

electronics today

OCTOBER 1978

INTERNATIONAL

45p

Television

Chess

MRM 101

RF Meter

SCRUMPI 3

Gain Control



**8-PAGE
TECH-TIPS
SPECIAL**

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

TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

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

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

The kit includes fully finished metalwork, solid teak cabinet, filter sweep pedal, professional quality components (all resistors either 2% metal oxide or 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!



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

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

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

200 + 200 watt AMPLIFIER

As featured in Electronics Today International

400W rms continuous — 800W peak!

0.03% THD at FULL power!

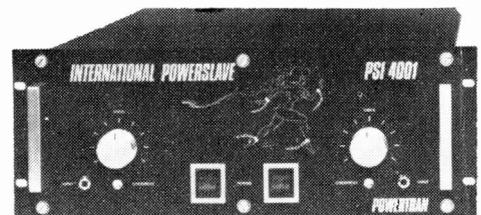
PLUS all the following features too!

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

**SUPER NEW
LOW PRICES!**

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

PSI 4001 SLAVE MODEL



PSI 4002 STUDIO MODEL



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

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

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

U.K. ORDERS: Subject to 12% surcharge for VAT* (i.e. add 1/2% to the price). No charge is made for carriage,* or at current rate if changed.

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

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OUR CATALOGUE IS FREE! WRITE OR PHONE NOW!

POWERTRAN ELECTRONICS

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electronics today

OCTOBER 1978 VOL 7 NO 10

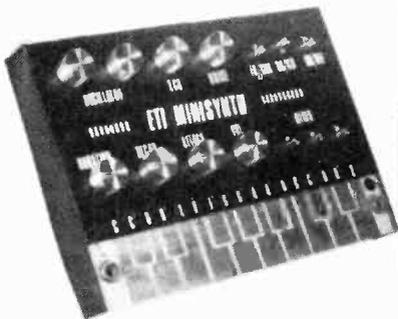
INTERNATIONAL

FEATURES

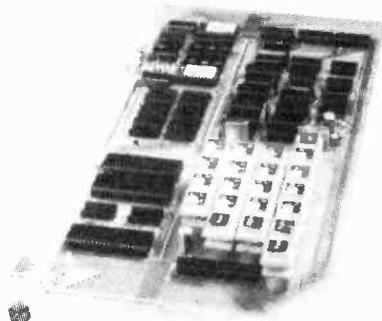
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BOOKS AND COMPONENTS

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	60p†
BP6	Engineers and Machinists Reference Tables	40p†
BP7	Radio & Electronic Colour Codes and Data	15p†
BP10	Modern Crystal and Transistor Set Circuits for beginners	35p†
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BP22	79 Electronic Novelty Circuits	75p†
BP23	First Book of Practical Electronic Projects	75p†
BP24	52 Projects Using IC741 (or equivalents)	75p†
BP26	Radio Antenna Handbook for Long Distance Reception and Transmission	85p†
BP27	Giant Chart of Radio Electronic Semiconductor and Logic Symbols	60p†
BP29	Major Solid State Audio Hi-Fi Construction Projects	85p†
BP32	How to Build Your Own Metal & Treasure Locators	85p†
BP34	Practical Repair & Renovation of Colour TVs	95p†
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BP44	I.C. 555 Timer Projects	£1.45†
BP47	Mobile Discotheque Handbook	£1.35†
129	Universal Gram-motor Speed Indicator	10p†
160	Coil Design and Construction Manual	75p†
196	AF-RF Reactance — Frequency Chart for Constructors	15p†
202	Handbook of Integrated Circuits (ICs) Equivalents and Substitutes	75p†
205	First Book of Hi-Fi Loudspeaker Enclosures	75p†
213	Electronic Circuits for Model Railways	85p†
214	Audio Enthusiasts Handbook	85p†
216	Electronic Gadgets and Games	85p†
217	Solid State Power Supply Handbook	85p†
219	Solid State Novelty Projects	85p†
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222	Solid State Shortwave Receivers for Beginners	95p†
223	50 Projects Using IC CA3 130	95p†
224	50 CMOS IC Projects	95p†
225	A Practical Introduction to Digital ICs	95p†
226	How to Build Advanced Short Wave Receivers	£1.20†
RCC	Resistor Colour Code Disc Calculator	10p†

BOOKS BY NEWNES

No. 229	Beginners Guide to Electronics	Price £2.25†
No. 230	Beginners Guide to Television	Price £2.25†
No. 231	Beginners Guide to Transistors	Price £2.25†
No. 233	Beginners Guide to Radio	Price £2.75†
No. 234	Beginners Guide to Colour Television	Price £2.25†
No. 235	Electronic Diagrams	Price £1.80†
No. 236	Electronic Components	Price £1.80†
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
1/16in OBA	839	£1.20	1/16in 4BA	846	£0.32
1/16in OBA	840	£0.75	1/16in 4BA	847	£0.25
1/16in 2BA	842	£0.85	1/16in 6BA	848	£0.40
1/16in 2BA	843	£0.45	1/16in 6BA	849	£0.21
1/16in 2BA	844	£0.52	1/16in 6BA	850	£0.25
1/16in 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	£0.34

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	£0.80*
Push switch — Push to make	1978	£0.13*
Push switch — Push to break	1979	£0.18*

ROCKER SWITCH	Colour	No.	Price
A range of rocker switches SPST — moulded in high insulation	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	£0.55*
Miniature DPDT toggle, 2 amp 250V a.c.	1960	£0.70*
Miniature DPDT toggle, centre off, 2 amp 250V a.c.	1961	£0.85*
Push-button SPST, 2 amp 250V a.c.	1962	£0.78*
Push-button SPDT, 2 amp 250V a.c.	1963	£0.83*
Push-button DPDT, 2 amp 250V a.c.	1964	£0.98*

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

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

FUSE HOLDERS AND FUSES

Description	Order No.	Price
20mm x 5mm chassis mounting	506	£0.07*
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	6p	1A	615	3A	619
250mA	612	5p	1.5A	616	4A	620
500mA	613	5p	2A	617	5A	621
800mA	614	7p	2.5A	618		6p

ANTI-SURGE 20mm	Type	No.	Type	No.
100mA	622	1A	625	2.5A
250mA	623	2A	626	3.15A
500mA	624	1.6A	627	5A

All 7p each

QUICK BLOW 1 1/4in	Type	No.	Type	No.	Type	No.
250mA	631	500mA	632	800mA	634	

All 7p each

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

All 6p each

CASES AND BOXES

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

No.	Length	Width	Height	Price
155	8in	5 1/2in	2in	£1.25*
156	11in	6in	3in	£2.12*
157	6in	4 3/4in	1 1/4in	£1.30*
158	9in	5 1/4in	2 1/2in	£1.78*

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 1/2in	2 1/2in	1 1/2in	62p*
160	4in	4in	1 1/2in	62p*
161	4in	2in	1 1/2in	62p*
162	5 1/2in	4in	1 1/2in	70p*
163	4in	2 1/2in	2in	64p*
164	3in	2in	1in	44p*
165	7in	5in	2 1/2in	£1.04*
166	8in	6in	3in	£1.32*
167	6in	4in	2in	86p*

METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor-like Mullard C280 series. Mixed values ranging from 0.01uF-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	
2026	6V-0.6V 1 amp	£2.50*	P.&P. 45p
2027	9V-0.9V 1 amp	£2.00*	P.&P. 45p
2028	12V-0.12V 1 amp	£2.60*	P.&P. 55p
2029	15V-0.15V 1 amp	£2.75*	P.&P. 65p
2030	30V-0.30V 1 amp	£3.45*	P.&P. 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	
2031	1/2 amp	£5.80*	P.&P. 86p
2032	1 amp	£6.80*	P.&P. 86p
2033	2 amp	£7.40*	P.&P. £10

AUDIO LEADS

107	FM Indoor Ribbon Aerial	£0.60*
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	£0.76*
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 & ski.	£1.10*
117	AC mains connecting lead for cassette recorders & radios. 2 metres	£0.68*
118	5 pin DIN phono plug to stereo headphone Jack socket	£1.05*
119	2+2 pin DIN plugs to stereo Jack socket with attenuation network for stereo headphones. Length 0.2m	£0.90*
120	Car stereo connector. Variable geometry plug to fit most car cassette. 8-track cartridge & combination units. Supplied with inline fused power lead and instructions	£0.60*
123	6.6m Coiled Guitar Lead Mono Jack Plug to Mono Jack Plug BLACK	£1.50*
124	3 pin DIN plug to 3 pin DIN plug. Length 1.5m	£0.75*
125	5 pin DIN plug to 5 pin DIN plug. Length 1.5m	£0.75*
126	5 pin DIN plug to Tinned open end. Length 1.5m	£0.75*
127	5 pin DIN plug to 4 Phono Plugs. All colour coded. Length 1.5m	£1.30*
128	5 pin DIN plug to 5 pin DIN socket. Length 1.5m	£0.80*
129	5 pin DIN plug to 5 pin DIN plug mirror image. Length 1.5m	£1.05*
130	2 pin DIN plug to 2 pin DIN inline socket. Length 5m	£0.88*
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.

