm 5\text{V}$, $R_L = 50\Omega$, $T_C = 25^\circ\text{C}$	5	7		5	7		V_{PP}
Supply Current	$T_C = 25^\circ\text{C}$, $R_L = \infty$, $V_S = \pm 15\text{V}$		60	75		60	80	mA
Supply Current	$V_S = \pm 5\text{V}$		50			50		mA
Power Consumption	$T_C = 25^\circ\text{C}$, $R_L = \infty$, $V_S = \pm 15\text{V}$		1.80	2.25		1.80	2.40	W
Power Consumption	$V_S = \pm 5\text{V}$		500			500		mW



LH0063 Small Signal Rise Time



LH0063 Supply Current vs Supply Voltage



NOTE 1: Unless otherwise specified, these specifications apply for +15V applied to pins 1 and 2, -15V applied to pins 7 and 8, and pin 5 shorted to pin 6. Unless otherwise

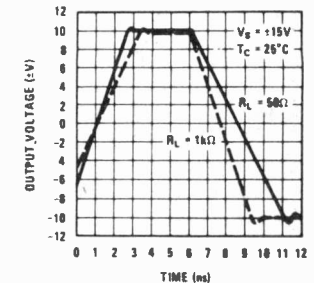
noted, specifications apply over a temperature range of -55 C to 125 C for the LH0063 and -25 C to 85 C for the LH0063C. Typical values shown are for 25 C.

AC ELECTRICAL CHARACTERISTICS

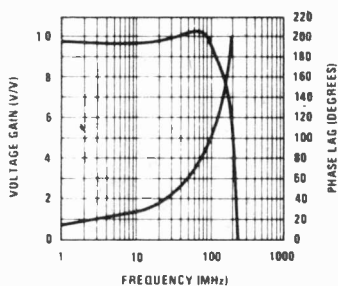
LH0063/LH0063C: ($T_C = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$, $R_S = 50\Omega$, $R_L = 50\Omega$)

PARAMETER	CONDITIONS	LIMITS						UNITS
		LH0063			LH0063C			
		MIN	TYP	MAX	MIN	TYP	MAX	
Slew Rate	$R_L = 1 \text{ k}\Omega$, $V_{IN} = \pm 10\text{V}$		6000			6000		V/ μs
Slew Rate	$R_L = 50\Omega$, $V_{IN} = \pm 10\text{V}$, $T_C = 25^\circ\text{C}$	2000	4000		2000	4000		V/ μs
Bandwidth	$V_{IN} = 1 \text{ Vrms}$		200			200		MHz
Phase Non-Linearity	8W = 1 to 20 MHz		2			2		degrees
Rise Time	$\Delta V_{IN} = 5\text{V}$		1.6			1.9		ns
Propagation Delay	$\Delta V_{IN} = .5\text{V}$		1.9			2.1		ns
Harmonic Distortion			<0.1			<0.1		%

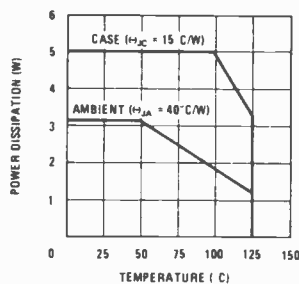
LH0063 Large Signal Pulse Response



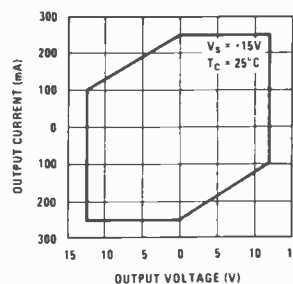
LH0063 Frequency Response



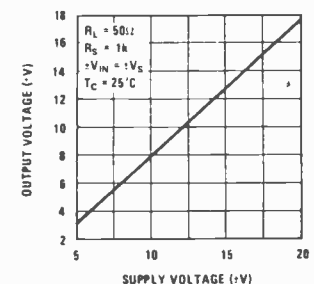
LH0063 Power Dissipation



LH0063 DC Safe Operating Area



LH0063 Output Voltage vs Supply Voltage



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ditto 20p, 2K Helitrim 20p, 5K PCB 20p, 1M
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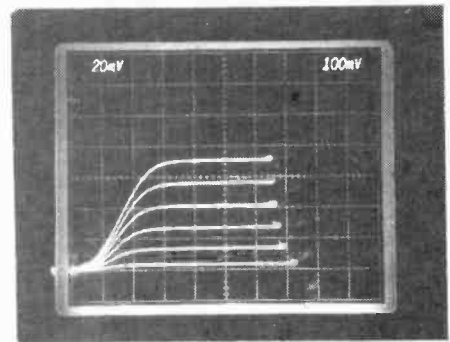
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CURVE TRACER



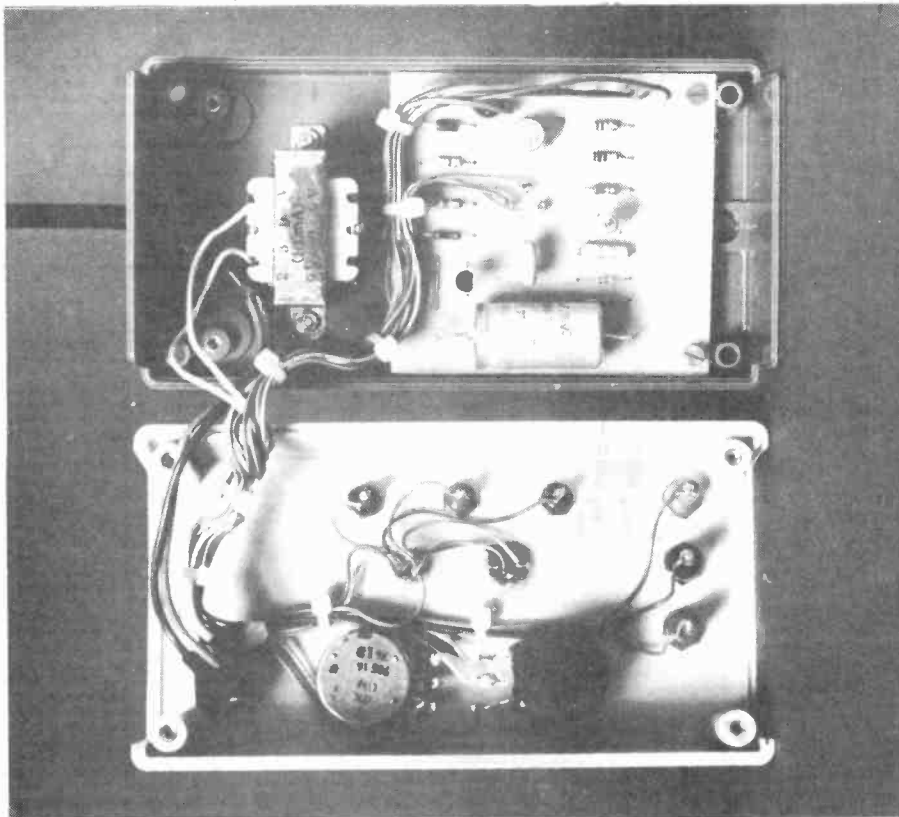
Display the dynamic characteristics of a variety of semi conductor devices with out curve tracer. Design by J. H. Adams.

THE CURVES INVOLVED in this design are not unfortunately those of the Bardots and Welchs of this world but curves that, to some, are just as interesting. The design will allow the dynamic voltage-current characteristics of diodes and transistors to be displayed on the screen of a DC 'scope capable of taking an external X input.

The performance of the unit will not be up to that of a commercial machine but considering such commercial designs are priced in the thousand pound range while our design could be built for around five pounds, we're not doing too badly.



View of the internal layout of the prototype version



Construction of the curve tracer is straightforward. Mount all the components on the PCB according to the overlay. The internal layout of our prototype is shown in the photographs. The unit is mains powered and a battery supply is not suitable for this circuit.

Initially try the curve tracer with a high gain nrn transistor, a BC108 will be ideal. Connect it to one of the tracer's sockets and connect the unit to the 'scope. Set the Y gain on the 'scope at maximum and set up the maximum required level of collector voltage by adjusting RV1. RV2 will control the number of steps displayed on the screen. The X sensitivity of the 'scope should be 1V per division.

The performance of the unit is degraded by the slight drop in the DC potential on C1 during the 10mS sweep and the slight effect of the 100R sampling resistor, in that its volt drop is included in the observed collector potential. However as stated above the unit will give a good indication of the dynamic performance of a wide range of semiconductor devices (as the photograph shows) at a price that is a fraction of similar commercial equipment.

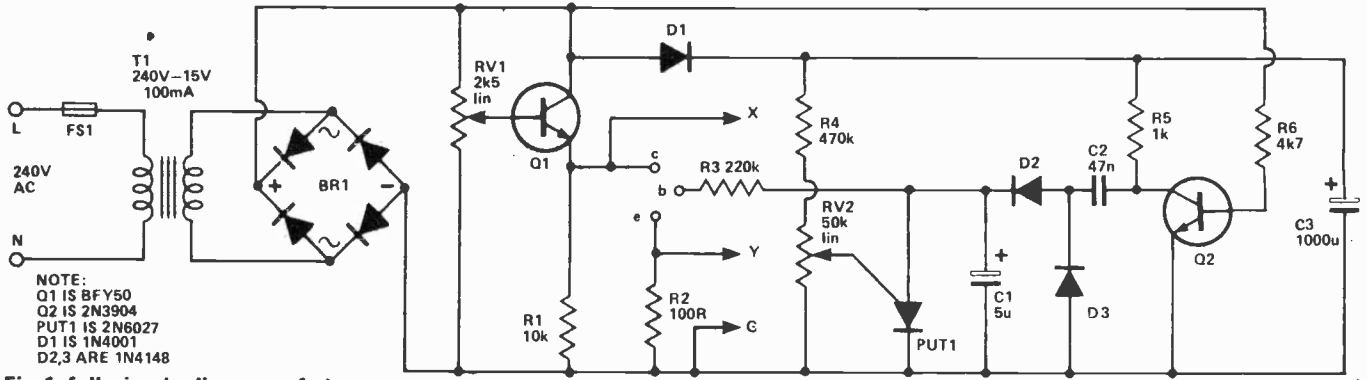


Fig. 1 full circuit diagram of the curve tracer.

HOW IT WORKS

The principles of the full circuit can perhaps be best explained by consideration of a simpler form of the circuit. Figs. 2 and 3 show circuits for investigating the dynamic characteristics of a diode and transistor (at fixed base current) respectively.

The 'diode circuit' will, unless an inverter is available, produce a trace that will appear upside down.

Operation of this circuit is quite straightforward. RV1 allows the peak value of the AC supply to be adjusted. This is then applied to the device under test via a current limiting resistor as well as to the X input of the scope. The current flow in the device at any time is proportional to the voltage developed across a low value sampling resistor in the current path. This voltage is fed to the Y input of the scope.

The simple transistor tester functions in much the same way. RV1 allows the base current to be adjusted within the range 10µA to 100µA.

The characteristics of an N-Channel FET (2N3819) may also be examined with this basic building block. The output characteristics are displayed for a gate voltage selected by RV1. Transfer characteristics (gate voltage vs. Drain Current) may be shown by transferring lead X to the gate terminal and mining the 1000µF capacitor to the 15V supply (observing the change in polarity).

Moving now to the full circuit of Fig 1 that allows a far more informative display providing, as it does, simultaneous displays of the characteristic curves for several equally spaced values of base current.

The circuit operates as follows. Every 10 ms the collector supply swings up and back over a half cycle of the full-wave rectified supply. At the end of each half cycle, there is a short period during which the supply potential is below about 0.6 V, and during this time, Q3 turns off, sending a pulse from its collector into the charge store C1 C2 D3 D2. Each pulse increases the potential in C1 by approximately 0.2 V. This would go on until the potential on C1 was 20 V were it not for Q2, the little known and much mis-described programmable unijunction transistor, PUT. This device is the semiconductor version of a neon lamp, insulating up to a certain p.d. and conducting heavily at potentials above this breakdown value, but with the added advantage in that, through a third terminal, this breakdown potential is programmable over quite a wide range. Varying this control potential through the setting of VR2 sets the

number of steps that will occur before the potential on C1 is great enough to make Q2 fire, reducing the capacitor's potential to approximately 0.6 V and so re-starting the sweep sequence.

The tracer can hardly be expected to match all the performance of a commercial curve tracer, the prices of which range into thousands of pounds. There are errors, due to the slight droop in d.c. potential on C1, and hence in base current, during the 10ms sweep, and due to the slight effect of the 100R sampling resistor, in that its volt drop is included in the observed collector potential, but as can be seen, these are quite insignificant as regards the final display. The only problem which may arise is the appearance of Radio 4 on the current axis (seen as a thickening of the trace). This is easily cured by placing a 10n disc capacitor across the actual Y-inputs of the oscilloscope.

A suitable transistor for the device under test is any reasonably high gain npn transistor, e.g. BC108. VR1 controls the maximum collector voltage, whilst VR2 sets the number of sweeps displayed. With the values given, the difference in base current between one step and the next is approximately given by:

$$\frac{1}{5R} \mu\text{A, where } R \text{ is in megohms.}$$

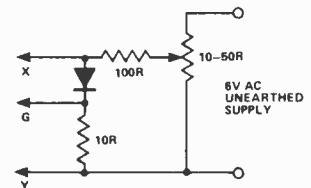


Fig. 2 simple diode tester

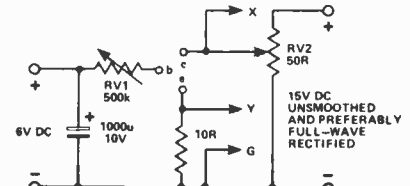


Fig. 3 fixed current transistor tester

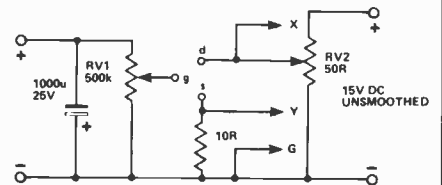
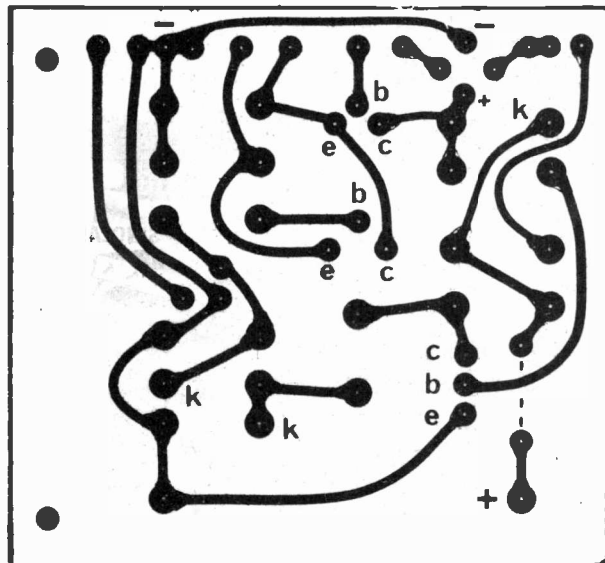


Fig. 4 circuit for investigating FET transfer characteristics.