162D1 — values from 47mFD-10mFD	80p*
162D2 — values from 10mFD-100mFD	80p*
162D3 — values from 100mFD-680mFD	80p*

BI-PAK CATALOGUE

NEW EDITION NOW AVAILABLE

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

ONLY 65p POST FREE

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

V.A.T. Add 12 1/2% to prices marked*. 8% to those unmarked. Items marked are zero rated.

P.&P. 35p unless otherwise shown.

BI-PAK

DEPT. ETI10, P.O. Box 6, Ware, Herts

COMPONENTS SHOP: 18 BALDOCK STREET, WARE, HERTS.

AUDIO KITS OF DISTINCTION FROM **POWERTRAN**

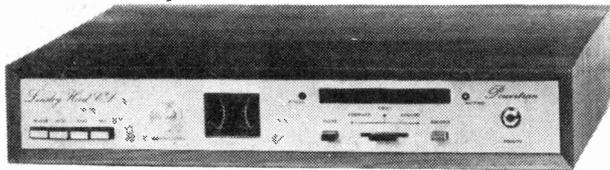
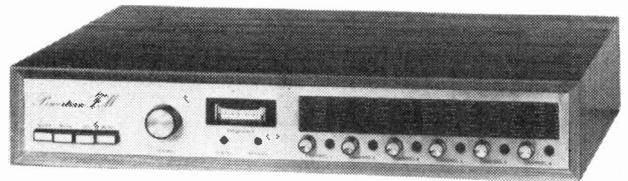


DE LUXE EASY TO BUILD LINSLEY-HOOD 75W AMPLIFIER £99.30 + VAT

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

WIRELESS WORLD FM TUNER £70.20 + VAT

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

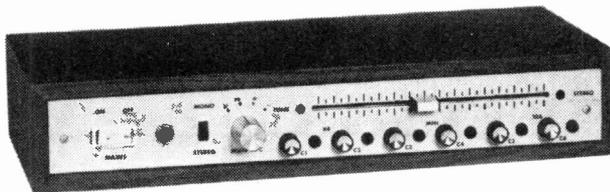
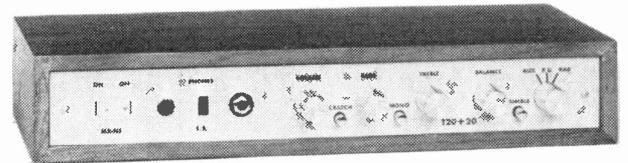


LINSLEY-HOOD CASSETTE DECK £79.60 + VAT

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

T20 + 20 AMPLIFIER £33.10 + VAT

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

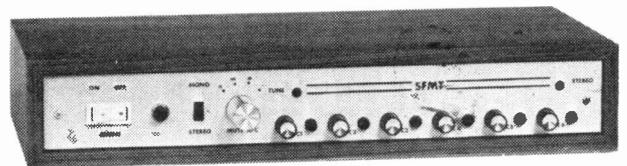


WWII TUNER £47.70 + VAT

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

POWERTRAN SFMT TUNER £35.90 + VAT

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



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

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

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

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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

PORTWAY INDUSTRIAL ESTATE
ANDOVER HANTS SP10 3NM

ANDOVER
(0264) 64455

news digest. .

for light music

These charming little blobs are Motorola's new BF900 MOSFETs, designed for use in FM tuner designs. They possess a power gain of 20 dB at 200 MHz and low capacitance. The dual gate configuration is intended for AGC operation where the first gate receives the RF while the second controls the transconductance (DC). Both gates are diode protected. Dead clever these

Hong Kong King

Some numbers to tick off on your fingers. In the first six months of the year Hong Kong exported 16 million watches (worth £77m). These break down as 61% mechanical, 29% LCD and only 10% LED and quartz analogue com-

bined. Surprising LED figures eh?

Germany developed a sudden lust for these non-tockers and their imports leapt up by 287%, putting them as the second largest consumers — behind the US and ahead of us!

blobs... Motorola Ltd, Semiconductor Division, York House, Empire Way, Wembley, Middx.

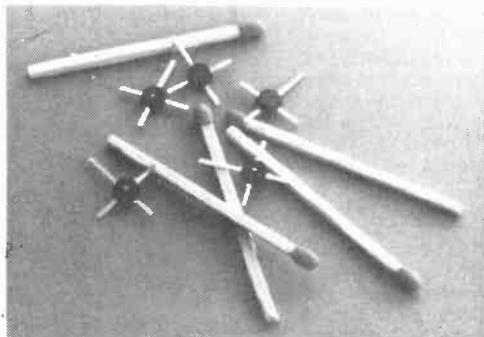
forget who not?

You know we've quite forgotten why we used this photo at all. Now let's see something to do with TV games? Anyway the editorial desks have been bereft of nice lady photos lately — so this one appeared as an oasis amid the dusty filing trays.

P.S. Binatone the people who make the box in front — don't ask what box or in front of what or we won't



Speak to you again — claim to now taken over half the TV game market — the magic 51% in fact.



son of eti



The word is out. For months at ETI we've been planning a second magazine for the electronics enthusiast. Because of the intense competition in this field we've kept quiet about it but now all can be revealed.

ETI has been remarkably successful but we've never pretended that we are ideal reading for the newcomer to electronics—we have assumed that the reader is already hooked into the hobby.

Hobby Electronics will hit the newstands in just over a month and is designed as a companion to ETI—indeed it is being prepared by the same editorial team.

HE is written for the person wanting to find out about electronics—there'll be projects of course but we reckon we've got some pretty good features as well including 'Into Electronics' a major introductory series linked to the O/A level Electronics course.

In next month's ETI we'll give you a complete breakdown of the contents of No. 1. The cover shown here is of a 'dry-run' issue that has already been produced in small quantities.

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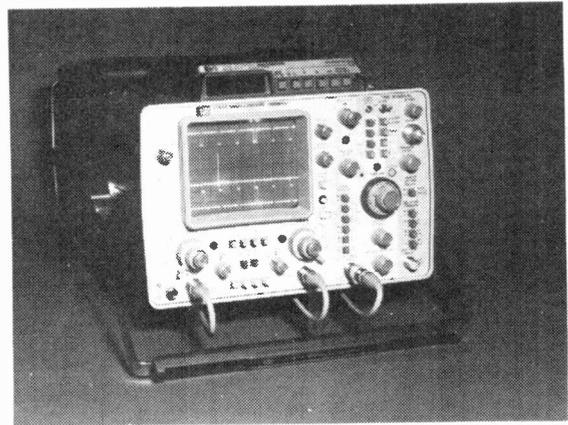
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Semiconductor prices are always changing and the trend is generally downwards. So ring for latest up-to-date details.

... news

drool here



Now before we go any further this lot costs about £2,000, and is definitely pie in the sky for most of us — but its lovely all the same. For once we're gonna let someone describe their own product — take it away HP.

Called the Hewlett-Packard Model 1742A Delta Time Oscilloscope, the instrument is also available with an optional 3-1/2 digit autoranging digital multimeter which displays time in seconds, milliseconds, or microseconds. This DMM option (034 or 035) can be ordered installed initially, or added later in the field because the delta time capability is built-in the basic oscilloscope. The DMM can also be used to

measure ac and dc voltage and current as well as resistance.

In the delta time mode, the oscilloscope measures time between two events on either channel A or B, or between an event on one channel and an event on the other. Measurements of high-speed digital timing, transition times, propagation delay, and clock phasing are rapid and with greater accuracy than with traditional differential delay time base oscilloscopes.

Stable internal triggering to 100 MHz requires 1 cm vertical deflection (only 0.3 cm to 25 MHz).

Excuse us while our workbench gently weeps.

close encounters calls

There are probably only a handful of ETI readers who aren't 'Star Wars' fans and most of the staff here have seen it more than once. At the beginning of August one of our people was in North America and saw the first follow-up, 'Battlestar Galactica', made by John Dykstra, the principle effects man on 'Star Wars'.

Battlestar Galactica itself is the equivalent of a battleship and the only survivor of twelve such giant fighting ships from a sneak attack launched by the Cylons. The mission of Galactica is to gather together the human survivors of the Galaxy and to find the lost planet Earth which was colonised in the long distant past by other humans.

Like 'Star Wars', the

film is full of parables, in this case the Old Testament escape of Moses from Egypt is only thinly disguised. Throughout the film you can't help noticing the Star Wars parallels, even down to the noise made by the laser guns.

Galactica is a film you'll have to see if you get the chance — it lacks the novelty of 'Star Wars', there's no R2D2, Darth Vader or light sabres but the effects are excellent none the less.

Universal, who handle the film, have not yet decided if the film will be distributed here. It is a major, and very expensive (at \$14,000,000), pilot for a TV series. If it is shown it will not be before next spring.

digest..

watch reaction

Once more into the breach . . . and all that stuff. Why is it that buying anything these days turns into a battle between salesman and (intended) victim? Are there nought but sharks lurking on the far side of the counters? Are all the good men honest and true working for ETI? (ouch).

Forgive the outpourings of despair gentle reader but there really are times when we do wonder. With apologies to all the excellent retail outlets in the trade that we and you know and love, for we feel it may serve to recount this little tale of what happened when one of our staff was perusing digital watches in a nameless emporium in Tottenham Court Road.