PARTS LIST

RESISTORS

R1	10k
R2	100R
R3	220k
R4	470k
R5	1k0
R6	4k7

CAPACITORS

C1	5u0 25 V electrolytic
C2	47n polyester
C3	1 000 25 V electrolytic

SEMICONDUCTORS

Q1	BFY50
Q2	2N3904
PUT1	2N6027
D1	1N4001
D2,3	1N4148
BR1	0.9A 400V

POTENTIOMETERS

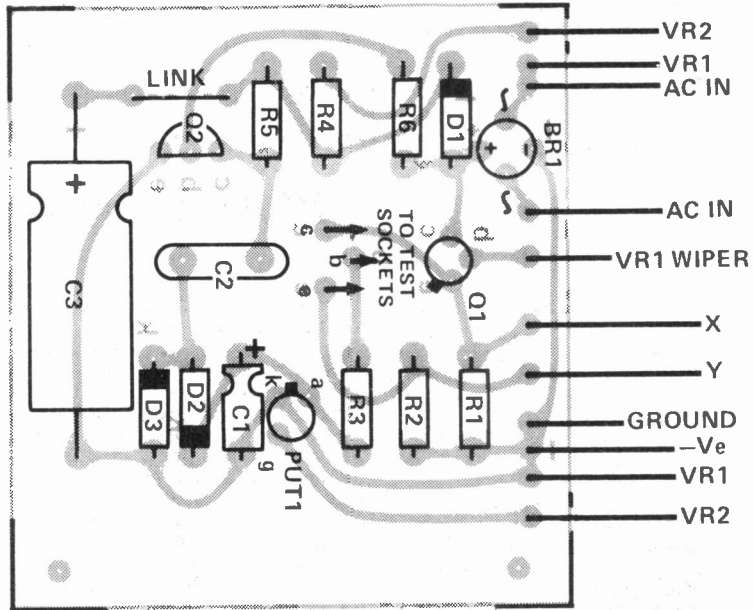
RV1	2k5 1in
RV2	50k 1in

MISCELLANEOUS

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BUYLINES

The components used in this project should in the main, be generally available — the only component likely to cause problems is the PUT, but this should be available from the larger mail order outlets.



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7402	.12	74156	.60	74551	.26	2N2054	.57
7403	.12	74157	.54	74564	.20	2N3055	.57
7404	.10	74160	1.04	74574	.38	2N3752	.12
7406	.27	74162	.80	745112	.56	2N3754	.12
7406	.27	74163	1.18	745124	3.25	2N3819	.29
7406	.12	74164	.87				
7409	.13	74165	.93				
7410	.12	74175	.67				
7411	.21	74176	.84				
7412	.21	74180	.86				
7413	.24	74190	1.04				
7417	.64	74192	.98				
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7437	.23	74LS02	.18				
7438	.23	74LS04	.19				
7440	.16	74LS06	.21				
7441	.50	74LS08	.21				
7442	.38	74LS09	.21				
7443	.85	74LS10	.21				
7445	.67	74LS11	.21				
7446	.67	74LS14	1.10				
7447	.59	74LS20	.18				
7448	.48	74LS21	.21				
7450	.16	74LS22	.24				
7451	.16	74LS27	.26				
7453	.16	74LS28	.29				
7454	.16	74LS40	.25				
7450	.16	74LS42	.54				
7470	.36	74LS51	.29				
7472	.32	74LS54	.32				
7473	.21	74LS86	.33				
7474	.26	74LS90	.66				
7475	.29	74LS93	.86				
7476	.31	74LS107	.34				
7483	.68	74LS112	1.00				
7485	.84	74LS123	.85				
7486	.25	74LS124	2.20				
7489	1.95	74LS151	.95				
7490	.38	74LS153	.64				
7491	.62	74LS157	.64				
7482	.42	74LS164	1.42				
7493	.29	74LS175	1.05				
7495	.51	74LS193	1.33				
7496	.67	74LS194	2.06				
74104	.48	74S TTL					
74105	.48	74S TTL					
74107	.27	74S04	.26				
74109	.45	74S05	.48				
74111	.29	74S12	.28				
74122	.47	74S08	.38				
74123	.38	74S10	.38				
74141	.71	74S11	.38				

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microfile.....

Gary Evans has been out and about this month, taking in a Personal Computer show and visiting a TV studio amongst other things.

THE NUMBER OF shows/seminars concerning themselves with many aspects of Microprocessors and personal computers has, like the hardware itself, shown a dramatic increase over the past few years. Unfortunately not all these events live up to their initial promise and some are not worth the cost of travelling to the venue, let alone the extortionate prices charged for admission to some of these gatherings. The PCW show towards the end of September was a refreshing change.

When it comes to exhibitions, about the only thing to do is to get as many people with products likely to be of interest to visitors to set up a stall. If you can arrange to have some new products launched, a competition and some interesting activity going on in the sidelines — all well and good. PCW did just this and it worked.

I'd have liked to have gone to all three days of the show in order to attend the various seminars held — as it was, last month's ETI was printed at the same time as the show and I was only able to get to the exhibition on the Saturday morning. I suspect the seminars were up to the general high standard of the rest of the event however.

The fact that the exhibition was crowded when I was there, it took me all my time trying to get from one stall to another amongst the multitude of people who see their role in life as standing in the middle of gangways, is not a criticism, more a testament to the show's success.

I look forward to more shows along these lines in the future.

Anita Harris — Pet?

A couple of months ago I went to the recording of a TV show pilot where one of the stars of the show, along with Anita Harris and Roger Elliott, was a Pet Computer.

I'll say more about the show but may I just digress for a couple of lines to tell one of the few after dinner stories I know — this desire having been brought on by the mention of the word pilot above.

If you do certain jobs, being a pilot or trendy journalist are amongst them, when at parties that information is dragged out of you the same string of inevitable questions pour out — different questions for different jobs — but the same questions for the same jobs — if you know what I mean. Very boring. Well, my story concerns a pilot who, being fed up with the situation, in response to the next such interrogation replied "I travel in aluminium tubing" — that at least proved no questions. That's the story then — not very exciting but it's the way I tell 'em

Back to the PET and the TV show however and to why the PET was there. One of the computer's co-stars may have given some of you a clue. Roger Elliott is the TV Times astrologer and — slight groan — the PET was put to the task of flashing Anita's details (astrological) over it's screen.

They say that an actor should never go on stage with animals or small children, for fear of being upstaged. To this list, although for a different reason, should be added small computers. The reason is they very rarely behave for any length of time as Roger Elliott found out when the PET started promising that it was "Time for a song" when Anita obviously was ready for no such thing.

The program was made by HTV who's main claim to fame, or is it eternal damnation, in my book to date is that they produce Mr and Mrs. While not in that league — the pilot was much better — I did not enjoy the show that much but the production team seemed to think it was OK so maybe you'll see it on your screens at some time in the future.

I can't resist just one more tilt at Mr and Mrs — it appears that four of these dreadful things are reeled off in the same day — not all in front of the same audience, who could stand the strain?, especially when you consider that the people who have parted with their hard earned time to watch this entertainment are in the main, old age pensioners, who should really be taking things easier at their age.

I mustn't be too unkind to Mr and Mrs though, after all there is Nicholas Parsons.

Pet Problems

When Julian Allason of PETSOFTE phoned this month to ask if I had any problems I was just about to mention the fact that my car had just fallen to bits, and that my dog had a limp amongst other things when he explained that he was merely reading from the screen of PET which was running a new program called Eliza. Eliza simulates a consultation with a psychiatrist and my encounter with the machine went something like this.

PET What is your problem?
 ME Emotional insecurity
 PET Do you have any psychiatric problems?
 ME Yes
 PET Are you sure?
 ME Yes
 PET: Do not repeat yourself.
 ME Oh God!
 PET What does that suggest to you?
 ME I'm not sure
 PET: Did you come to be because you're not sure?
 ME Yes
 PET: I see
 ME Where do we go from here?
 PET: Why do you ask?
 ME Because I'm not sure
 PET How long have you been not sure?
 ME Five years
 PET: I see

Well, follow that — Petsoft have probably the widest range of PET software in this country with 70 titles in their current catalogue and aims for 100 in the next. A reciprocal arrangement with Personal Software Inc, whereby Petsoft material will be distributed in the United States and Canada and the best of Personal Software's material sold over here means even more to choose from.—If you have a PET, Petsoft are worth knowing.

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Put A Chrysler Sidelight In Your Life

I've been exposing myself this month, but before you get the wrong idea — although I suspect most of you already have, I mean to say that I've been out and about talking to computer clubs.

The meetings ranged in size from the 400 or so at the first meeting of the North London Computer Club,

through a 100 or so at Sussex University to the twenty or so at the Thames Valley group of the ACC's meeting. I enjoyed myself at each event, and picked up some very good ideas from the very high calibre of people that numbered among the audience at each event. Among the handy things I learn't at Sussex was that the exact sequence of operations required to turn the sidelights of a Chrysler Sunbeam on this could not be discovered by your humble reporter, a number of undergraduates and a lecturer in mathematics, but had to be resolved by a call to the car hire firm.

All the clubs would welcome new members — The North London Computing Club is held at the North London Polytechnic, Holloway, LONDON N7 8DB. Tel. Stephanie Bromley — 01-607 8663 (Office), 01-359 2282 (Home), or Mike O'Reilly, — 01-607 2789 ext 2100.

The Thames Valley ACC group meets on the first Thursday of every month at the Griffin (A pub—good move ACC) 10 Church Road, Caversham, Reading, Berkshire.



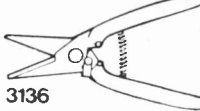
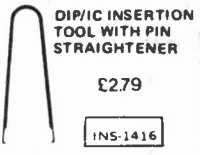
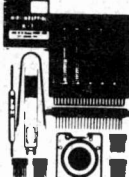



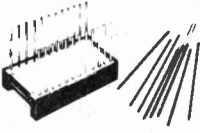

For the Sussex University Group — who will welcome outsiders to their meeting with open arms and hands, for the money you know — Contact. Pete Guile, University of Sussex, Falmer, BRIGHTON, Sussex.

ET

ok

WIRE WRAPPING CENTRE

ok

<p>HOBBY WRAP Model BW 630</p>  <p>Battery Wire-Wrapping Tool Complete with Bit and Sleeve</p> <p>NEW</p> <p>£26.75 B£31.95 C£2.82 D£7.44</p>	<p>WIRE-WRAPPING TOOL For .025" (0.63mm) sq post "MODIFIED" wrap, positive indexing, anti-overwrapping device</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>A Bit for AWG 30</td> <td>BW-630</td> </tr> <tr> <td>B Bit for AWG 26-28</td> <td>BW-2628</td> </tr> <tr> <td>C Bit for AWG 30</td> <td>BT-30</td> </tr> <tr> <td>D Bit for AWG 26-28</td> <td>BT-2628</td> </tr> </table>	A Bit for AWG 30	BW-630	B Bit for AWG 26-28	BW-2628	C Bit for AWG 30	BT-30	D Bit for AWG 26-28	BT-2628	 <p>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.</p> <p>£4.07</p>	<p>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.</p>  <p>3136 £3.46</p>				
A Bit for AWG 30	BW-630														
B Bit for AWG 26-28	BW-2628														
C Bit for AWG 30	BT-30														
D Bit for AWG 26-28	BT-2628														
<p>DIP/IC EXTRACTOR TOOL £1.19 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.</p>  <p>INS-1416 £2.79</p>	<p>DIP/IC INSERTION TOOL WITH PIN STRAIGHTENER INS-1416 £2.79</p> 	<p>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.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Wire-Wrapping Kit</td> <td>WK-4B (Blue)</td> </tr> </table> <p>£19.22</p>	Wire-Wrapping Kit	WK-4B (Blue)	<p>IC TEST CLIPS £2.97 FOR DUAL-IN-LINE PACKAGES</p> <ul style="list-style-type: none"> • Provide full access to integrated circuit DIP leads. • Remove DIP's damage free. • Simplify prototype and production testing, field service work, and quality control. • Available in sizes to accommodate all DIP's; TC-14 fits 14-pin DIP's etc. 										
Wire-Wrapping Kit	WK-4B (Blue)														
<p>FROM 80P TERMINAL AND DISTRIBUTION STRIPS Bread boarding building blocks with universal matrices of solderless plug-in tiepoints.</p> <ul style="list-style-type: none"> • 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. 		<p>HOBBY WRAP TOOL Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0.63mm) Square Post.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Regular Wrap</td> <td>A</td> <td>WSU-30</td> </tr> <tr> <td>Modified Wrap</td> <td>B</td> <td>WSU-30M</td> </tr> </table> <p>A £4.74. B £5.07</p> 	Regular Wrap	A	WSU-30	Modified Wrap	B	WSU-30M	<p>DIP SOCKET Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, tin-plate finish pins .025 (0.63mm) sq., .100 (2.54mm) centre spacing.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>14 Pin Dip Socket</td> <td>14 Dip</td> </tr> <tr> <td>16 Pin Dip Socket</td> <td>16 Dip</td> </tr> </table> <p>FROM 29p</p> 	14 Pin Dip Socket	14 Dip	16 Pin Dip Socket	16 Dip		
Regular Wrap	A	WSU-30													
Modified Wrap	B	WSU-30M													
14 Pin Dip Socket	14 Dip														
16 Pin Dip Socket	16 Dip														
<p>RIBBON CABLE ASSEMBLY £2.92</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>With 14 Pin Dip Plug - 2" Long</td> <td>DE 14-2</td> </tr> <tr> <td>With 14 Pin Dip Plug - 4" Long</td> <td>DE 14-4</td> </tr> <tr> <td>With 14 Pin Dip Plug - 8" Long</td> <td>DE 14-8</td> </tr> <tr> <td>With 16 Pin Dip Plug - 2" Long</td> <td>DE 16-2</td> </tr> <tr> <td>With 16 Pin Dip Plug - 4" Long</td> <td>DE 16-4</td> </tr> <tr> <td>With 16 Pin Dip Plug - 8" Long</td> <td>DE 16-8</td> </tr> </table> 		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	<p>OK Machine & Tool U.K. Limited 48a The Avenue Southampton SO12SY Telephone Southampton (0703) 38966 7 Telex 477222 Cablegram OKMAC</p> <p style="text-align: center; font-size: 1.5em; font-weight: bold;">DISTRIBUTORS WANTED***</p>	
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														

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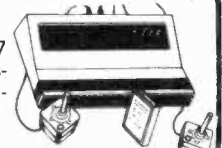
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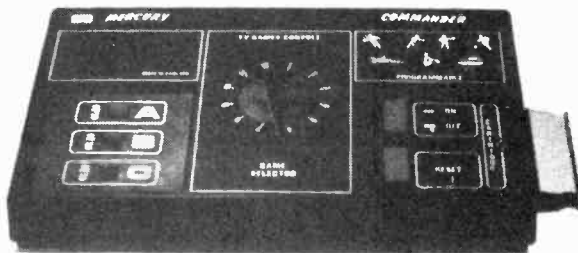
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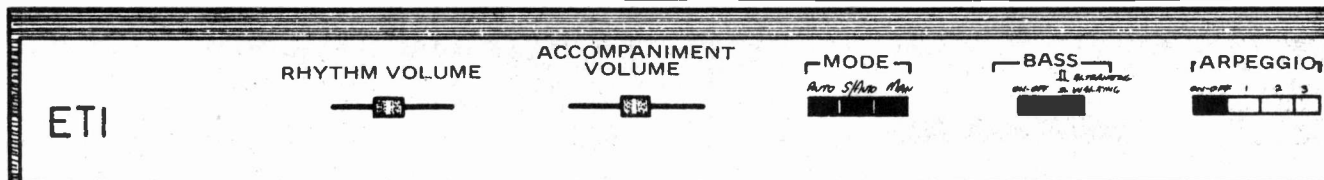
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AUTOCHORD

PART TWO



THIS MONTH WE complete the description of the auto chord instrument. Last month's article covered the circuit descriptions of the various blocks that make up the unit and of the operation of the complete design.

This month we complete the project by describing the construction of the instrument.

Construction

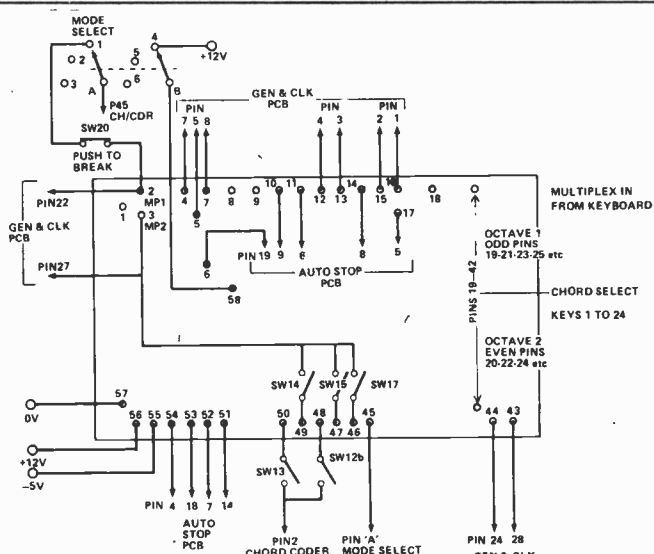
The components should be mounted on the PCBs according to the overlays shown. Pay particular attention to the diodes, capacitors and other polarity sensitive devices.