Sales Person: (*Closing in with a glint; Can I help you sir?*)

ETI Dupe: It is O.K. thanks I'm just looking at your men's watches — do you have any in stainless steel?

Sales Person: (*Rubs hands speculatively*) You can see all we have down there — those Seiko are very nice machines(?)

ETI Dupe: How much?

Sales Person: £90.50 — plus VAT of course. Worth every penny though. Rolls-Royce of watches these — fantastic.

ETI Dupe: Yes very nice — but why are they so much more expensive than those others?

Sales Person: Oh there's no comparison. These work on a totally different principle to ANY other digital watch, and this method is much more expensive to make. Quartz you know.

ETI Dupe: (*Displaying his full range of knowledge on the subject*) But they all use quartz crystals in the oscillators, and most use the same frequency even don't they?

Sales Person: (*Gives smug look and shakes head sagely*) No, no, no, no — you've been reading some of these Sunday supplements. Absolute rubbish those. Seiko don't even use an oscillator at all — none of these frequencies at all. Not a moving part in the entire watch.

ETI Dupe: (*Beginning to lose contact with reality*) But if it doesn't use an oscillator what does it count to keep time?

Sales Person: (*Totally confident*): Days sir. Very reliable these. Accurate to five secs a month. LCD display, backlight, the whole bit.

ETI Dupe: (*Mystified*) LCD? What's that stand for?

Sales Person: (*Efficiently and knowledgably*) Lit Continuously sir. No need to push a button to find the time out here. . . .

At that point we'll draw an editorial veil over the proceedings. Believe us or not as you wish — but perhaps shops should show the discourse to their staff, and fire anyone who can find nought wrong.

P.S. We're working on a project for a watch that counts days, rather than messy 32k oscillator signals. Ours times the intervals between ice ages by periods of the moon, and divides by 11,500,000,000,000.

Texas at home

A users club now exists for those fortunate to own TI machines. Called the '59 Club' it resides at 27 Montem Lane, Slough, Berks under the watchful eye of one Tim London. A

program library is in there somewhere too, and a newsletter is envisaged. So if you're into Texas keystrokes you know where to go now.

WHAT'S MISSING?
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Our little lady is perfectly intact thank you! We took her T-Shirt away just to show you how lost you'd be without one.
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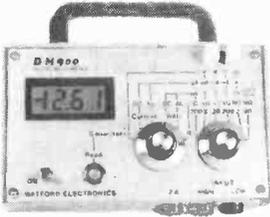
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WATFORD ELECTRONICS



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

(as published in E.T.I. August 1978)
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- 5 AC & DC Voltage ranges; 6 resistance ranges
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The prototype accuracy is better than 1%

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

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

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

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

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3.5mm 15p	10p	8p	12p	DPST 34p	DPST 34p	½A DPDT	13p
MONO 23p	15p	13p	20p	DPDT 38p	DPDT 38p	4 pole 2-way	24p
STEREO 31p	18p	15p	24p	4 pole on/off	4 pole on/off	PUSH BUTTON	
						Spring loaded	
						SPST on/off	60p
						SPDT c/over	65p
						DPDT 6 Tag	85p
						MINIATURE	
						Non Locking	
						Push to Make	15p
						Push Break	25p
DIN	PLUGS	SOCKETS	In Line				
2 PIN Loudspeaker	11p	7p	18p				
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CO-AXIAL (TV)	14p	14p	14p				
PHONO							
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Metal screened	12p	8p double	—				
		10p 3-way	—				
BANANA							
4mm	11p	12p	—				
2mm	10p	10p	—				
1mm	7p	7p	—				
WANDER							
3mm	8p	8p	—				
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33	39	113	50	173	105	298	168	390	230
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47	98	124	180	183	298	327	286	396	215
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54	28	136	55	193	130	353	228	490	180
55	30	138	85	194	166	365	65	668	182
63	150	145	108	196	100	367	65	669	182
73	46	147	170	197	140	368	66	670	248
75	48	148	173	221	96	373	120		
76	40	151	96	240	236	375	160		
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 ETI Oct. 1978
 Parts now available Send SAE for List.

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 Convert your TV into a VDU by using the new Thompson-CSF TV-CRT controller chip SF F96364 16 line by 64 characters text refreshment. Cursor management. Cursor management on screen, Line erasing. Compatible with any computing system.

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 (Send 30p stamps for full technical data)

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 Full Ascii Coded 56 Key **£45.50***

... news digest ..



feeling sporty?

Somewhere amid the teeming multitudes of watches that don't go tick in the night, this button ridden wristband from Casio appealed to us. Apart from the usual watch type functions the F100 is a 1/100S stop-watch with lap time facility. Depending on whether you go for the black case or the posh stainless one, it will cost you between £25 and £50.

rca has disc trouble

Oh for a standard that is a standard standard. Witness this latest piece of lunacy:

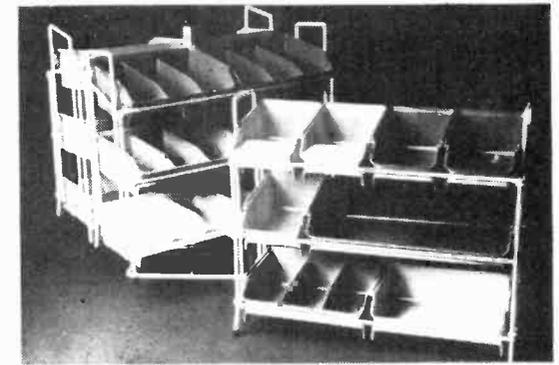
Sometime next year video discs will impact on our lives. Japanese firms are meeting to try and agree a standard format in an effort to avoid shades of four channel lunacy being seen again. So far so good. Unbelievably good in fact.

However just to be bloody awkward both RCA and Philips have their own totally incompatible systems all set to burst forth like over-ripe spots. It can be confidently expected that both will

hang onto their own like grim death — if they take part in the talks at all — and thus create another battle which at best only one can win, and both will probably get clobbered in.

Informal talks are reported to have already begun in Japan and great interest being shown in combining both video and digital audio retrieval in one product. Good luck to those who would standardise and thus software nicely, and a plague of tolerance failures be upon those who would confound and confuse.

stand before the bench



Although designed as a component handling system, it seems to us this little array would make a handy addition to the home constructors work-bench. A wide array of bins are available and all

come in four colours to satisfy the houseproud or colour blind. Designated the 40-12-H it is produced by Link-Hampson Ltd of 5 Bone Lane, Newbury, Berkshire. Look ye thence for further details.

OSTS new from ambit international

Ambit stoppress...news on items available....KV1210: triple AM tuning diode with 2.9v bias only £2.75....DT1200 Digital frequency readout module 911223 ultra low THD/IMD mpx decoder module £9.95.....944378 'Hyperfi' mpx decoder with post decoder muting and pilot cancel £19.95..... VMOS

COUNTER ATTRACTIONS:

From previous advertisements, we trust you all now know that the OSTs supply only the very best quality parts, and that buying from the OSTs you may construct your circuit in total confidence that the parts will not let you down - so this month we feature a couple of really excellent products that will shortly feature as 'standards':
ICM7207 A frequency counter crystal controlled gating and timing IC £4.95
ICM7208 A seven decade counter for use with the 7207 £14.95
ICM7217 Four decade presetable counter/timer with carry out & LED drive £9.50
 25p and an SAE brings you a photocopy of a feature article describing a 500MHz counter using the 7207/8 and 11C900 ECL prescaler for around £60.

Please note that OSTs prices exclude VAT at 8% throughout this side of the page. Most ambit items are at 12½% except those marked *. Please keep orders separately totalled, although a single combined payment, and 25p postage charge, will be sufficient.

CD4000 CMOS

4000	17p	4059	563p	4522	149p
4001	17p	4060	115p	4527	157p
4002	17p	4063	109p	4528	102p
4006	109p	4066	53p	4529	141p
4007	18p	4067	400p	4530	90p
4008	80p	4068	25p	4531	141p
4009	58p	4069	20p	4532	125p
4010	58p	4070	20p	4534	614p
4011	17p	4071	20p	4536	380p
4012	17p	4072	20p	4538	150p
4013	55p	4073	20p	4539	110p
4016	52p	4075	20p	4541	141p
4017	80p	4076	90p	4543	174p
4018	80p	4077	20p	4549	399p
4019	60p	4078	20p	4553	440p
4020	93p	4081	20p	4554	153p
4021	82p	4082	20p	4556	77p
4022	90p	4085	82p	4557	386p
4023	17p	4086	82p	4558	117p
4024	76p	4089	150p	4559	388p
4025	17p	4093	50p	4560	219p
4026	180p	4094	190p	4561	65p
4027	55p	4096	105p	4562	530p
4028	72p	4097	372p	4566	159p
4029	100p	4098	110p	4568	281p
4030	58p	4099	122p	4569	303p
4031	250p	4160	90p	4572	25p
4032	100p	4161	90p	4580	600p
4033	145p	4162	90p	4581	319p
4034	200p	4163	90p	4582	164p
4035	120p	4174	104p	4583	84p
4036	250p	4175	95p	4584	63p
4037	100p	4194	95p	4585	100p
4038	105p	4501	23p		
4039	250p	4502	91p		
4040	83p	4503	69p		
4041	90p	4506	51p		
4042	85p	4507	55p		
4043	85p	4508	28p		
4044	80p	4510	99p		
4045	150p	4511	149p		
4046	130p	4512	98p		
4047	99p	4513	206p		
4048	60p	4514	260p		
4049	55p	4515	300p		
4050	55p	4516	125p		
4051	65p	4517	382p		
4052	65p	4518	103p		
4053	65p	4519	57p		
4054	120p	4520	109p		
4055	135p	4521	236p		