The project involves a great deal of interwiring between the various boards and switches of the design.

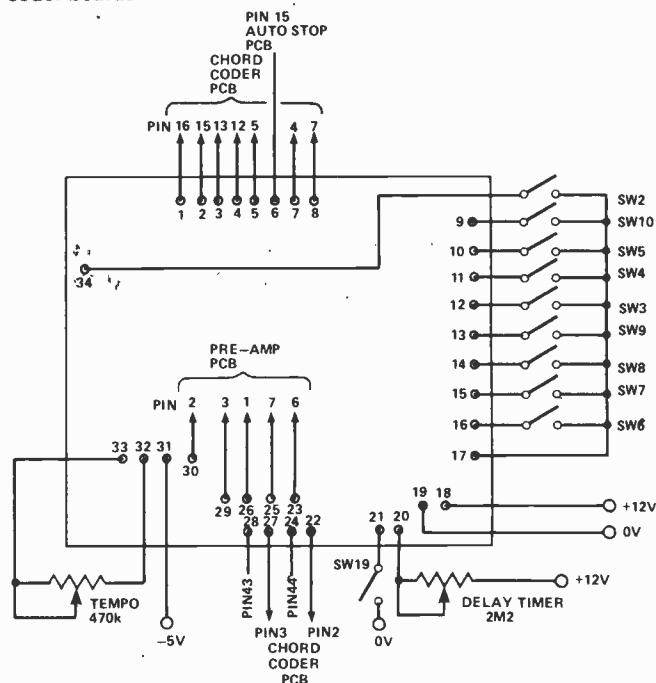
The interconnections are shown in the accompanying diagrams and great care should be taken to ensure that no errors are made at this stage — they will prove difficult to trace at this stage.

We give no details of the housing of the project as this will depend entirely upon the instrument in which the auto chord is to be installed.

The finished unit can be added to most organs, being easiest to fit to a unit that uses DC keying. In use the project should add an extra dimension to even the most limited of musicians efforts.



Above and below interconnection details for the generator and coder boards



Part two of the autochord project details the construction of the instrument

Maplin
Electronic Components
1000 High Street, London W15 7PN
Tel: 01-899 6909

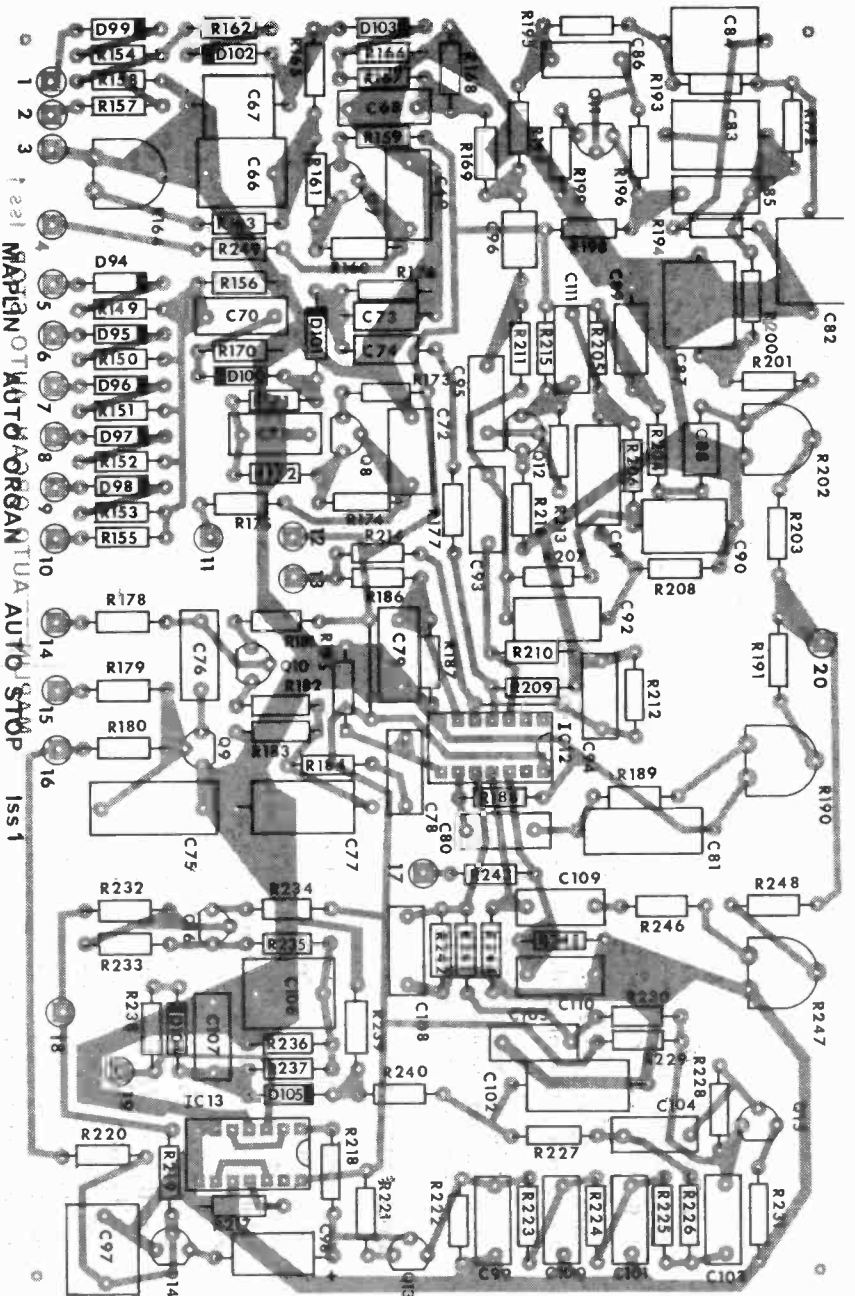
RHYTHM SELECT
Auto Stop Timer
Auto Stop Timer

AUTO STOP TIMER
Auto Stop Timer

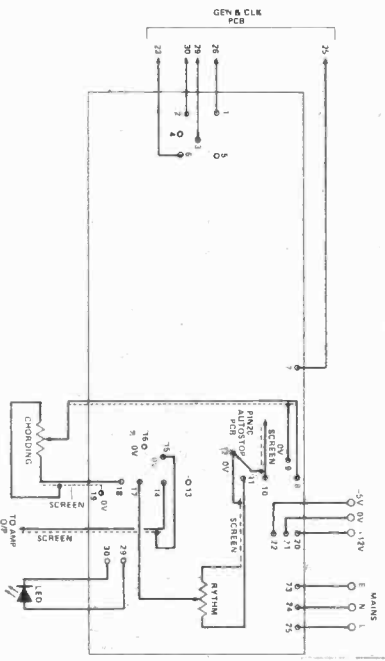
Auto Stop Timer
Auto Stop Timer

Auto Stop Timer
Auto Stop Timer

Auto
Organ

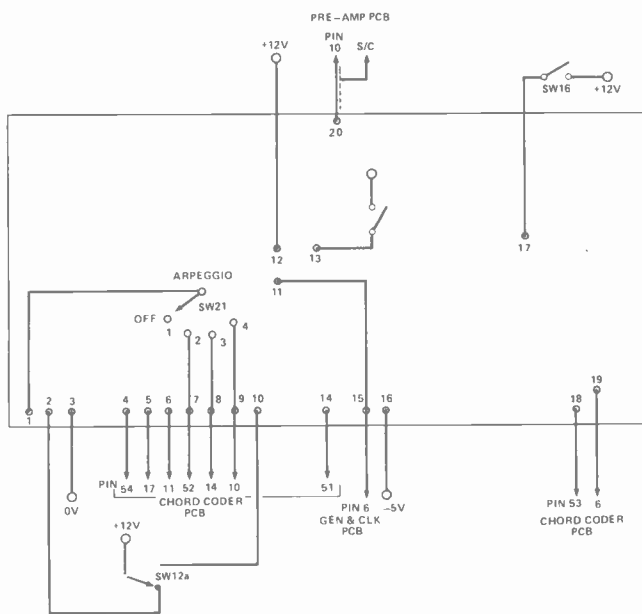
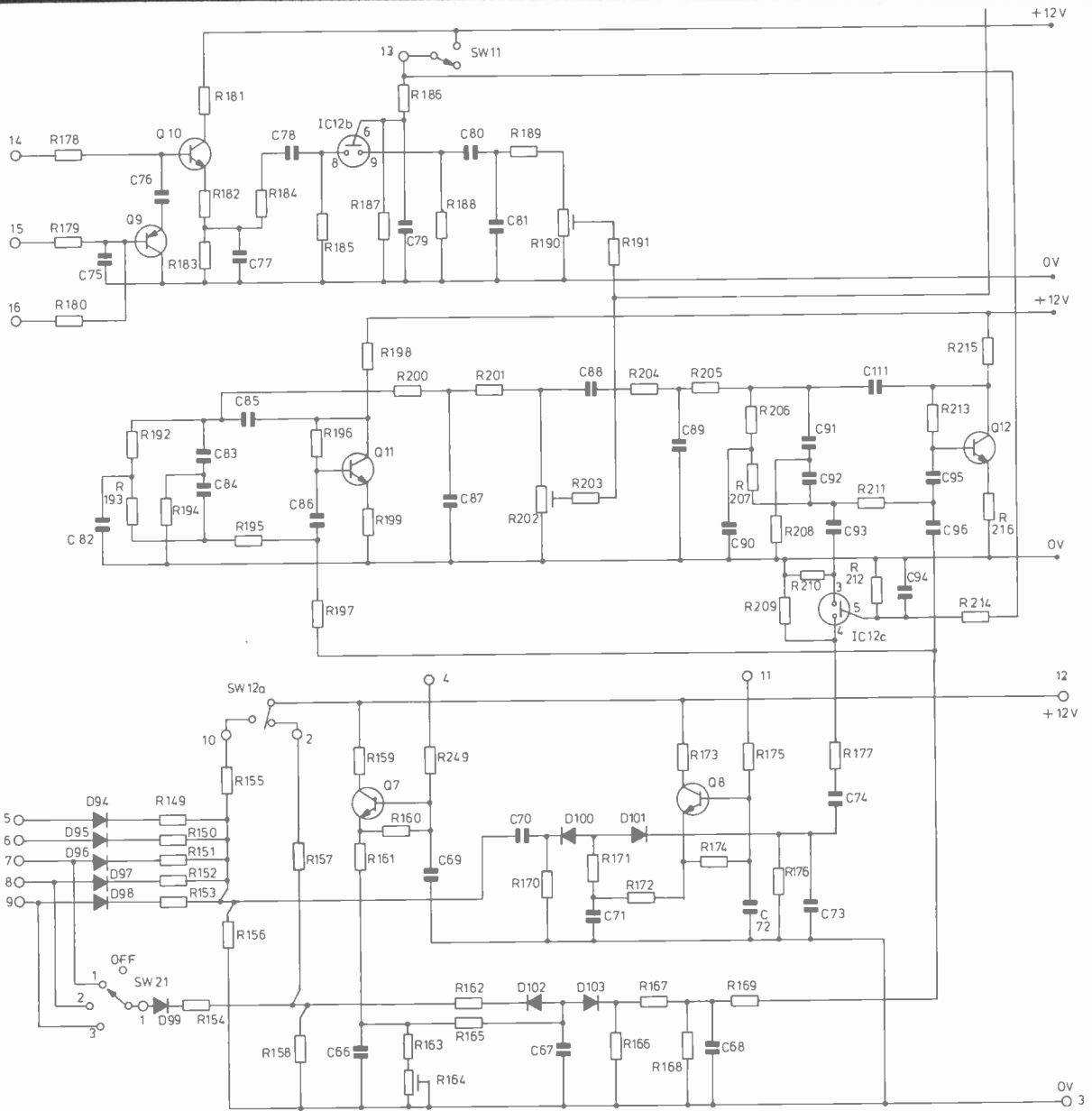


Power supply and voice generator connection details

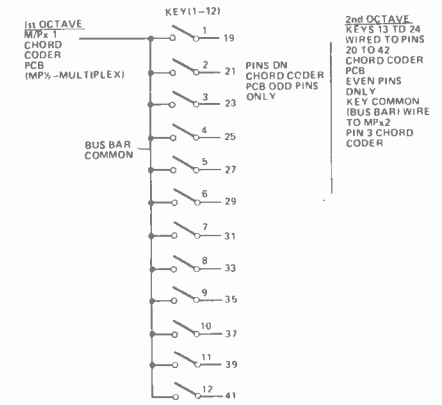


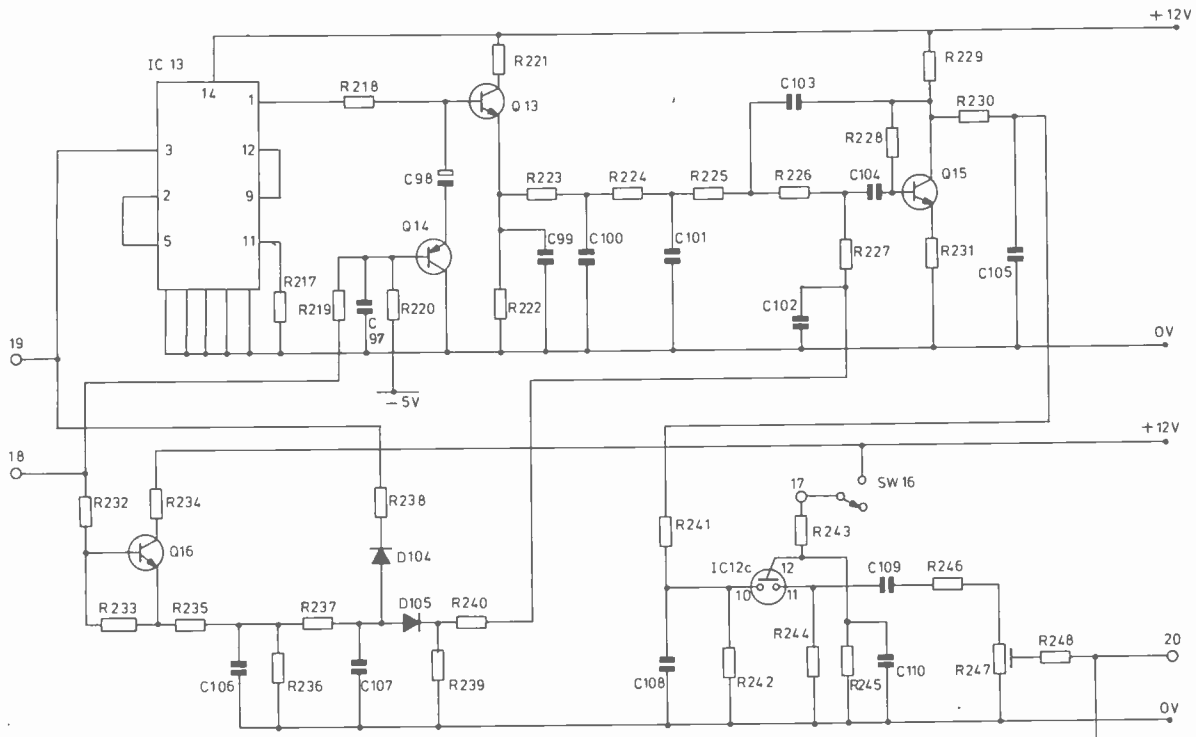
Maplin Electronics will supply a complete kit of parts, including screened boards, for this project. See their advert for address and telephone number.