Micromarket

6800 series	8216	£2.25	2114	£10
	8224	£4	2708	£10.55
6800P	£13	8228	£5.25	
6820P	£6	8251	£8	
6850P	£6.75	8255	£5.40	
6810P	£4			
6852	£15			
8080 series	2102	£1.70		
	2112	£3.40		
8080	£16	2513	£7.54	
8212		4027	£5.78	

Voltage Regs

NEW LOW PRICES

7800 series UC TO220 package 1A	all 95p
7900 series UC TO220 package 1A	all £1
78MUC series TO220 package ½A	all 90p
78LCP series TO92 100mA	all 35p

L200 up to 3A/adjustable V&A 195p
78MGT2C ½amp adjustable volts 175p
79MGT2C ½amp adjustable volts 175p

723C precision controller 65p

MAINS FILTERS FOR NOISE/RFI etc

1 amp in IEC connector	£4.83
5 amp in 'wire in' case	£8.87
NES50A 73p	

LINEARS non-consumer

BIMOS	LM324N	71p
	LM339N	66p
	LM348N	186p
	LM3900N	60p
	709CH to5	64p
	709PC dil	36p
	710HC to5	65p
	710PC dil	59p
	723CN	65p
	741CH to5	66p
	741CN 8dil	77p
	741CN	70p
	748CN	36p
	NE531T	120p
	NE531N	105p

OPTO 7 seg displays

0.43" High Efficiency HP:

5082-7650	red CA	
5082-7653	red CC	
5082-7660	yellow CA	233p
5082-7663	yellow CC	
5082-7670	green CA	
5082-7673	green CC	

0.3" Standard HP

5082-7730	red CA	147p
5082-7740	red CC	

0.5" Fairchild

FND500	red CA	150p
FND507	red CC	150p

TLL-Standard AND LP Schottky

All prices listed in pence *

'N'	'LSN'	'N'	'LSN'	'N'	'LSN'	'N'	'LSN'
7400	13	20	7455	35	24	74126	57
7401	13	20	7460	47		74128	74
7402	14	20	7463			74132	73
7403	14	20	7470	28		74133	78
7404	14	24	7472	28		74136	40
7405	18	26	7473	32		74138	60
7406	38	7474	27	38	74139	60	
7407	38	7475	38	40	74141	56	
7408	17	24	7476	37	74142	265	
7409	17	24	7478		74143	312	
7410	15	24	7480	48	74144	312	
7411	20	24	7481	86	74145	65	
7412	17	24	7482	69	74147	175	
7413	30	52	7483A		74148	105	
7414	51	130	7484	97	74150	99	
7415	24	7485	104	99	74151	64	
7416	30	7486		40	74153	64	
7417	30	7489	205		74154	96	
7420	16	24	7490	33	90	74155	54
7421	29	24	7491	76	110	74156	110
7422	24	24	7492	38	78	74157	67
7423	27	7493	32	99	74158	60	
7425	27	7494	75		74159	210	
7426	36	27	7495A	65	99	74160	130
7427	27	29	7496	58	120	74161	92
7428	35	32	7497	185		74162	92
7430	17	24	74100	119		74163	92
7432	25	24	74104	63		74164	104
7433	40	32	74105	62		74165	105
7437	40	24	74107	32		74167	20
7438	33	24	74109	63	38	74168	
7440	17	24	74110	54		74169	200
7441	74		74111	68		74170	230
7442	70	99	74112	88		74172	625
7443	115		74113	38	74	74173	170
7444	112		74114	38	74	74173	170
7445	94		74116	198		74174	87
7446	94		74118	83		74175	87
7447	82		74119	115		74176	75
7448	56	99	74121	25		74177	78
7449	56	99	74122	46		74180	85
7450	17		74123	48		74181	165
7451	17	24	74124	48		74182	160
7452	17		74125	38	44	74183	210
7454	17	24	74125	38	44	74184	135

From the World's leading radio innovation source:

New this month, the DT1200 AM/FM/Time digital readout module in a fully screened enclosure for panel mounting. A frequency counter with 10.7MHz offset for FM and 455kHz offset for AM, plus a quartz based digital clock function - including an mpx beacon and fine tuning indication. Single 12v 350mA rail operation, only £45.00 for all this!

Moving Coil Meters

Ambit offers a very wide range of low cost meters, together with the unique 'Meter Made' scale system for professional grade scale customizing:

Series	Scale Area	Illumination	cost*
900	14x31mm	internal 12v	250p
920	30x50mm	from behind	275p
930	36x63mm	internal 12v	375p
940	twin 35x45mm	from behind	350p
950	55x45mm	from behind	300p

Stock movement 200uA/750V. The 930 series is 5% linear, others are 77uA at 50% FSD. These and many others available in quantity for OEM's SAE for full scale details please. (Not in cat.)

Coils & Filters by TOKO

After a period of relative price stability, please note that some prices are increased - as a direct result of the failure of £ versus stronger trading currencies. (Mainly Yen)

7 & 10mm IFTs for AM/FM - 1000s es	
455/470kHz most types of appcs	30p
10.7MHz	33p

Short Wave Coils sets
 Now two ranges of impedance/coupling ea 33p

TV video and sound IFs/detectors
 Another new range in 10mm 33p
 6MHz ceramic IF sound filter 80p

Molded VHF coils full catalogue 15p
 Ultra stable coils for 30 - 200MHz from 20p

Chokes - biggest range/biggest stocks
 Most E12 values ex stock, any to order

7BA series 1uH to 1mH	16p
8BR series 100uH to 33mH	19p
10RB series 33mH to 120mH	33p

Radio/Audio/Comms ICs:

Only the very best quality - and only types we have used in our own laboratory tests (Radio frequency + mixers + oscillators)

TD1062	DC to VHF front end system	1.95
TD1083/ULN2204	am/fm/uln in one IC	1.95
TD1090/ULN2242	am/fm hit tuner system	3.35
HA1197	LF/30MHz am receiver system	1.40
CA3123E/A720	LF/30MHz linear system	1.40
TBA651	LF/30MHz linear system	1.81
SD6000	DMOS RF/Mixer pair	3.75

IF amplifiers

CA3089E/KB4402	famous FM IF system	1.94
HA1137W/K	4420 as 3089 + deviation mute	2.20
CA3189E	update with deviation mute	2.75
TBA120A/SN76600N	FM if and detector	1.00
TBA120S	hi-gain version TBA120	1.20
MC1350P	agg. IF amp	0.75
MC1330P	synch AM demodulator	1.35
MC1495L	precision 4 quad multiplier	6.86
MC1496P	popular double balanced mixer	1.25

Communications circuits

KB4406	differential amplifier	0.50
KB4412	2 bal. mixers/agg/gain/doub. conv	2.55
KB4413	am/fm/ssh det. AGC, ANL, mute	2.75
KB4417	3mV mic preprocessor preamp	2.55
KB4423	FM noise blanker system	2.55

Audio preamps

LM38T	stereo high gain/low THD	1.81
LM1303	stereo audio optimized AO	0.99
TD1054	high quality with alt option	1.95
KB4417	see above	

Audio Power amps

TBA810AS	7W RMS overload protected	1.09
TDA2002	8W/2Ω in pentawatt package	1.95
TDA2020	15W RMS hi-fi power dc coupled	2.99
TCA940	10W higher voltage 810	1.00
ULN2283	1W 2.5 to 12v supply capability	1.00
LM3300P	1W power	1.00
LM380N14	2.5W power	1.00
HA1370	HiFi 15w in easy heatsink pack	2.99

Stereo Decoder Devices

MC1310/KB4400	original pll decoder	2.20
CA3090AO	RCAs pll decoder	3.25
uA758	Buffered version of 1310	2.20
LM1307/uA707	non pll type	1.55
HA1196	advanced agc, sep pll low thd	3.95
HA11223	new pilot cancel low thd/ind	4.35

All ambit decoders are supplied with the LED beacon of your choice. Please state colour.

Discrete semiconductors

Some of the biggest stocks of specialist MOS and FET transistors for radio in the UK.

BF900	50p* 40673	55p*	40822	43p*	
40823	51p*	MEM680	75p*	BF256S	34p*

Most types for most RF circuitry, inc. new UHF T package types etc. See price list.....

Hitachi VMOS 100W power devices:
 Start saving now for the biggest breakthrough in power transistor technology yet. Ambit has the new Hitachi VMOS data (E1) and by the time you read this, we should have received our first stock order. But they aren't cheap.

Discrete LEDs - the best value of all:

LED size:	2.5x5mm	5mm dia	clip
RED	17p	14p	2p
YELLOW	20p	15p	2p
GREEN	20p	16p	2p

10% disc for 10 off, 25% discount per 100

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 A very wide selection of BOTH Alps SUB series units, (Schadow/AB/Oreor compatible) & the miniature Dialstat units. Available in 'DIY' systems for maximum flexibility and low cost.