BYLINES



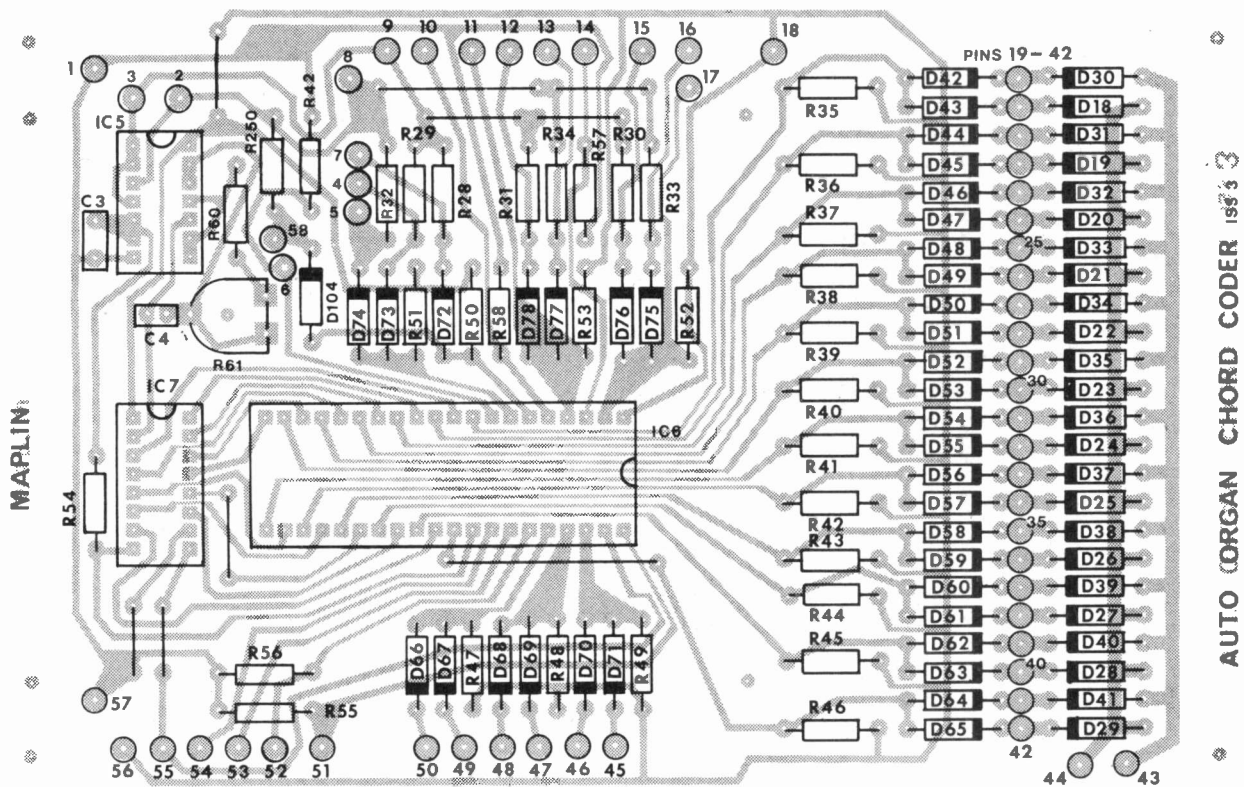
KEYING ARRANGEMENTS

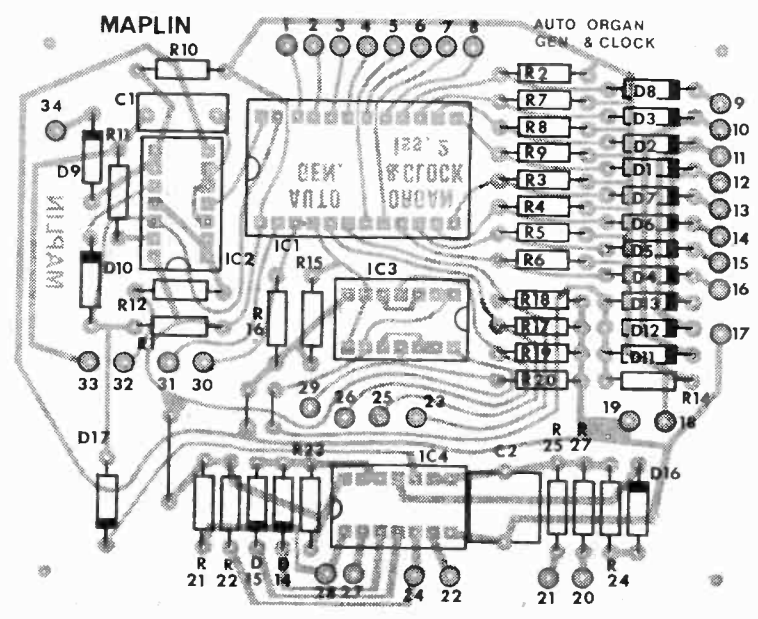
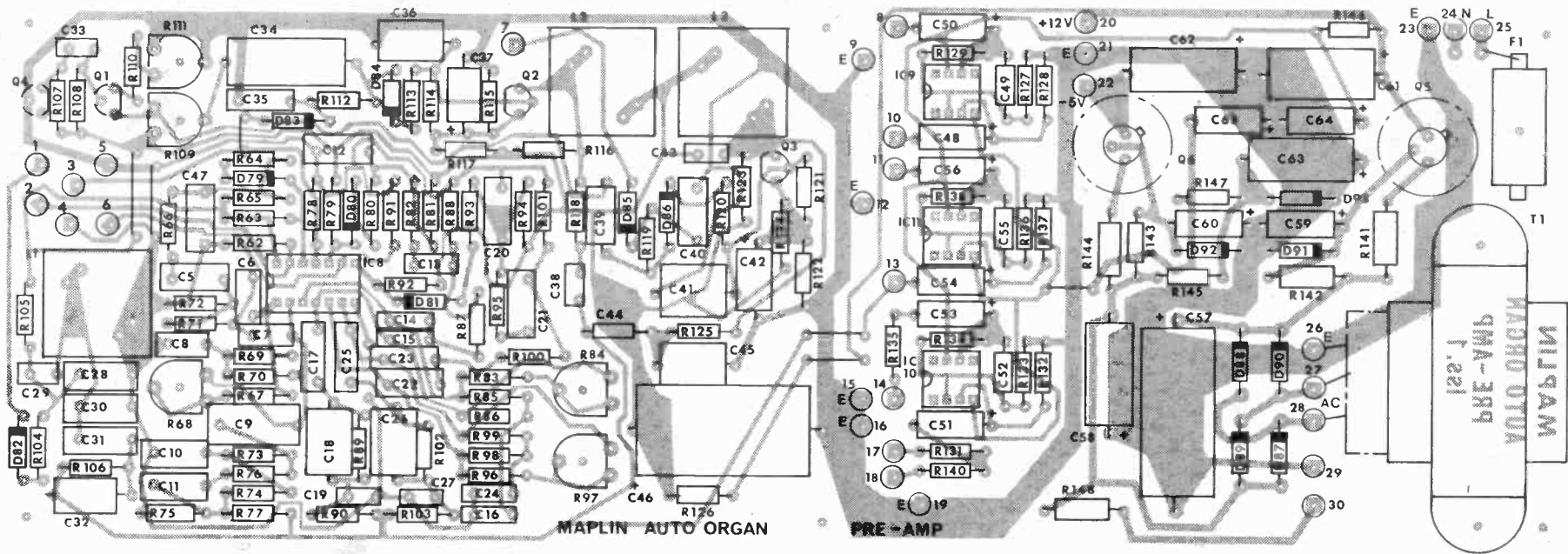




Above, and to the left, circuit diagram of the auto stop module

The overlay for the chord coder is shown below take care that all the diodes are inserted in the right position.





Above the power supply and pre-amp board of the auto organ. The interconnections between this and the rest of the boards are shown in the accompanying drawings.

Left is the overlay for the generator and clock section of the auto organ.

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Our Price **£21.95**



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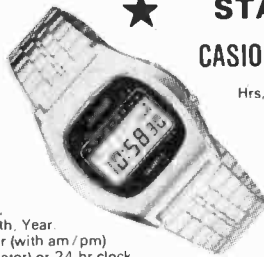
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THIS MONTH'S



STAR BUY



CASIO 54QS-16B

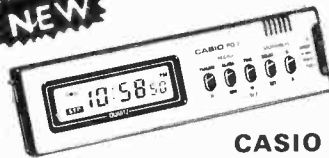
Hrs, mins, secs, day.
OR Hrs, mins,
date, day,
10 secs, secs
by flash

Day,
Date,
Month, Year.
12-hr (with am/pm)
indicator) or 24-hr clock.

Stainless steel. Mineral glass.
Water resistant to 100 feet.

£39.95

NEW



CASIO PQ-7

TRAVEL ALARM CLOCK

Battery-powered quartz alarm clock with repeat feature. Countdown alarm/timer 1/10 second stopwatch. Constant LC Display. Nightlight. 1 year batteries. $4\frac{1}{4}$ x $1\frac{1}{4}$ x $\frac{1}{2}$ inch. 1.6oz. For caravan or boat. (£24.95) **£19.95.**

SOLAR powered watches — so called. We won't sell them. Send us a S.A.E. and we will tell you why not.

CBM Giant 4 digit. 5 functions. Light.



5903 (£15.95)
Chrome
Bracelet

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Gilt
Strap

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ALARM

6 digits, 6 functions, plus backlight and alarm setting.
5-minute snooze facility (£28.95)

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PH-ALARM/CHRONO

Hours, minutes, seconds or date, day, am/pm indicator. Day, date, month, year. Chrono measuring net, lap and 1st and 2nd place times from 1/100 second to 1 hour. All Stainless Steel, Mineral Glass. Not to be confused with cheaper models with chromed case and plastic.

£39.95



LADIES' LCD WATCHES

5 functions, backlight. Gold or Silver finish (please specify).
Dress Watch. Round. Milanese bracelet **L1 £14.95**
Cocktail Watches. Integral bracelet. 3 styles **£18.95**



CASIO LADIES' LCD WATCHES



7 + 2 functions
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(£35.95)

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Stopwatch
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52QS-14B

Right 8 mm
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£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
(£35.95)

£29.95

51QR-19B. 6 digit
(£44.95)

£34.95

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. Selectable 12 hour (with am/pm) or 24 hour clock.

54QS-16B
Left, 6 digit
(£49.95)

£39.95

54QS-15B
6 digit
(£54.95)

£44.95



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 (£69.95)

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29CS-11B
World Time (£84.95)

£69.95



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

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£54.95

25CS-16B
Square (£84.95)

£69.95



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 (£74.95)

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49CS-25B
6 digit (£84.95)

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Not illustrated 53CS-19B, 4 digit, barrel shaped, **£64.95.** 49CS-24B, 6 digit (£79.95) **£64.95.** 53CGS-17L. Gold plated, on strap (£84.95) **£69.95.**

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LOOK

Our 2nd edition illustrated catalogue is now available. The much increased range shows many welcome price reductions.

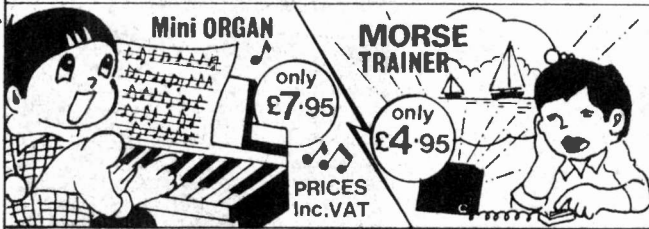
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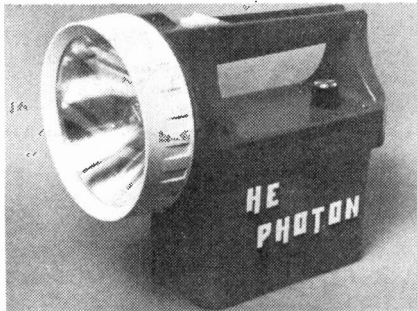
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Hobby Electronics

Next
Month

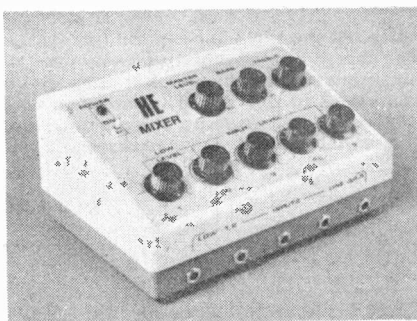
The December issue will be on sale on November 10th

Light Beam Phone



True wire-less communication for which you don't need a licence! Our project next month — which we are calling the 'HE Photon Phone' uses two standard torches which we've converted — all the electronics fit into it beautifully. In our tests we've been able to make our units work over a distance of 50 feet; even if you don't want to build it, you'll be fascinated by the techniques there's even a remote control facility included.

Audio Mixer Project

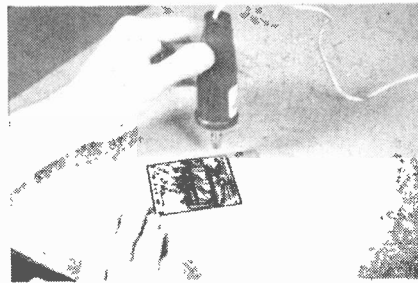


A really neat project designed by a professional audio engineer — that's a quick summary of our mixer, choose your own number of inputs (we've opted for three high level and two low level ones). There's a bass and treble control and of course a master level control. Building it should be simplicity itself as everything, including the level controls is on a single printed circuit board. Power is supplied by two PP3 batteries; inputs and outputs are via standard jack sockets.

Bias

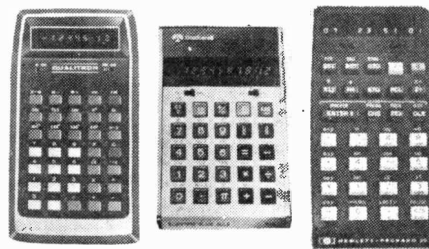
No — not political, tape. Why do you need a high frequency signal added to a tape recording — you never hear it so why is it necessary? Next month we tell you.

DIY PCB's



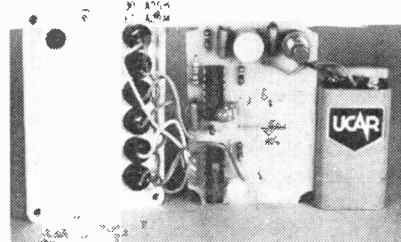
The neatest way to build a project is on a PCB — few would deny that, yet PCB's are frightening to those who haven't tackled them before. Next month we will be launching Hobbiprints — a really easy way to make the PCB's which we show in HE and we'll show you how to use them.

Calculators



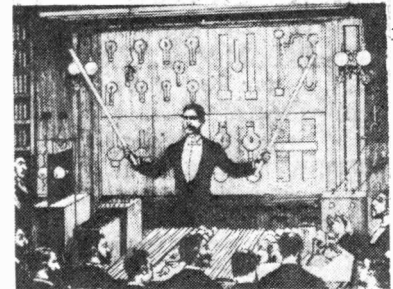
The world of calculators has gone the way of HiFi — the facilities offered often cause confusion. We take a look at the current terminology of the calculator market enabling you to find out if the facilities offered are really the ones you want.

Electronic Dice



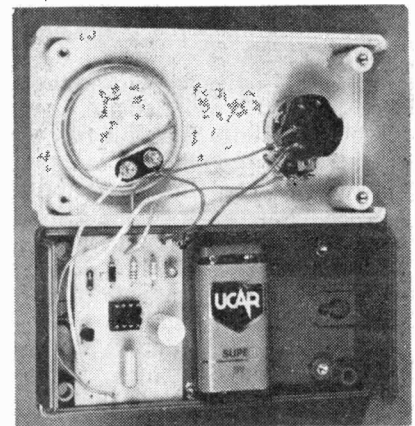
Press the button and one of six LED's comes on at random. From the photograph you can see this is really a straightforward project. The light stays on automatically — there isn't even an on-off switch!

The Tesla Controversy



Nikola Tesla was without doubt a genius — he even has a unit of measurement named after him — but even 35 years after his death there are those who believe that much of his work has been suppressed.

Metronome



Using just a single 555 IC, this project can be built on either a PCB or Veroboard — we give you details for both. The beat rate can be varied from 30 to 120 beats a minute.

SPECIAL OFFER

Next month you'll be able to get a top quality soldering iron, either 240V or 12V, through our offer in HE. Today's regular price is £4.00 but next month you can get this for:

£2.35 inc.

audiophile.

Ron Harris takes to the high seas this month — well the Thames anyway — to discover a remarkable new drive unit from Strathearn. Back on dry land news of a linear motor tone arm

IT WAS ENOUGH to make Nelson spin in his grave. One of Her Majesty's ships, battle-worn from the fire of enemy guns, put to use as an area to hold a press reception! And for something as totally unmaritime as loudspeakers!