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From the biggest and best range.....

TUNERHEADS for 88-108MHz band 2 (varicap)

EF5803	6 cct, 3 MOSFETs, amp. osc	19.75
EF5801	6 cct, 2 MOSFETs, osc op	17.45
EF5600	sect, MOSFET RF, by TOKO	14.95
EF5400	4cct balanced mixer/pin agc	9.75
EC3202	3cct FET input mixer	8.25

TUNERSETS by LARS HOLT (head+IF)

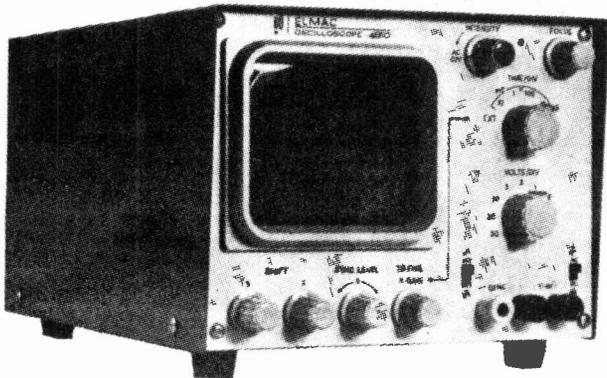
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(as recommended by ETI)

Oscilloscope offer from KRAMER & CO.

Sole U.K. Importers

4" Oscilloscope for under £100



SPECIFICATIONS

ELECTRICAL DATA

VERTICAL AXIS (Y) Deflection Sensitivity — 100mV/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 1 μ sec/div in 5 steps FINE Control — Variable between steps — includes time-base calibration position. Blanking — Internal — on all ranges SYNCHRONISATION Selection — Internal, external Synchronisation Level — Continues from positive to negative

POWER SUPPLY. Input voltage — 115/220V AC \pm 10% at 50/60Hz. Power Dissipation — 18W

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

PHYSICAL DATA Dimensions — 15cm (h) x 20.5cm (w) x 28cm (d). Weight — 4.3Kg (approx.). Stand — 2 position flat and inclined. Case — Steel, epoxy enamelled. Front Panel — Aluminium, enamelled epoxy printing

Cash with order

£99 + VAT

Oscilloscope Offer, Kramer & Co. 9 October Place, Holders Hill Road London NW14 1EJ

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—SPECIAL OFFER—



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These units are ideal for a Disco, Group or home party. The lamps are never off, each one is dimmed for a second and then back to full brightness.

500mm long, designed for 3 x 100W lamps (not included), complete with 2 metres of cable and 12 months guarantee. Fully suppressed, all electronic (not bi-metal).

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shorts

● Tandy is doing well with its home computer in the USA, and is expanding, both physically and financially, that side of the business.

● New from GI — the Cricket chip. The AY-3-8910 is a programmable sound generator and is software controlled, needing only a power supply and clock to begin chirping or hooting or ...

● Bowmar has Texas's range and is homing in. Texas are being sued for \$3 million by Bowmar who allege the supply of a large number of defective calculator keyboards.

● XR4741 to you. Nothing to do with sci-fi but a new quad op-amp. Very low noise and better than a 741 in all respects. Available from RASTRA at 275 King St, Hammersmith, London W6. Ideal for audio projects where the hissing of summer circuits is not required.

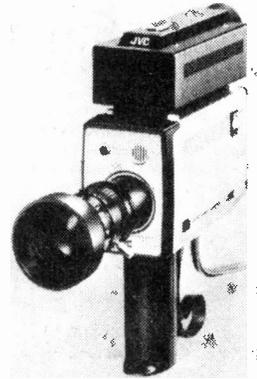
● The Government's hi-fi firm, Strathem are to launch their new SM2000 turntable in the autumn, which will replace the SMA2 model. Once again the unit looks technically sound — maybe success at last for nationalised-fi?

● 4k RAMs which require only 42% of the 2114 standard requirement are now available from Dage Eurosem, and a low power standby mode lets them claim a 70% power saving on an 8k x 16 memory with 50% duty cycle. Scrooge Electronics take note.

● How about this — Britain has exported electronics to HONG KONG. Blink not sir and read further. A British (wave that flag harder sonny) MPU system is being installed in Hong Kong's airport to control and direct traffic on the runways. Lights around the strips are controlled by the system to guide aircraft, and a VDU gives updated info and what's where and when. Pity nearly all the planes are Boeings ...

● UK's electricity costs are still among the highest in the world, according to a survey released this month. And our prices are rising third fastest too. 15.9% for commercial users, and only SA, the USA and Canada can better that. Aren't we lucky little consumers then? Where oh where has all the North Sea oil gone?

mans best PAL



The GC-3300 colour video camera from JVC is the latest item from the land of the rising yen to come to our attention. The camera will significantly add to JVC's range of home/professional video equipment and with what JVC describe as a "domestic" price tag of £1350, the GC-3300 is one of the lowest priced colour cameras on sale in the UK.

The camera has a built in 38mm CRT viewfinder, six-to-one zoom lens with macro setting, built in condenser microphone and other features that make the GC-3300 a very versatile camera. Acceptable pictures can be produced at very low (250 lux-bright domestic light level) light levels.

The camera is based on a two tube design which uses a system of multiplexing to produce the colour signal that in most designs requires three tubes.

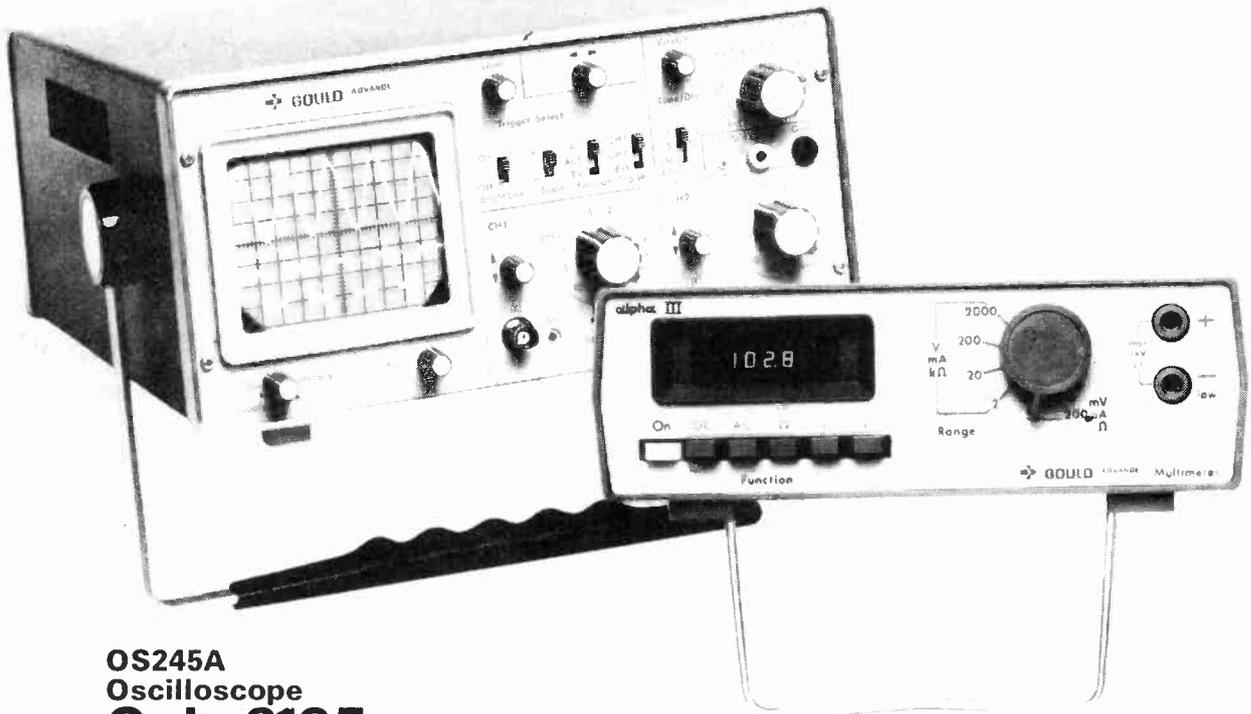
odds & ...

LCD Multimeter — August 78. On the circuit diagram the annotations for R31 and 32 should be reversed as should those for SW2A and SW2D. Fig. 4. should have the following designations added to wafers of SW2B and SW2C. Unmarked terminal at "six 'o' clock" should be 11 and one to right of it 10. Swap references to terminals 4 and X.

Non-inverting input of IC9C should be taken to junction of IC9A's output with R44 and Ctest terminal not to junction of SW2E's wiper and R44 as shown.

STAC time — September 78 On the component overlay IC2 should be rotated through 180°.

Gould Advance Instruments - Professional quality at a realistic price.



OS245A Oscilloscope
Only £195 (excluding VAT)

Alpha III Digital Multimeter **Only £89** (excluding VAT)

OS245A Oscilloscope

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

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

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

- *DC-10MHz bandwidth
- *Dual trace
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 Registered Number 263834 England.