Mind you, HMS Belfast can only be considered appropriate, for it was Strathearn Audio (based in Belfast and government owned) who sent me the music echoing through the wardrooms.

The occasion was the launching — for once no pun intended — of their new speaker system, the 21000. This is a 'four box' affair with the base units cast loose from the rest. Frequencies up to 500Hz are handled by the 8" bass drivers reflex mounted in the enclosures. Above 500Hz everything is produced by the real star of the system, Strathearn's new driver, the SLC2.

Film Star?

The principle on which these speakers operate is very similar to that of the Wharfedale Isodynamic headphones. In the SLC2 an aluminium conductor, about a metre long, is bonded onto a polyester film which is stretched inside a moulded frame about 130mm x 600mm. Rows of magnets flank the diaphragm creating a high uniform field in the vicinity. When the signal current passes through the conductor it is driven by the force generated due to its being in a magnetic field.

Thus the polyester film is the speakers 'cone' if you like. Since this will radiate from both front and back (dipole radiation) the unit has damping pads fitted to absorb the anti-phase rear radiation. Mass of the driver is very low, so very little overhang to worry about. As the area is effectively all driven, it should not 'break up' at all on any input signal.

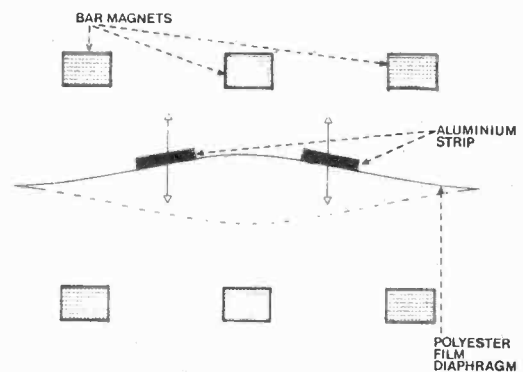
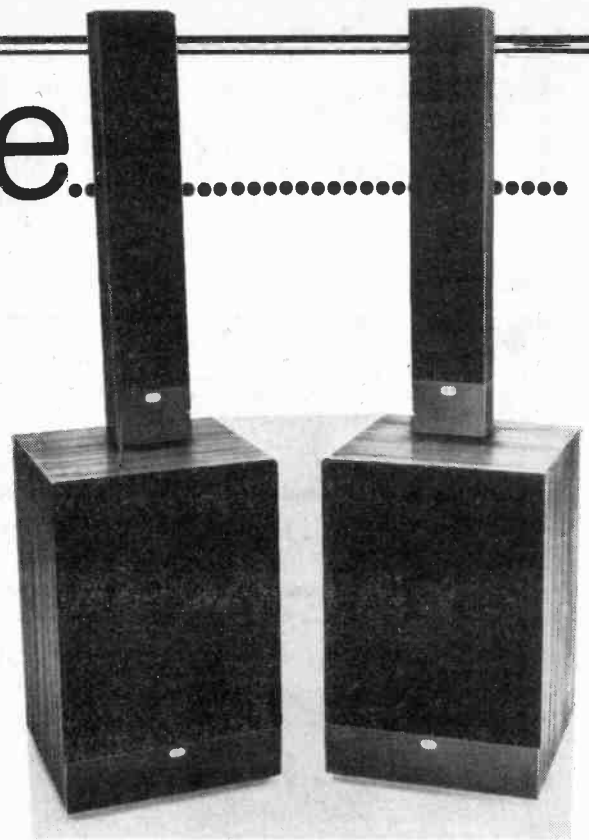
The only drawback is the very low impedance of the aluminium strip itself — about 0R5 in fact. In order to make this usable Strathearn have transformer coupled — which at least makes the unit adaptable to any required input impedance.

To claim, however, that this produces a purely resistive load is at best extremely optimistic, at worst

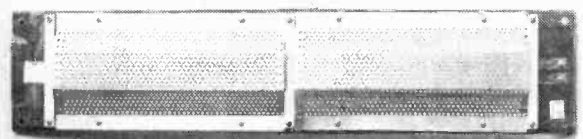
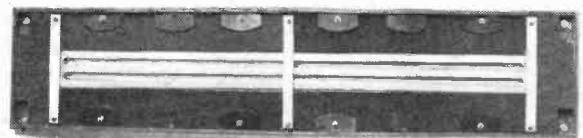
Sound Track

I'm going to reserve judgement on the 21000 system as a whole until I've had an opportunity to listen under more favourable conditions than HMS Belfast at 100°F with 49 other people crowding me lugholes! It was clear though that the SLC2 is a remarkable unit, and is perhaps worthy of better. We shall see.

The system sells for £375 RRP, and is expected to have appeared in the shops by the time you can get down there.

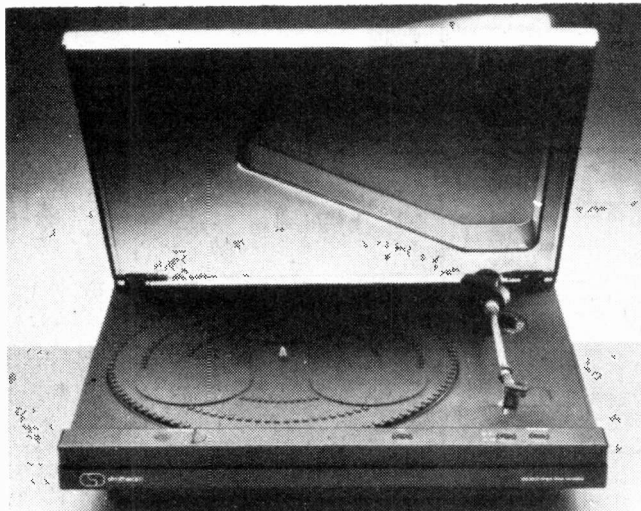


The 21000 from all angles. At the top we have the full system. Below that the diagram shows the operating principle of the SLC1. The polyester diaphragm acts as the speaker cone. Below this caption two internal views of the unit. The radiating areas can be seen in the top diagram, and the lower rear view illustrates the damping material to control rear radiation.



Decked Out

At the same demo Strathearn were using their SM2000 turntable as the sound source. It was a good advert. They had a line of Sonus, Supex, ADC, Shure and Ortofon cartridges all neatly installed in spare carry arms, and all of which tracked very well when asked to. Several people — me included — were surprised at the ease with which the SM2000 handled these devices and



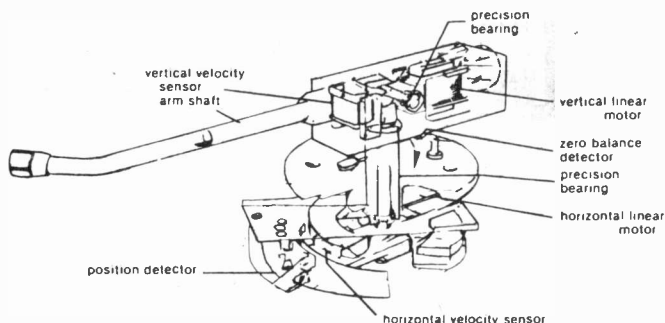
how well the sound each is capable of was preserved. Indeed on this evidence the SM2000 is a very capable unit indeed — a comparison with some better established machines (including schhh — you know what) might be very interesting indeed. How about it, Strathearn?

Details of both from Strathearn Audio Ltd, Kennedy Way Industrial Estate, Kennedy Way, Belfast.

Arms Against The British?

There can be only two basic ways of doing a job — simple and complicated. Both can take vast amounts of thoughts to realise (who said simple meant obvious?) and are capable of excellent results. Witness belt and direct drive turntables as represented by the Linn and the Technics SP10.

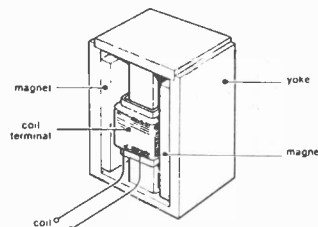
Sony have applied the latter approach to pickup arm design with the result that they end up with two linear motors, two velocity sensors, two position sensors, a deal of electronics and potentiometers to set tracking weight!



Exploded view of the Sony motorised pickup arm. Tracking weight is applied by a potentiometer mounted remotely on the plinth.

In fact the velocity sensors are simply two more linear motors used as generators. Servos drive the motors which take the arm across the record in the proper manner. In the vertical direction too all control of the arm movement is down to a linear motor. Arm resonance is suppressed, by varying the current to the coils — from somewhere around 25dB in an undamped system to about 3dB in the Sony system using their XL55 cartridge.

Right: A close up of the linear motors used in the arm design. These double as position sensors by using the same device as a generator, i.e. allowing them to be moved by the arm and measuring the current generated in the coils.



Advantage Complications

Gains from this method are claimed to be insensitivity to external vibration, improved tracking and better definition and imaginery. Bias of course can be forgotten, as the motor controls movement across the vinyl canyons, and tracking weight can be changed while the stylus is in action.

All this sounds well-nigh perfect does it not? On paper the design looks marvellous (so did the Titanic — cynic) but we shall have to wait until they market it in this country to find out *how* good it is. Meanwhile eat your heart out SME!

From Service to Taste

A little congratulation and a whoopee cushion to finish on. Firstly many thanks to Celestion for some fast excellent service this month. Some nameless person from the pit (no not me — *another* one!) blew a bass unit in one of our Ditton 66's. One phone-call later I was on my way to pick up a replacement from Ipswich. And that four years after buying the speakers — and it was our fault. Nice to be able to commend a big hi-fi firm for service for a change.

Now Audiophile enquiry service is normally dealing with people with impeccable taste. However it appears there is one exception. So that this person does not have derision heaped upon his unworthy shoulders and be cast from the company of his peers let us refer to him as Mr Smith.

This person wrote in — nothing wrong there you may say — he even dated his letter. Again nothing amiss about that. Trouble was he 'dayed' and timed it too. I quote with shaking head and furrowed brow . . .

"So at 8.05 pm on Thursday evening I am turning off some corny comedy on the television set to write enquiring about . . ."

There we have it. The heronion crime is in the open. Thursday eh? 8.05 eh? Corny comedy eh? The only comedy on TV at that time is the 'Good Life' — which any human male with a micro-gram of taste and appreciation of the opposite gender should be watching avidly for the glorious presence of Felicity Kendal!

Oh Mr Smith may your hi-fi forgive you — I cannot!

ETI

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.

Pot Cores. We have now received our delivery of Ferro pot cores. These are ex unused equipment. They contain the bobbins but of course these have to be wound and you would have to unwind. Three pairs available.

FX 2243	4.5 cm	3.0 cm	81
FX 2242	3.5 cm	2.3 cm	70 per pair
FX 2240	2.5 cm	1.6 cm	60 per pair

Quantity discounts apply.

Component Panel Ref. 3055. Taken from unused P.S.U.s, these contain 4x2N 3055 power transistors with mica insulators all on heat sink and 4 variable pots, preset type with spindle locks. Real bargain at £1.08 each.

Component Board 421. Again from unused equipment, major items on these are two power silicon transistors, Motor Rola ref. SJ 5433 mounted on a heat sink with mica insulators, also behind the panel are two power rectifiers ST NS 100B. Price 9.6p.

E.H.T. Mains Transformer. With induction control, normal primary and output voltage approx. 4kV 3mA. Voltage can be varied by applying DC to lower bobbin. Unused, ex P.S.U.s. Price £4.32.

Mus. Centre Dust Cover. Size 12 x 10 x 1 1/2" with attachments for hanging. Price £3.95. Covers only.

Hi-Fi Console. Pleasingly designed shelving arrangement which could tidy up your equipment, sorry it's called only but a real bargain at £7.35.

Telephone Answering Machines. Used but apparently complete and probably in working order. However, we are allowed to supply these only for breaking up, they should be very suitable for conversion to open reel tape recorder, background music machine, echo chamber, etc. All untested but we guarantee to replace any major item in the machine should it be faulty. Machines less outer case £7.50 case slightly broken but substantially whole £10.26. Unbroken cases £12.45 and finally with new looking cases £14.50. Post £2.50 per machine. Many accessories available for these machines. Please enquire.

Wall Mounting Thermostat. The Satchwell room stat. Mains 20 amp suitable over normal air temperatures between 30-80 F. Suitable also for greenhouse control. Nicely finished in white enamel. Price £3.25.

10 r.p.m. Motor with 230v mains coil. Not like the usual of these geared motors this has a good length of 1/4" shaft. Price £2.50+20p.

Rigonda Intermzzo 10+10 hi-fi amplifier with belt driven record deck with speed control and strobe check. The best hi-fi offered by Rigonda. Original selling price was in excess of £125. We have approx. 50 of these unused but with various faults. Untested. Believed complete except for cartridge and speakers. Offered at £33.50, less than the price of the very high quality deck incorporated. If cannot collect add £3 to cover the special packing and carriage charge.

Loudspeaker Grill. Good quality rigid plastic, ideal for use in car or home systems on speakers. Two sizes available 12 x 12 — 85p, 18 x 18 — 60p.

6 Digit Counter — Resettable, coil voltage 48 DC or 115V AC, current 100 mA approx. Price £2.10.

10 Digit Switch Pad. Made, we believe, for GPO pushbutton telephones, each button operates 2 pole switch which returns when depressed, panel size 2 1/2" x 3 1/2" x 1 1/2" pushbuttons with clear plastic protected digits 0-9. Price £2.16.

Mains Blower. Real bargain blower made by Smiths, the motor is let into the turbulator so these can be stacked sideways to give variable air outlet using the minimum of space. Overall size of the blower is 7 dia x 2 1/2" and the air outlet 1 1/2" x 2 1/2". Price only £2.50.

Dial Indicator used for tool making and precision measuring, the famous John Bull shows differences of 0.1 mm. A beautifully made precision instrument, price in most tool shops would be £12-£15. We have a fair quantity, price £10.75.

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.

A Special Bulk Purchase enables us to offer this keyboard at a lowest ever price. 49 Coded keys encoded into a direct TTL compatible 7 bit output. Features: such as delayed strobe, 5 volt D.C. single rail operation and rollover protection make this an absolute must for the MPU constructor! Supplied complete with connection diagram and edge connector, at a secondhand "no time to test" price of only £18.63, post £1.50.

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Interested in Tape Control? American made type 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 NCR Class 46-2 reference 205 H8 R56, these are B bit tape punches, powered from 115V 50HZ in very good condition with tape £1.6, carriage £3.20.

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10v-0-10v	4 amps	TM 50	£3.78	£1.25
10v-0-10v	12 1/2 amp	TM 15	£4.86	£1.25
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13v	100 mA	TM 21	£1.62	40p
13v	1/2 amp	TM 7	£2.16	50p
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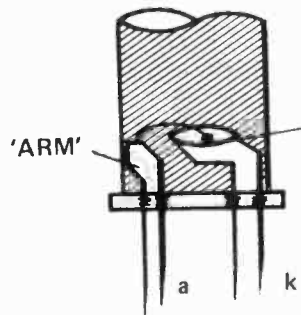
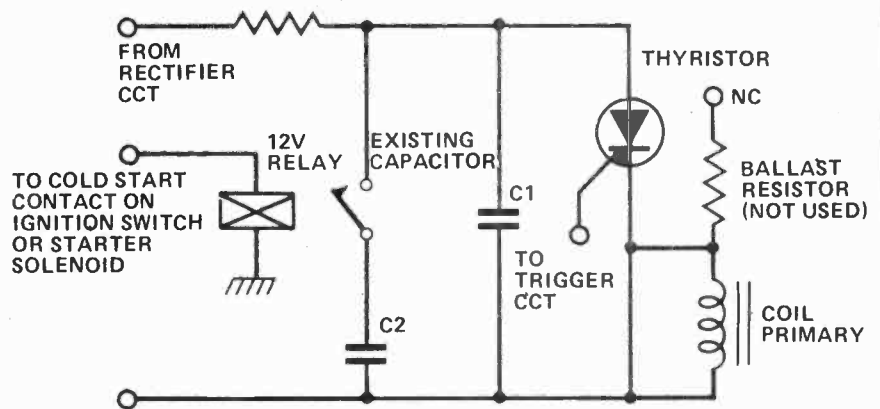
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'Cold-start' For CD Units

T. Lyons

Many cars are fitted with cold-start coils, which operate at full current only on starting, then are fed via a ballast resistor. This resistor is normally discarded when CD ignition is fitted, and the coil is run at 'full power' all the time. It's a simple matter to arrange for the cold-start circuit to operate a relay inside the CD unit which switches in a second capacitor C2 across the main one, thus increasing the energy of the spark when the engine is starting. After starting, C2 is no longer in circuit and the main capacitor C1 alone supplied current to the coil, thus alleviating any charging problems with attendant loss of power at high revs.