Alpha III Digital Multimeter

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

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

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- *Fully guaranteed for 2 years

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Or please charge my Access *

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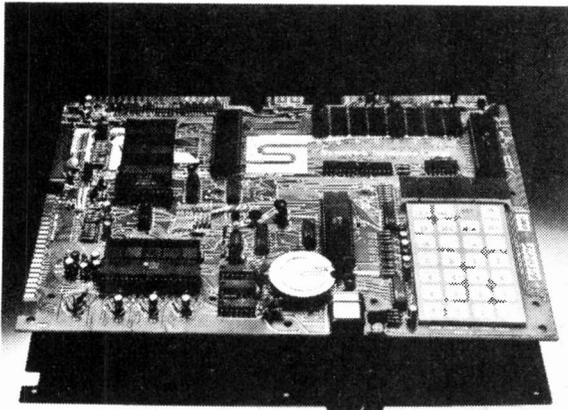
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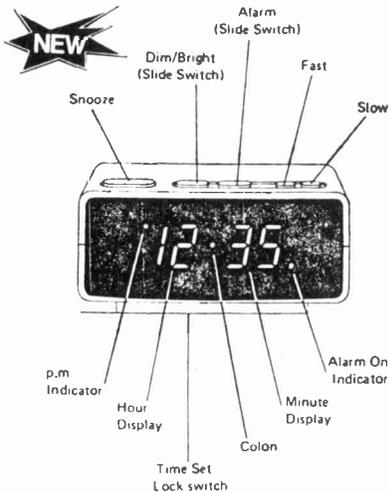


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- ★ 4K byte ROM Monitor
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- Feature and Specification**
- ★ Hour, minute display
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Size 5.15 x 3.93 x 2.36 (131mm x 100mm x 60mm)
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(P&P £1.00 each). Please note ropelight kits are available only by Mail Order.

PIEZO HORNS FANTASTIC SPECIAL OFFER TO READERS OF ELECTRONICS TODAY. Tweeters for your disco, PA system or Hi-Fi. Frequency range 5K-20K. No X-over required. They can be used in any PA system up to 100W. Why pay more?
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PROJECTORS **SQUIRE MULTIFECT 150** — including rotator and effects wheel. A truly versatile projector which uses a powerful 150W Tungsten bulb, all effects attachments simply slot in ready for use.
A BARGAIN AT £40.50 (P&P £1.00).

SOLAR 250 Utilising a 250W Quartz-Iodine bulb giving brilliant light output, this projector is fan-cooled and can be used free standing or ceiling mounted. Dual effect system for stunning versatility. Rotators are extra. Huge choice of special effects and attachments! **NOW ONLY £70.20** (P&P £2.00).

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All Roger Squire's shops have a service department which carries large stocks of DISCO SPARES & ACCESSORIES. For example: Fane and H. H. Disco Speakers 12" and 15" BSR and Garrard decks at discount prices.

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S.R.B. Miniature Soldering Iron 16/18 watt **£3.50 + 25p P&P**

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- 3.
4.
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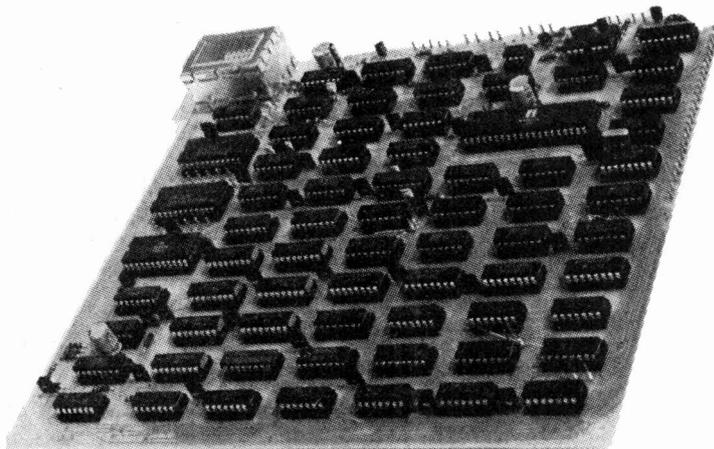
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COMPLEX SOUND GENERATOR

Not quite a synthesizer, but more than your average stylus organ — that's the ETI project team's musical offering this month

WHILE WE WOULD not claim that our Minisynth is the latest in polyphonic synthesizers (It'd never stand up in court) we want to emphasise that this is definitely not another in the never ending stream of Rolf Harris multivibrators.

Complex Chip, Easy Sound

The project is based on a new sound generator IC from Texas Instruments. This device has an on board VCO, low frequency oscillator, noise source, envelope generator and a number of mixing circuits.

The final instrument can be used to provide a number of sounds, some musical, some not. You can use it to entertain, or, in case of those of us whose talents lie in fields other than music, annoy friends and foe alike.

Construction

Construction of the project is relatively straight-forward. Carefully follow the component overlay, as usual, noting the orientation of all electrolytic and tantalum capacitors. It makes sense to use IC sockets for the three ICs.

Before starting construction of the electronic components it might be an idea to tin the keyboard area in order that a more reliable contact is made.

Tinning can be carried out by coating the 'keys' with blobs of solder, heating the whole area up (large soldering iron required — we hope you won't use this for the rest of the construction) and quickly wiping away excess solder with a wet cloth.

The probe can be fashioned from an old biro, which has had its innards replaced by a wire that is connected to the original pall point.

The choice case for the project is much up to personal taste. We put our instrument in a case we made ourselves from thin plywood, painted black.

Playing With

The only way to become familiar with the Minisynth is to sit down with the instrument and play with it. This is a painful experience for all concerned and while it won't make you blind could well make you deaf if

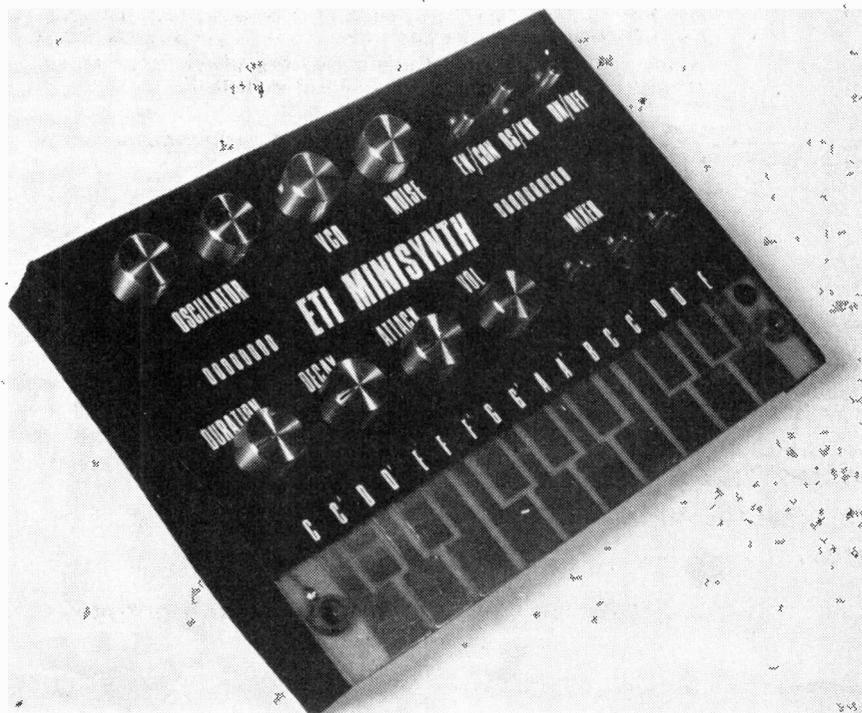
the volume is up too far. Some of the sounds produced at this stage are, to say the least, gruesome and for the sake of all concerned this learning period should take place in private. You can expose your talents when the mechanics of playing the machine have been mastered.

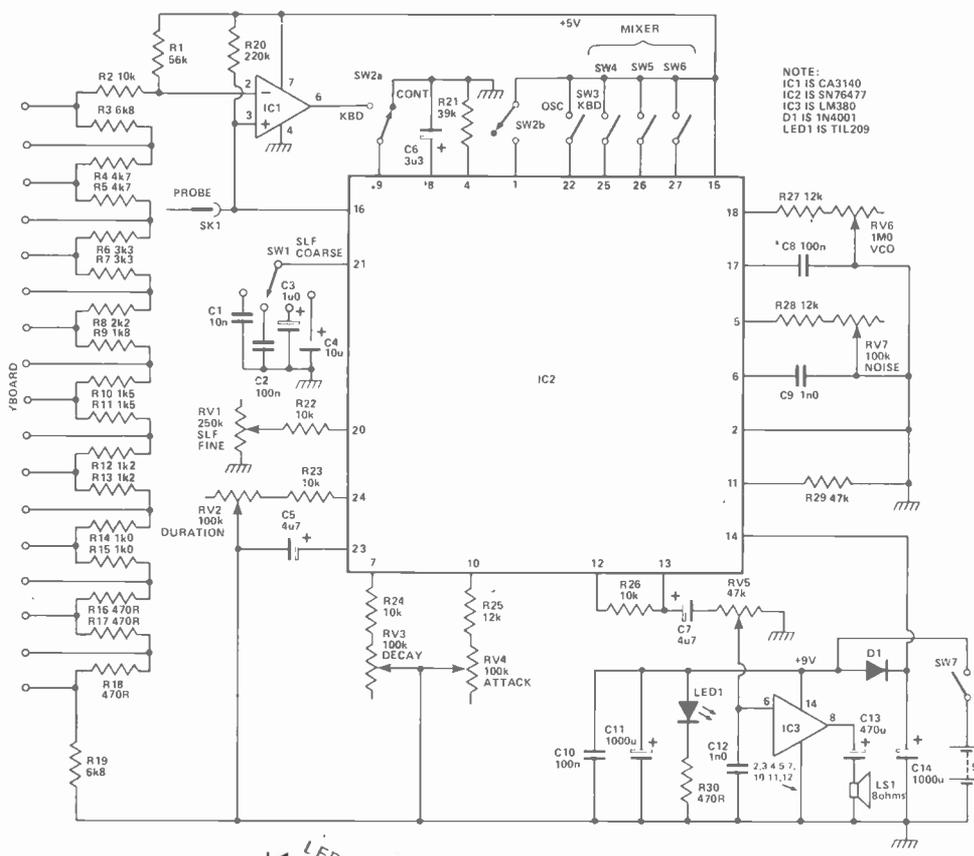
A good starting point for the controls is to set the DURATION, ATTACK and DECAY controls to minimum, the SLF OSCILLATOR's course control to the highest frequency range with the fine control set at minimum. Set the VCO and NOISE controls to their mid points and all the MIXER switches down (towards you) — this will select the output from the main VCO. The ENVELOPE/CONTINUOUS control should be down and the OSCILLATOR/KEYBOARD control away from you.

Switching the instrument on should produce a note, the frequency of which can be altered by the VCO control. At this stage the note will be unaffected by the keyboard.

By moving the OSCILLATOR/KEYBOARD control to the down position the Minisynth can be played via the keyboard, the VCO control as a tune facility.

With the ENVELOPE/CONTINUOUS control in its present position the note selected by the keyboard will be maintained until the probe is removed from the keyboard. Moving the switch to the up position will mean that the notes selected will be modified by the output of an envelope generator. The envelope generator is set up by the DURATION, ATTACK and DELAY controls. The control functions are self-explanatory, the only point to





The SN76477 IC that forms the basis of this project is a bipolar/1²L device that provides a VCO, low frequency oscillator, noise source and filter, an envelope generator plus various other mixing and control logic all in a 28 pin DIL package. The block diagram shows the internal arrangement of the various blocks within the IC and the pins to which external control networks are connected. For full data on the device consult the data sheet published in February's ETI.

Although the SN76477 does most of the work, we require two additional ICs, IC3 to provide adequate audio output and IC1, which forms part of the keyboard circuit — the section we shall now look at in detail.

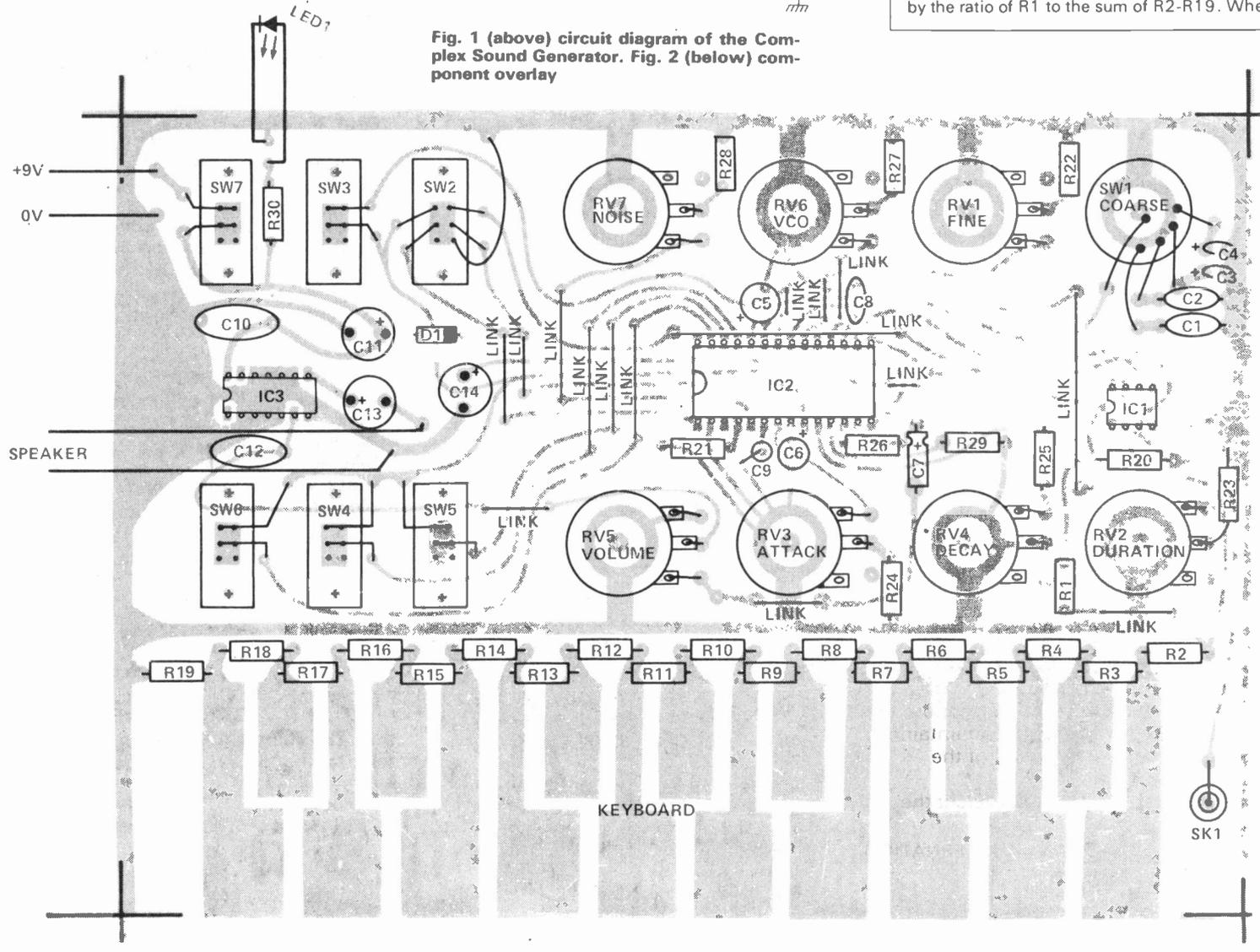
VCO and Keyboard

A voltage applied to pin 16 of IC2 will, if the external VCO select (pin22) is Low, determine the frequency of oscillation of the IC's on chip VCO. The Higher the external control voltage the lower the frequency produced. The range of the VCO is internally set at a ratio of 10:1, while the minimum frequency of operation is determined by C8 and by the series combination of RV7 and RV6(tune). The duty cycle of the oscillator is set at 50% by leaving pin 19 open.

The external control voltage is derived from the potential divider chain formed by the resistors R1-R19, the particular value being tapped off by the stylus.

IC1 provides an indication that the stylus has touched the keyboard. The inverting input (pin 2) of IC1 is held at a voltage that is determined by the ratio of R1 to the sum of R2-R19. When

Fig. 1 (above) circuit diagram of the Complex Sound Generator. Fig. 2 (below) component overlay



HOW IT WORKS

the stylus is not in contact with the keyboard R20 ensures that the non-inverting input (pin 3) is above this fixed voltage, the output of IC1 is thus high.

As the stylus touches the keyboard, the voltage at pin 3 will be pulled down to a level below that on pin 2 by the relatively low impedance voltage determined by the lower leg of the resistor chain. This will cause the output of IC1 to go low. The output of IC1 is taken to SW2a which selects either this signal or 0 V as the output to pin 9 of IC2.

Pin 9 is the system enable input. IC2 is inhibited when this pin is held high, taking it low enables the various sections of the IC. The transition of this pin from high to low (IC1's action as the keyboard is touched) also initiates the one shot logic (enabled by SW2b) that can provide sounds of short duration — this is described in detail below.

SLF Oscillator

The on chip VCO, as well as being controlled from the external voltage derived from the potential divider chain, can be modulated by an on chip Super Low Frequency oscillator. The VCO is controlled by this oscillator when the VCO select (pin 22) is high.

The SLF can be operated in the range 0.1-30 Hz, the particular frequency being set by the capacitors C1-C4 (selected by SW1) and by the combined resistance of R22 and RV1 (oscillator fine).

As well as providing a sawtooth output for control of the VCO, the SLF oscillator provides an output that is taken to the mixer section of IC2 described below.

Noise Generator and Filter

The on chip noise oscillator's input is taken, via R21, to ground. This sets up the conditions for correct operation of this section the output of which is fed to a noise filter. This modifies the noise generator's output by reducing the high frequency content of the signal. The specific 3dB point is set by C9 and by the value of R28 and RV7 (filter) in series.

Mixer

Outputs from the noise filter, VCO and SLF oscillator are fed to a mixer circuit. This combines the three signals in a manner determined by the logic levels on pins 25, 26 and 27 of the IC2 (mixer select). The particular output or combination of outputs corresponding to the eight possible states of these pins is shown in table 1. The output of the mixer is fed to the envelope generator and modulator.