RLA is any 12 volt relay, and C2 can have the same value as the existing capacitor C1, usually 470n or 1u0.



LED Spotting

A. Kenny

Since the leadout on LED's varies according to the manufacturers preference, leadout diagrams are not always worthy of the trust placed in them. In some cases a reverse connection will destroy the device being used.

A simple way to avoid this is to use the following technique:

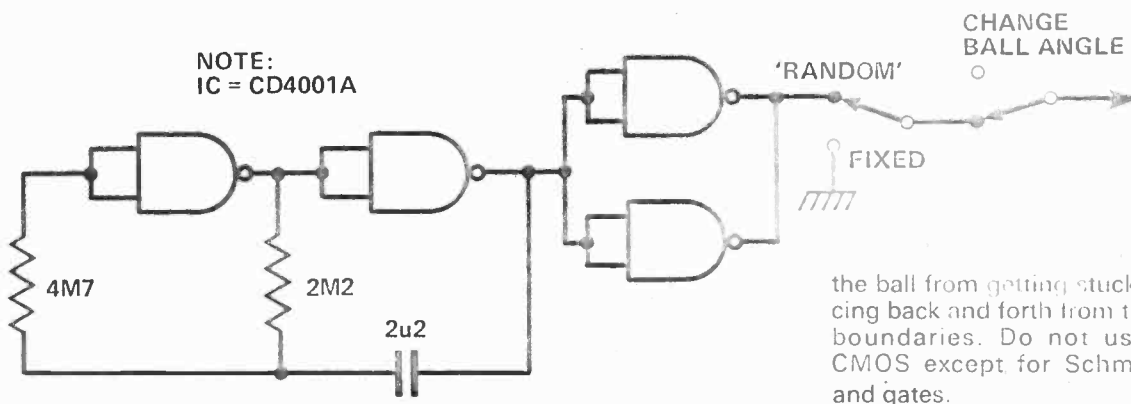
If the LED is held up to the light, the structure can be clearly seen. There is a "cup" and an "arm" carrying a fine wire to the LED itself, which is in the "basin" of the cup (see drawing).

The lead with the cup is the cathode, and the other is the anode (of course).

TV Game Resurrection

S. Rice

Now that the novelty of TV games has worn thin and most of the units are gathering dust in the corner reserved for other five-minute wonders, here's a chance to add new spice to leisure time. The circuit is an oscillator clocking at about one cycle per 4 seconds. This switches the ball angle "randomly" making the game unpredictable and difficult. Also this prevents



the ball from getting stuck and bouncing back and forth from the bats and boundaries. Do not use B suffix CMOS except for Schmidt trigger and gates.

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

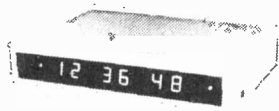
ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics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

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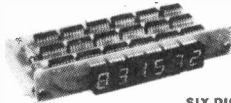
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CD4014	0.83	CD4038	0.96	CD4068	0.20	CD40102	2.13	CD4518	0.97
CD4015	0.83	CD4039	2.78	CD4069	0.20	CD40103	2.13	CD4520	1.04
CD4016	0.48	CD4040	0.97	CD4070	0.48	CD40104	1.10	CD4527	1.43
CD4017	0.79	CD4041	0.75	CD4071	0.20	CD40105	1.06	CD4532	1.21
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CD4022	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		
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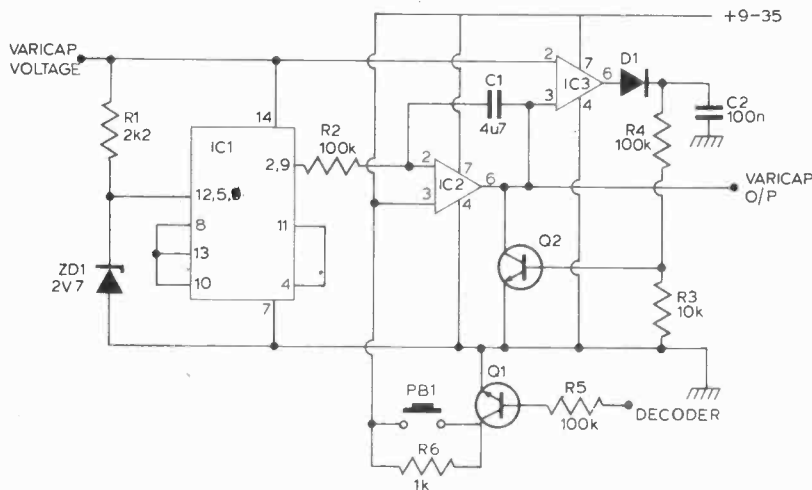
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Automatic Stereo Tuner

J. P. Macaulay



The circuit shown will automatically tune an FM tuner to stereo broadcasts only. On switch on the indicator pin of the stereo decoder is at 0V. In consequence Q1 is biased off and pins 6 and 3 of IC1 are at the positive varicap supply voltage. As this IC, a 4007, is wired as a transmission gate this voltage holds the gate on. The impedance across the gate is in the region of 300 ohms. IC2, a 741, is used as an integrator, the input voltage from across ZD1 is connected through the gate. The output of this IC therefore is a positive going ramp which is fed to the varicap tuning diodes.

On reception of a stereo broadcast the voltage at the decoder indicator pin goes positive driving Q1 into saturation and closing the transmission gate.

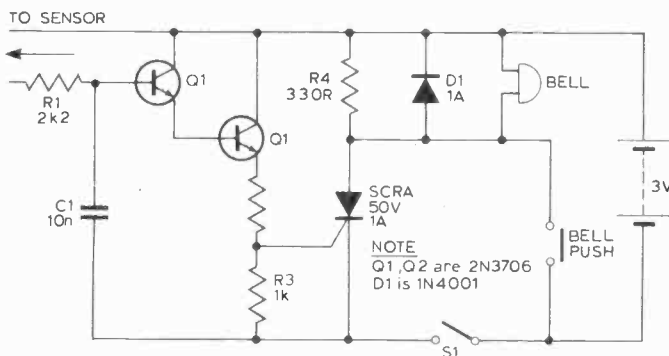
Since the closed position of the gate places an impedance of the order of 10^9 ohms in series with the integrator the output is "frozen" keeping the station in tune. This state of affairs continues until PB1 is pressed, whereupon the integrator will once again start to ramp positively in search of another station.

A second 741, IC3, is used as a comparator. The varicap voltage is sampled by the inverting input whilst the tuning voltage feeds the non-inverting input. As soon as the tuning voltage reaches the same level as the varicap voltage the comparator's output swings positive forward biasing Q2 and discharging C1. The circuit will now go through the entire sequence again.

The varicap voltage must not exceed 15V unless the transmission gate is operated from a stabilised supply of less than 15V output. The supply line to the op amps should be several volts greater than this.

Rain Alarm/Door Bell

S. Lamb

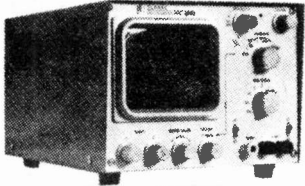


With S1 open the circuit function as a doorbell. With S1 closed, rain falling on the sensor will turn on Q1, Q2 and the thyristor will trigger activating the

bell. R4 provides the holding for the thyristor while D1 prevents any damage to the thyristor from back EMF in the bell coil. The sensor is

made from 3 square inches of copper clad board with a razor cut down the centre. C1 prevents any mains pickup in the sensor leads.

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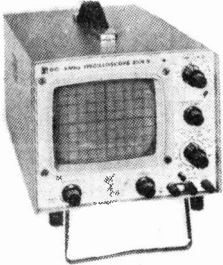


SPECIFICATIONS

ELECTRICAL DATA
VERTICAL AXIS (Y) Deflection Sensitivity — 100m V/division
 Bandwidth (between 3 dB 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/40 pF in shunt. Input Voltage — Max — 600V P P
HORIZONTAL AXIS (X) Deflection Sensitivity — 0.400mV/division
 Bandwidth (between 3 dB 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 1µ sec/div in 5 steps FINE Control — Variable between steps — includes time-base calibration position. Blanking — Internal — on all ranges
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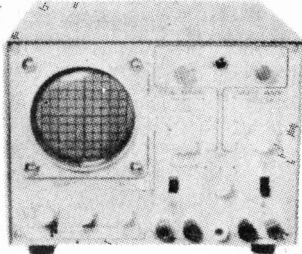
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SWITCHES — Min Toggle, SPST 8 x 5 x 7mm 45p. DPDT 8 x 7 x 7mm 60p. DPDT Centre Off 12 x 11 x 9mm 75p. DPDT C/O Sliders 20p. R S Single Pole C/O Push Buttons 45p. Roller Micro Switches 15p. Min. Micro Switches 13 x 10 x 4mm 20p. Min Push to make or push to break Switches 16 x 6mm 15p.

SOLDER 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 1/2 Track Dual Impedance Rec / Playback 50p. BSR SRP90 1/4 Track Stereo Rec / Playback £1.95. TD10 Assemblies, two heads, 1/4 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 Buzzer, 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

EDGE 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 TO3 SIL 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

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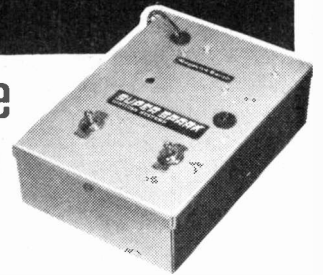
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AT BREADBOARD '78 Stand D3

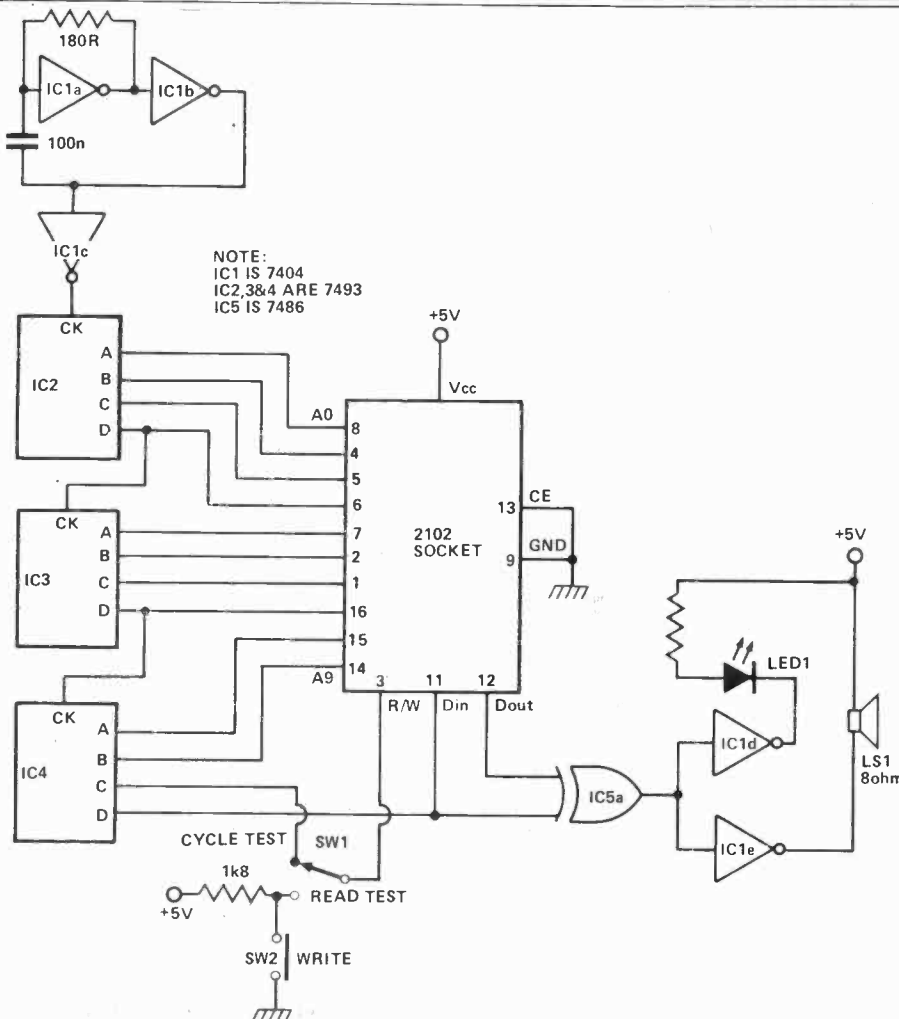
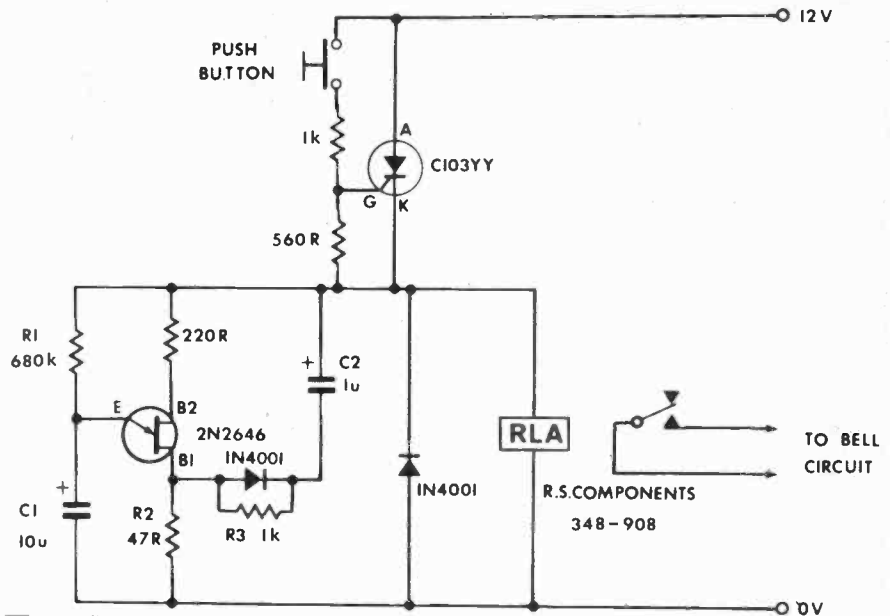
Unijunction Pulse Stretcher — Door Bell Extender

D. Wedlake

The circuit presented is a practical monostable timer which was designed to extend the ringing time of a door bell. It can be useful in cases when the bell push button might not be engaged long enough to attract attention, though it could be used in many other applications.

When the push button is closed the thyristor will switch on delivering power to the unijunction transistor timing circuit and energising the relay, the contacts of which are used to control the bell circuit. At the same time, capacitor C2 quickly charges to the load voltage potential via R3. After a time interval given approximately by $0.8 C1 R1$ (about 6 seconds in this case) the unijunction transistor will fire and the corresponding output pulse which is coupled to

the cathode of the thyristor via C2 will put the thyristor in reverse bias switching it off. With these values the relay will become energised for at least 6 seconds.



2102 Memory Tester

S. Sunderland

This circuit provides for the testing of 1024 Bit X1 memories, such as the 2102 series, in two modes. Mode-1 cycles the memory continuously through write and read, alternately writing zeros and ones then reading to ensure the write was successful. Mode-2 allows the write of a signal onto the memory, then continuously reads it to ensure the data is stable.

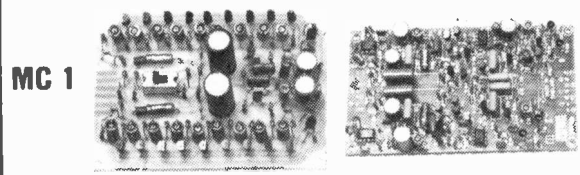
In both modes, the output from the memory is compared with what should be there, and if there is a difference, an LED flashes, accompanied by a click from the speaker. In mode-2, on power on, a continuous noise will be heard from the speaker, on pressing the 'WRITE' button this should vanish, similarly, a brief pulse of noise will be heard in mode-1 before the write is completed. The oscillator frequency is about 20 kHz with components shown.

In mode-2, when the supply voltage drops below 4.5V memory is not stable for more than a fraction of a second, although this does not show up using mode-1.

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MC 1 PRE-AMPLIFIER

Suitable for nearly all moving-coil cartridges. Sensitivity 70/170μV switchable on the p.c.b. This module brings signals from the now popular low output moving-coil cartridges up to 3mV (typical signal required by most pre-amp disc inputs). Can be powered from a 9V battery or from our REG 1 regulator board.

REG 1 — POWER SUPPLY

The regulator module, REG 1 provides 15.0-15v to power the CPR 1 and MC 1. It can be used with any of our power amp supplies or our small transformer TR 6. The power amp kit will accommodate it.

POWER AMPLIFIERS

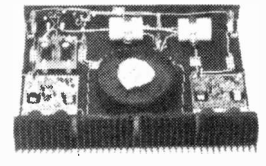
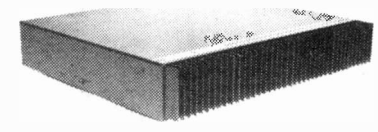
It would be pointless to list in so small a space the number of recording studios, educational and government establishments, etc., who have been using CRIMSON amps satisfactorily for quite some time. We have a reputation for the highest quality at the lowest prices. The power amp is available in five types, they all have the same specification. T.H.D. typically 0.1% any power 1kHz 8 ohms. F.O. insignificant, slew rate limit 25V/μs, signal to noise ratio 110dB, frequency response 10Hz-35kHz, -3dB, stability unconditional; protection drives any load safely, sensitivity 775mV (250mV or 100mV on request), size 120 x 80 x 25mm.

POWER SUPPLIES

We produce suitable power supplies which use our superb TOROIDAL transformers only 50mm high with a 120-240 primary and single bolt fixing (includes capacitors/bridge rectifier).

POWER AMPLIFIER KIT

The kit includes all metalwork, heatsinks and hardware to house any two of our power amp modules plus a power supply. It is contemporarily styled and its quality is consistent with that of our other products. Comprehensive instructions and full back-up service enables a novice to build it with confidence in a few hours.



POWER AMPLIFIER MODULES

CE 608	60W/8 ohms 35.0-35v	£16.30
CE 1004	100W/4 ohms 35.0-35v	£19.22
CE 1008	100W/8 ohms 45.0-45v	£23.22
CE 1704	170W/4 ohms 45.0-45v	£29.12
CE 1706	170W/8 ohms 60.0-60v	£31.90

TOROIDAL POWER SUPPLIES

CPS1	for 2 x CE 608 or 1 x CE 1004	£14.47
CPS2	for 2 x CE 1004 or 2/4 x CE 608	£16.82
CPS3	for 2 x CE 1008 or 1 x CE 1704	£17.66
CPS4	for 1 x CE 1008	£15.31
CPS5	for 1 x CE 1708	£22.68
CPS6	for 2 x CE 1704 or 2 x CE 1708	£23.98

HEATSINKS

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Fan, 80mm, state 120 or 240v	£18.60
Fan mounted on two drilled 100mm heatsinks, 2 x 4 C/W, 65 C max with two 170W modules	£29.16

THERMAL CUT-OUT, 70 C £1.90

POWER AMP KIT £32.40

PRE-AMPS: These are available in two versions — one uses standard components, and the other (the S) uses MO resistors where necessary and tantalum capacitors.

CPR1	£29.49	CPRIS	£39.98
MCI	£18.50	MCIS	£29.49

POWER SUPPLY:

REG1	£6.75	TR6	£1.75
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TRANSISTORS	8C328 15p	8U208 160p	2N4061 12p	7490 32p	74194 92p	4501 19p	DIODES	18p	ZENER DIODES 400mW	10p
AC126 18p	8C338 15p	OC25 76p	2N4062 20p	7491 65p	74195 85p	BY127 59p	BY127 18p	2.7V to 33V		
AC127 17p	8C547 11p	OC28 108p	2N4123 23p	7492 45p	74196 92p	0A47 10p	0A47 10p			
AC128 24p	8C548 10p	OC35 108p		7493 34p	74197 92p	0A81 15p	0A81 15p	VERO BOARDS 0.1" copper		
AC141 24p	8C549 11p	OC71 19p		7494 80p	74198 150p	0A200 6p	0A200 6p	2.5" x 5"	57p	
AC142 24p	8C557 14p	OC72 34p		7495 55p	74199 150p	0A202 9p	0A202 9p	3.75" x 5"	67p	
AC151 42p	8CY30 67p	OC84 46p	TTL	7496 62p		0A204 4p	0A204 4p			
AC152 53p	8CY34 74p	OC84 46p	TIP29 40p	7497 240p	CMOS	0A204 4p	0A204 4p			
AC153 56p	8CY59 24p	TIP30 40p	TIP30 40p	7400 7400	4000 15p	0A204 4p	0A204 4p	CERAMIC CAP 50V	2p	
AC176 18p	8CY70 14p	TIP31 50p	TIP31 50p	7401 7401	4001 15p	0A204 4p	0A204 4p	22pF to 47000pF		
AC187 23p	8CY71 14p	TIP32 55p	TIP32 55p	7402 7402	4002 16p	0A204 4p	0A204 4p			
AC188 23p	8O115 52p	TIP33 75p	TIP33 75p	7403 7403	4006 110p	0A204 4p	0A204 4p	POLYESTER CAP 250V		
AD149 65p	8O121 79p	TIP34 98p	TIP34 98p	7404 7404	4006 110p	0A204 4p	0A204 4p	.01, .015, .022, .033, .047, .068, .1 uF	5p	
AD161 38p	8O123 79p	TIP35A 253p	TIP35A 253p	7405 7405	4007 16p	0A204 4p	0A204 4p	.15, .22, .33	7p	
AD162 38p	8O124 97p	TIP36A 389p	TIP36A 389p	7406 7406	4007 16p	0A204 4p	0A204 4p	.47, .68 uF	13p	
AF114 30p	8O131 35p	TIP41A 59p	TIP41A 59p	7407 7407	4008 15p	0A204 4p	0A204 4p	1 uF	17p	
AF118 30p	8O132 35p	TIP42A 59p	TIP42A 59p	7408 7408	4011 15p	0A204 4p	0A204 4p	2.2 uF	28p	
AF125 27p	8O135 38p	TIP2955 126p	TIP2955 126p	7409 7409	4012 16p	0A204 4p	0A204 4p	6.8 uF	48p	
AF126 27p	8O136 36p	TIP3055 64p	TIP3055 64p	7410 7410	4012 16p	0A204 4p	0A204 4p			
AF127 27p	8O137 38p	ZTX108 14p	ZTX108 14p	7411 7411	4013 35p	0A204 4p	0A204 4p	ELECTROLYTIC CAP 25V		
AF139 36p	8O138 38p	ZTX109 14p	ZTX109 14p	7412 7412	4013 35p	0A204 4p	0A204 4p	1 uF to 47 uF	7p	
AF186 54p	8O139 35p	ZTX300 16p	ZTX300 16p	7413 7413	4014 108p	0A204 4p	0A204 4p	68uF, 100uF	8p	
AF239 40p	8O140 35p	ZTX500 16p	ZTX500 16p	7414 7414	4015 80p	0A204 4p	0A204 4p	150uF	9p	
ASYS3 81p	8F115 25p	2N706 13p	2N706 13p	7415 7415	4016 80p	0A204 4p	0A204 4p	220uF	10p	
ASYS4 81p	8F167 29p	2N1131 23p	2N1131 23p	7416 7416	4017 65p	0A204 4p	0A204 4p	330uF	12p	
ASYS5 69p	8F173 27p	2N1132 23p	2N1132 23p	7417 7417	4018 90p	0A204 4p	0A204 4p	470uF	15p	
8C107 8p	8F178 34p	2N1302 38p	2N1302 38p	7418 7418	4019 65p	0A204 4p	0A204 4p	RESISTORS 0.25W	1p	
8C108 8p	8F179 37p	2N1304 54p	2N1304 54p	7419 7419	4020 95p	0A204 4p	0A204 4p	4.7 ohms to 1 Mohm		
8C109 8p	8F180 37p	2N1305 25p	2N1305 25p	7420 7420	4021 98p	0A204 4p	0A204 4p	POTENTIOMETERS (carbon)	26p	
8C113 17p	8F181 37p	2N1306 39p	2N1306 39p	7421 7421	4022 85p	0A204 4p	0A204 4p	5 Kohm to 1 Mohm log switched	60p	
8C117 20p	8F182 37p	2N1308 40p	2N1308 40p	7422 7422	4023 15p	0A204 4p	0A204 4p	PRESETS 0.1W horizontal	8p	
8C119 29p	8F183 37p	2N1613 22p	2N1613 22p	7423 7423	CMOS	0A204 4p	0A204 4p	100 ohm to 1 Mohm		
8C140 34p	8F184 28p	2N1711 21p	2N1711 21p	7424 7424	68p	0A204 4p	0A204 4p	TRANSFORMERS 240V primary	95p	
8C142 27p	8F185 30p	2N1893 44p	2N1893 44p	7425 7425	15p	0A204 4p	0A204 4p	6-0-6V 100mA	360p	
8C143 27p	8F194 13p	2N2217 27p	2N2217 27p	7426 7426	35p	0A204 4p	0A204 4p	0-6Vx2 1AX2	250p	
8C147 7p	8F196 13p	2N2219 21p	2N2219 21p	7427 7427	70p	0A204 4p	0A204 4p	9-0-9V 1A	290p	
8C149 8p	8F197 16p	2N2369 16p	2N2369 16p	7428 7428	100p	0A204 4p	0A204 4p	9-0-9V 2A	400p	
8C157 9p	8F198 16p	2N2483 26p	2N2483 26p	7429 7429	15p	0A204 4p	0A204 4p	0-12V 2A	370p	
8C158 9p	8F200 36p	2N2484 22p	2N2484 22p	7430 7430	24p	0A204 4p	0A204 4p	0-15Vx2 200mAx2	240p	
8C159 9p	8F224 16p	2N2905 22p	2N2905 22p	7431 7431	24p	0A204 4p	0A204 4p			
8C168 8p	8F257 37p	2N2906 22p	2N2906 22p	7432 7432	24p	0A204 4p	0A204 4p			
8C170 9p	8F258 40p	2N2907 22p	2N2907 22p	7433 7433	24p	0A204 4p	0A204 4p			
8C171 9p	8F259 44p	2N2926 10p	2N2926 10p	7434 7434	24p	0A204 4p	0A204 4p			
8C172 9p	8F299 30p	2N2926 8p	2N2926 8p	7435 7435	24p	0A204 4p	0A204 4p			
8C173 9p	8F299 30p	2N3053 18p	2N3053 18p	7436 7436	24p	0A204 4p	0A204 4p			
8C182 10p	8F299 30p	2N3054 50p	2N3054 50p	7437 7437	24p	0A204 4p	0A204 4p			
8C183 10p	8F299 30p	2N3055 50p	2N3055 50p	7438 7438	24p	0A204 4p	0A204 4p			
8C184 10p	8F299 30p	2N3072 8p	2N3072 8p	7439 7439	24p	0A204 4p	0A204 4p			
8C186 23p	8F330 38p	2N3703 8p	2N3703 8p	7440 7440	24p	0A204 4p	0A204 4p			
8C187 26p	8F385 29p	2N3704 8p	2N3704 8p	7441 7441	24p	0A204 4p	0A204 4p			
8C207 13p	8F386 31p	2N3706 9p	2N3706 9p	7442 7442	24p	0A204 4p	0A204 4p			
8C212 10p	8F387 20p	2N3707 9p	2N3707 9p	7443 7443	24p	0A204 4p	0A204 4p			
8C213 10p	8F550 15p	2N3710 8p	2N3710 8p	7444 7444	24p	0A204 4p	0A204 4p			
8C214 10p	8F551 15p	2N3711 8p	2N3711 8p	7445 7445	24p	0A204 4p	0A204 4p			
8C237 14p	8F553 28p	2N3772 177p	2N3772 177p	7446 7446	24p	0A204 4p	0A204 4p			
8C238 14p	8SX19 25p	2N3773 230p	2N3773 230p	7447 7447	24p	0A204 4p	0A204 4p			
8C301 30p	8SX20 21p	2N3866 61p	2N3866 61p	7448 7448	24p	0A204 4p	0A204 4p			
8C303 36p	8U205 140p	2N3904 8p	2N3904 8p	7449 7449	24p	0A204 4p	0A204 4p			

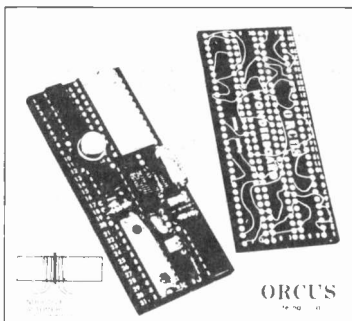
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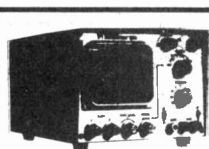
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SPECIFICATIONS

ELECTRICAL DATA

VERTICAL AXIS (Y)

Deflection Sensitivity

Bandwidth (between 3 dB points)

Input Attenuator - (calibrated)

Input Impedance

Input Voltage - Max

- 100mV/division
- 0C-5MHz
- 3 step 0.1, 0.2, 0.5, 1, 2, 5, 10, 20 50V/div
- 1 Meg/40 pf in shunt
- 600V P.P.

HORIZONTAL AXIS (X)

Deflection Sensitivity

Bandwidth (between 3dB points)

Gain Control

Input Impedance

Input Voltage - Max

- 0-400mV/division
1Hz-350kHz
- Continuous, when time base in EXT position
- 1 Meg
600V P.P.

TIME BASE

Sweep Range (calibrated)

FINE Control

Blanking

- 100msec/div to 1µ sec/div in 5 steps
- Variable between steps - includes timebase calibration position
- Internal - on all ranges

SYNCHRONIZATION

Selection

Synchronization Level

- Internal, external
- Continues from positive to negative Input Voltage
- 18V

POWER SUPPLY

Power Dissipation

- 4in. - flat face, single beam
- Maximum high voltage - 1.5kV
- Fitted with 8x10 division blue filter graticule

CRT DATA

PHYSICAL DATA

Dimensions

Weight

Stand

Case

Front Panel

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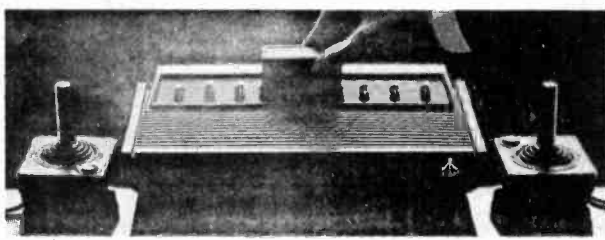
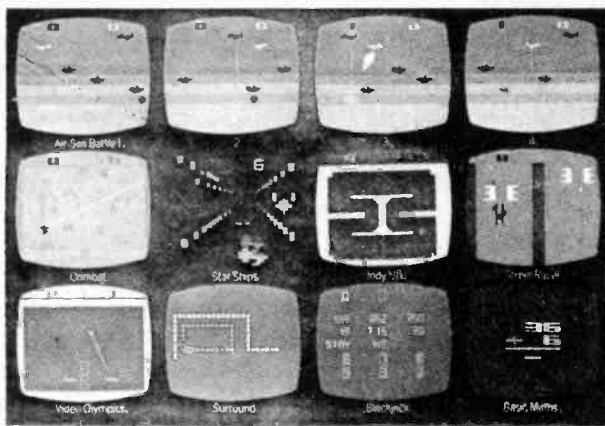
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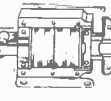
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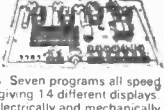
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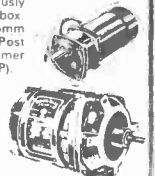
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General Electric 230v A.C. 1.600 r.p.m. 0.25 amp. Complete with
anti-vibration mounting bracket and capacitor O/A size 110mm x
90mm. Spindle 5/16 dia. 20mm long. Ex-equipment tested £3.00.
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RODENE UNISET TYPE 71 TIMER

0-60 sec. 230V a.c. operation. Incorporating a lapsed time indicator and
repeat facilities. A precision motorised timer ideal for process timing,
photography, welding, mixing, etc. Price £6.6 P&P 60p



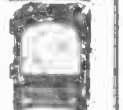
METERS (New) - 90mm DIAMETER

A.C. Amp. Type 62T 0-1A, 0-5A, 0-20A. A.C. Volt.
0-15V, 0-300V. D.C. Amp. Type 62C 0-2A, 0-10A,
0-20A. 0-100A. D.C. Volt. 0-15V, 0-30V. All types
£3.50 ea + P&P 50p (£4.32 inc. VAT), except 0-100A
D.C. price £5.00 + 50p P&P (£5.94 inc. VAT).



'VENNER TYPE' ERD TIME SWITCH

200/250V AC 30 amp. 2 on/2 off every 24 hrs. at any
manually pre-set time. 36-hour spring reserve and day
on/setting device. Built to highest Electricity Board
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SANGAMO WESTON TIME SWITCH

Type S251 200/250 V a.c. 2 on 2 off every 24 hours. 20 amps contacts with
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Also available with Solar dial. R & T

A.C. MAINS TIMER UNIT

Based on an electric clock, with 25 amp. single-
pole switch, which can be preset for any period up
to 12 hrs. ahead to switch on for any length of
time, from 10 mins to 6 hrs. then switch off. An
additional 60 min. audible timer is also incorpo-
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135 mm x 130 mm x 60 mm. Price £2.25. Post
40p (Total inc. VAT & Post £2.87). N.M.S.



POWER RHEOSTATS

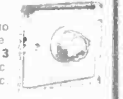
New ceramic construction, wirebus enamel,
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continuously rated.

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/ 500 / 1k / 1.5k / 2.5k / 5k ohm. £5.90 Post 35p (£6.75 inc. VAT
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Black Silver Skirted Knob calibrated in Nos. 1-9. 1 1/2 in. dia brass
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Easily fitted. Fully guaranteed by makers. Will control up to
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VAT & P). 2000 watt model £9.75 Post 40p (£10.96 inc. VAT
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YET ANOTHER OUTSTANDING OFFER

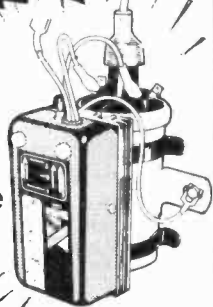
New IMF6 500V Dubilier wire ended capacitors. 10 for £1.50 P&P 50p.
(£2.16 inc. VAT & P&P) (Min 10).

N.M.S. - New Manufacturers' Surplus
R & T - Reconditioned and Tested

The latest kit innovation!

from Sparkrite

*Sparkrite -
was featured by Shaw Taylor
in "DRIVE IN"*



the quickest fitting
CLIP ON
capacitive discharge
electronic ignition
in KIT FORM

- Smoother running
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- Continual peak performance
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- Improved acceleration/top speeds
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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 transistor 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.

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Address

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Inc. V.A.T. and P.P.

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TACHS PULSE SLAVE UNIT £3.35

£

Cheque No.

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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!

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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**

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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**

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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**.

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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:

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- Price 30p + 15p Post.

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Copper T05 sink 17mm dia x 20mm. 10 for 40p; 100 for £3; 1,000 for £25.

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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**.

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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 DPCO 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 DPCO 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.

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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
TN4148	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**.

STEVENS ON

Electronic Components

SWITCHES

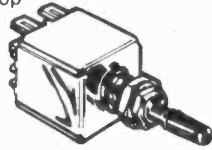
Real cell charges.

Subminiature toggle. Rated at 3A 250V.
 SPDT 65p SPDT centre off 70p
 DPDT 75p DPDT centre off 90p

Standard Toggle.
 SPST 34p DPDT 48p

Wavechange switches.
 1P12W, 2P6W, 3P4W or 4P3W
 all 37p each.

Miniature switches (non-locking)
 Push to make 15p Push to break 20p



POTENTIOMETERS

5K-2M2 single 26p ea. 100Ω-2M2 horizontal
 5K-2M2 stereo (dual) 75p ea. or vertical preset 6p ea.
 5K-2M2 DP switched 60p ea.

KNOBS

Ideal for use on mixers, etc. Push on type
 with coloured cap in red, black, green, blue,
 yellow and grey.
 Position line marked 14p each.



MICROPROCESSORS

6800	670p	6820	350p	21L02	110p
8080A	525p	6850	360p	2112	175p
6810	300p	AY5-1013	380p	2114	700p

REGULATORS

78L05	30p	79L05	70p	LM309K	110p
78L12	30p	79L12	70p	LM317	220p
78L15	30p	79L15	70p	LM323K	530p
7805	60p	7905	80p	LM723	35p
7812	60p	7912	80p		
7815	60p	7915	80p		

THYRISTORS AND TRIACS

Plastic cased Thyristors. Texas.

	4A	8A	12A
100V	36p	45p	62p
200V	42p	53p	68p
400V	51p	66p	86p

Plastic cased Triacs. Texas.

All rated at 400V

4A	70p	12A	90p	20A	185p
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AC127	17p	BCY71	14p	ZTX109	14p
AC128	16p	BCY72	14p	ZTX300	16p
AC176	18p	BD131	35p	2N697	12p
AD161	38p	BD132	35p	3N1302	38p
BC107	8p	BD135	38p	2N2905	22p
BC108	8p	BD139	35p	2N2907	22p
BC109	8p	BD140	35p	2N3053	18p
BC147	7p	BF244B	36p	2N3055	50p
BC148	7p	BFY50	15p	2N3442	135p
BC149	8p	BFY51	15p	2N3702	8p
BC158	9p	BFY52	15p	2N3704	8p
BC177	14p	MJ2955	98p	2N3705	9p
BC178	14p	MPSA06	20p	2N3706	9p
BC179	14p	MPSA56	20p	2N3707	9p
BC182	10p	TIP29C	60p	2N3708	8p
BC182L	10p	TIP30C	70p	2N3819	22p
BC184	10p	TIP31C	65p	2N3904	8p
BC184L	10p	TIP32C	80p	2N3905	8p
BC212	10p	ZTX107	14p	2N3906	8p
BC212L	10p	ZTX108	14p	2N4058	12p
BC214	10p			2N5457	32p
BC214	10p	1N914	4p	2N5458	30p
BC477	19p	1N4001	4p	2N5459	32p
BC478	19p	1N4002	4p	2N5777	50p
BC479	19p	1N4004	5p		
BC548	10p	1N4006	6p		
BCY70	14p				

DIODES

1N4148	3p
1N5401	13p
1N5402	15p
1N5404	16p
1N5406	18p

BZY88 series 2V7 to 33V 8p each.

LINEAR

A SELECTION ONLY!
 DETAILS IN CATALOGUE.

709	25p	LM324	50p	NE556	60p
741	22p	LM339	50p	NE565	120p
747	50p	LM380	75p	NE567	170p
748	30p	LM382	120p	SN76003	200p
CA3046	55p	LM1830	150p	SN76013	140p
CA3080	70p	LM3900	50p	SN76023	140p
CA3130	90p	LM3909	60p	SN76033	200p
CA3140	70p	MC1496	60p	TBA800	70p
LM301AN	28p	MC1458	35p	TDA1022	650p
LM318N	125p	NE555	25p	ZN414	75p

OPTO

LEDs 0.125in. 0.2in.
 Red TIL209 TIL220 9p
 Green TIL211 TIL221 13p
 Yellow TIL213 TIL223 13p
 Clips 3p 3p



DISPLAYS

DL704 0.3 in CC 130p
 DL707 0.3 in CA 130p
 FND500 0.5 in CC 100p

RESISTORS

Carbon film resistors.
 High stability, low noise 5%.
 E12 series, 4.7ohms to 10M. Any mix:
 100, 1k, 2, 3, each
 0.25W 22 1p 0.9p 0.8p
 0.5W 22 1.5p 1.2p 1p
 Special development packs consisting of 10 of each value from 4.7 ohms to 1 Megohm (650 res.)
 0.5W £7.50. 0.25W £5.70

CAPACITORS

HERE ARE JUST A FEW OF THE CAPACITORS STOCKED

TANTALUM BEAD each
 0.1, 0.15, 0.22, 0.33, 0.47, 0.68, 1 & 2.2uF @ 35V 9p
 4.7, 6.8, 10uF @ 25V 13p
 22 @ 16V, 47 @ 6V, 100 @ 3V 16p

MYLAR FILM
 0.001, 0.01, 0.022, 0.033, 0.047 3p
 0.068, 0.1 4p

RADIAL LEAD ELECTROLYTIC

63V	0.47	1.0	2.2	4.7	10	5p
			22	33	47	7p
	100					13p
		220				20p
25V	10	22	33	47		5p
	100					8p
		220				10p
			470			15p
						23p
10V		220				5p
			470			9p
						13p
			2200			23p

74LS

LS00	16p	LS95	65p
LS01	16p	LS123	56p
LS02	16p	LS125	40p
LS03	16p	LS126	40p
LS04	16p	LS132	60p
LS08	16p	LS136	36p
LS10	16p	LS138	54p
LS13	30p	LS139	50p
LS14	70p	LS151	50p
LS20	16p	LS153	50p
LS30	16p	LS155	80p
LS32	24p	LS156	80p
LS37	26p	LS157	45p
LS40	22p	LS164	90p
LS42	53p	LS174	60p
LS47	70p	LS175	60p
LS48	48p	LS190	80p
LS54	16p	LS192	70p
LS73	29p	LS193	70p
LS74	29p	LS196	80p
LS75	44p	LS251	60p
LS76	35p	LS257	55p
LS78	35p	LS258	55p
LS83	60p	LS266	40p
LS85	70p	LS283	60p
LS86	33p	LS290	55p
LS90	45p	LS365	45p
LS93	45p	LS366	45p
		LS367	45p
		LS368	45p
		LS386	35p
		LS670	180p

TTL

7400	12p	7493	34p
7401	12p	7494	52p
7402	12p	7495	52p
7404	12p	7496	50p
7408	14p	74121	25p
7410	12p	74122	33p
7413	25p	74123	40p
7414	48p	74125	35p
7420	12p	74126	35p
7427	24p	74132	50p
7430	12p	74141	56p
7442	43p	74148	90p
7447	55p	74150	70p
7448	58p	74151	50p
7454	14p	74156	52p
7473	25p	74157	52p
7474	25p	74164	70p
7475	32p	74165	70p
7476	28p	74170	125p
7485	70p	74171	68p
7489	145p	74177	58p
7490	32p	74190	72p
7492	35p	74191	72p
		74192	64p
		74193	64p
		74196	55p
		74197	55p

CMOS FULL DETAILS IN CATALOGUE

4001	15p	4029	60p
4002	15p	4040	68p
4007	15p	4042	54p
4011	15p	4046	100p
4013	35p	4049	28p
4015	60p	4050	28p
4016	35p	4066	40p
4017	55p	4068	20p
4018	65p	4069	16p
4023	15p	4071	16p
4024	45p	4075	16p
4026	95p	4093	48p
4027	35p	4510	70p
4028	52p	4511	70p
		4518	70p
		4520	65p

SKTS

Low profile by Texas

8 pin	10p	24 pin	24p
14 pin	12p	28 pin	28p
16 pin	13p	40 pin	40p

Soldercon pins: 100: 50p
 1000: 370p

AT LAST! OUR NEW 40 PAGE CATALOGUE OF COMPONENTS IS AVAILABLE. SEND S.A.E.



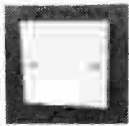
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A 300W Lightdimmer with NO knob. Dimming and on/off functions are controlled by touch. Features include

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- ★ Can be switched and dimmed from many locations using TDE/K kit making 2-way switching easy

★ ★ PRICE £8.99 TDE/K
£1.00



LIGHTING CONTROL KITS (300W)
TSD300K TOUCHSWITCH & DIMMER combined. One touch-plate for on/off. Small knob controls brightness. **£5.50**
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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



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. **£13.75**
White box (56x131x71mm)—drilled and undrilled **£2.50**



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12A **84p**
16A **105p**
20A **165p**
25A **190p**
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Diac **21p**

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	Watchdog	604	.85	4.69	7.68	5.53	18.75	
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	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
		General Purpose Pre-Amp	609	.65	3.13	—	—	3.78
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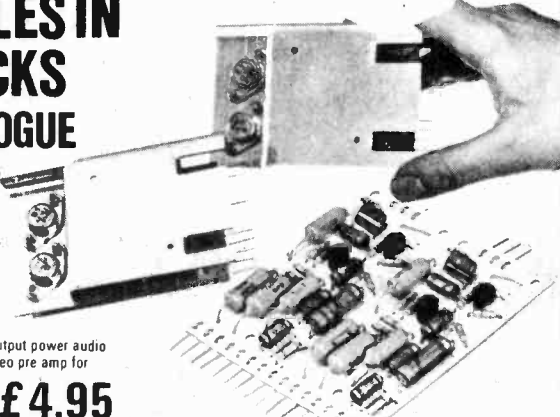
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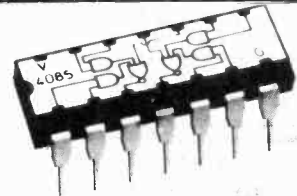
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AUDIO	42
BAMBER	90
BAYDIS	33
BI-PAK	4 & 5
B.N.R.S.	71
BULL, J.	90
CAMBRIDGE LEARNING	56
CATRONICS	42
CHARCROFT	97
CHILTMead	41
CHROMASONICS	86
CHROMATRONICS	102
COMMUNICATIONS MEA.	76
COMP, COMP, COMP	107
CRIMSON ELECTRIK	96
DALSTON ELECTRONICS	92
DELTA-TECH	96
DISCOUNT COMPUTING	98
DORAM	50 & 97
E.D.A.	100
ELECTROVALUE	58
FLADAR	68
GREENBANK	70
GREENWELD	100
HARRISON BROS.	98
H.B. COMPUTERS	98
HENRY'S	50, 63, 68 & 97
IBEK	75
I.L.P.	66
INTEGRATED CIRCUITS	28
KRAMER	33, 40, 75 & 94
L.B. ELECTRONICS	72
LEKTROKIT	30
MAPLIN	108
MARSHALLS	52
MEGA	50
METAC	14 & 15
MINIKITS	72
MOUNTAINDENE	72
NICHOLLS	75
N.I.C. MODELS	92
O.K. MACHINE	78
POWERLL	40
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PROGRESSIVE RADIO	94
R.C.S.	106
ROGER SQUIRES	33
R.T.V.C.	103
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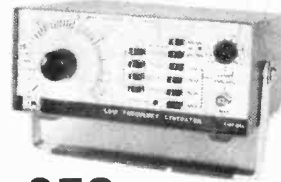
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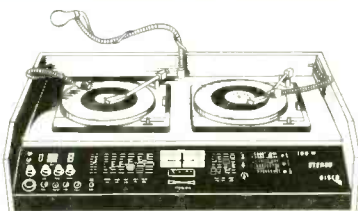
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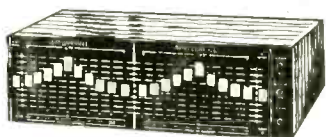
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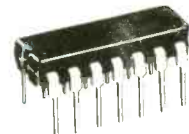
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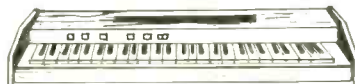
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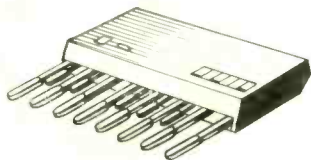
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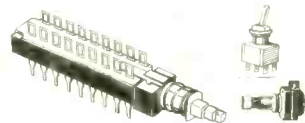
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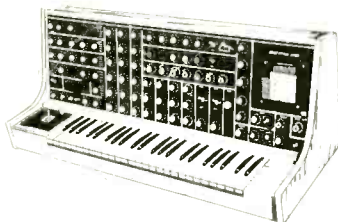
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