It should be noted that as opposed to TTL ICs, unconnected inputs of the SN76477 assume a low state.

One Shot Logic

The one shot logic is used to provide sounds of a short duration. The circuit is triggered by a negative going edge on the system enable input, the duration of the "one shot" being determined by C5 and R23 plus RV2 (duration).

ADL

The attack/decay logic determines the envelope of the IC's output controlling as it does the envelope generator.

lope of the IC's output controlling as it does the envelope generator.

The ADL mode is selected by logic level signals on pins 1 and 28. In our circuit pin 28 is left unconnected while pin 1 is taken to SW2b. This selects the output of the one shot when held high and of the VCO when taken low.

Envelope Generator and Modulator

The attack/decay characteristics of the output are determined by C8 in conjunction with R25 and RV4 (attack) and R24 and RV3 (decay).

Output Amplifier

The output of the envelope generator is taken internally to an on chip amplifier the gain of which is set by the ratio of R26/R29. The output of the amplifier appears at pin 13 and is taken via C7 and the volume control RV7 to IC3 an LM380. This IC acts as a power output stage. C11 ensures that the LM380 is stable under all operating conditions, while C12 provides DC isolation between IC3's output and the loudspeaker LSI.

Power Supply

The 9 V input is used to power IC3 directly and is then taken via D1 (to drop 0.6 V) to pin 14 of IC2. This is the input to an internal voltage regulator that powers the IC and also provides a stable 5 V at pin 15 for use elsewhere in the circuit. C10, C11 and C14 provide supply decoupling while LED1, together with current limiting resistor R30, provide an indication that power is applied to the circuit.

PARTS LIST

RESISTORS (all 1/4W 5%)

R1	56k
R2,22,23	
24,26	10k
R3,19	6k8
R4,5	4k7
R6,7	3k3
R8	2k2
R9	1k8
R10,11	1k5
R12,13	1k2
R14,15	1k0
R16,17,	
18,30	470R
R20	220k
R21	39k
R25,27,	
28	12k
R29	47k

POTENTIOMETERS

RV1	250k linear
RV2,3,	
4,7	100k linear
RV5	47k log
RV6	1M0 linear

CAPACITORS

C1	10n polyester
C2,8,10	100n polyester
C3	1u0 35 V tantalum
C4	10u 35 V tantalum
C5,7	4u7 10 V electrolytic
C6	3u3 35 V tantalum
C9,12	1n0 polystyrene
C11	1 000u 16 V electrolytic
C13,14	470 16 V electrolytic

SEMICONDUCTORS

IC1	CA3140
IC2	SN76477
IC3	LM380
D1	1N4001
LED1	TIL209

SWITCHES

SW1	single pole, four way rotary
SW2	DPDT
SW3-7	SPST

MISCELLANEOUS

PCB as pattern, case to suit, probe, 8 ohm loudspeaker, battery eliminator.

BUYLINES

All the components except IC2 should be widely available while IC2 will be stocked by Watford, Technomatic and other Texas suppliers. Watford are also to supply a complete kit for the project.

We do not have enough space to reproduce the foil pattern but it will be available on ETIPRINTS or can be obtained by sending an SAE to our offices. Please mark your envelope Complex Sound Foil Patterns.

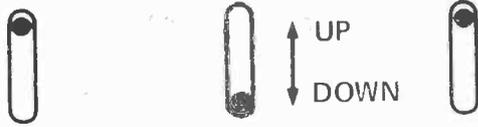
note is that because the Minisynth does not have a sample and hold facility in the keyboard section, the note required must be maintained throughout the period of the envelope.

The mixer controls select the

outputs from the various noise sources and oscillators on the instrument. At present it is the output of the main VCO that we are hearing. By setting the ENVELOPE/CONTINUOUS control back to its former position and

moving the leftmost mixer control up the output from the SLF OSCILLATOR can be heard. This oscillator is controlled by the fine and course controls at the top right hand corner of the instrument.

PROJECT: Sound Gen.



DOWN	DOWN	DOWN	VCO
DOWN	DOWN	UP	SLF/NOISE
DOWN	UP	DOWN	NOISE
DOWN	UP	UP	SLF/VCO
UP	DOWN	DOWN	SLF
UP	DOWN	UP	SLF/VCO/NOISE
UP	UP	DOWN	VCO/NOISE
UP	UP	UP	INHIBIT

TABLE 1

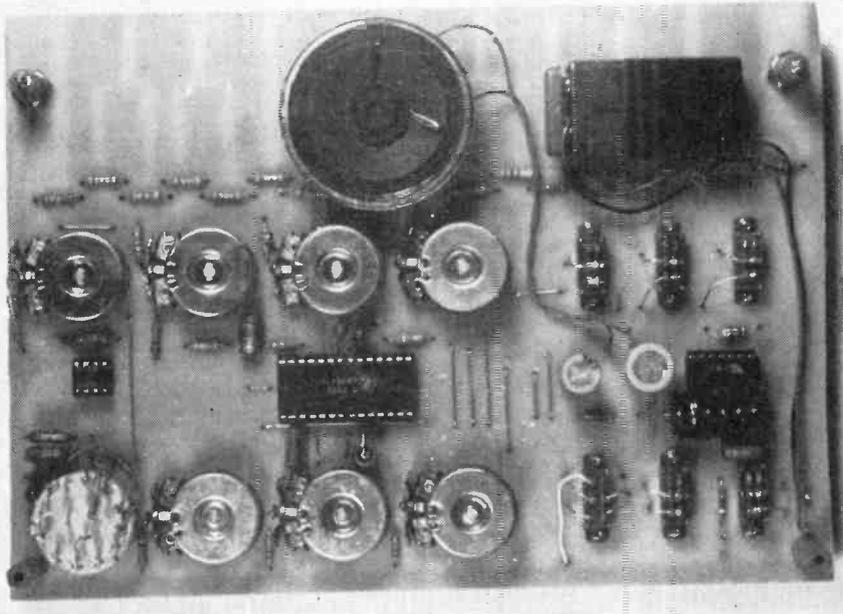
Set the leftmost mixer switch to down again and move the right hand switch up, the output from the noise generator will now be heard.

The various combinations of the oscillators and noise source

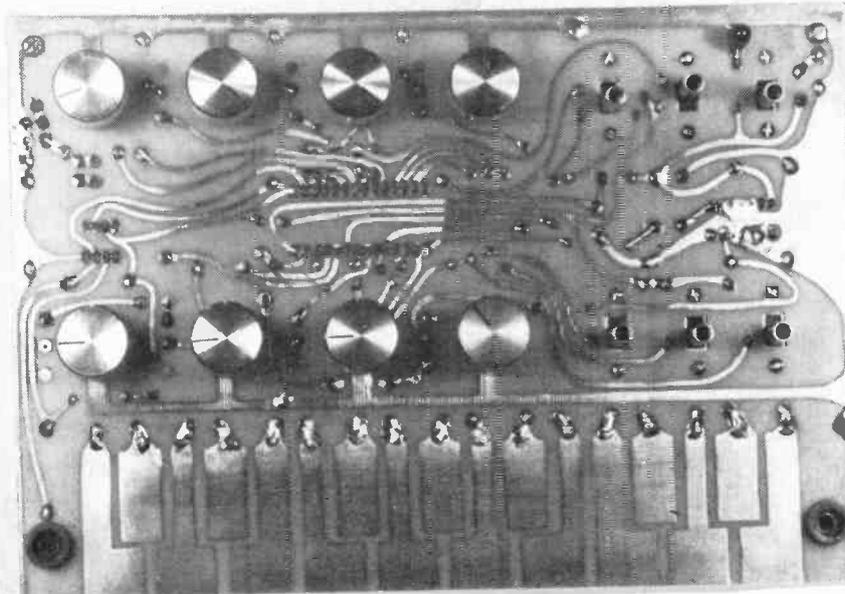
corresponding to the settings of the mixer controls are shown in Table 1.

That then is a run down of the various controls and their effects, its now up to you to put them together and hopefully make a little music.

ETI



Two photographs showing the PCB from above and below. Note the front panel lettering on page 17 is in error — the attack and delay designations being reversed.



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TRANSISTORS																													
2N636	0.39	2N2218	0.35	2N3393	0.17	2N4037	0.60	2N5192	0.80	2N6174	0.45	8C108A	0.16	8C1288	0.35	8C213C	0.15	8C337	0.20	8D240A	0.49	8F160	0.33	8FR79	0.30	ME4001	0.16	TIP30C	0.70
2N637	0.31	2N2218A	0.38	2N3396	0.19	2N4059	0.17	2N5194	0.80	4D361	0.55	8C108C	0.17	8C173A	0.25	8C213A	0.17	8C547	0.13	8D241A	0.49	8F167	0.37	8FR81	0.30	ME4002	0.16	TIP31A	0.54
2N638	0.49	2N2219	0.38	2N3395	0.19	2N4060	0.22	2N5195	0.97	4D362	0.55	8C109	0.16	8C179E	0.25	8C213B	0.17	8C547A	0.13	8D241C	0.65	8F173	0.37	8FR29	0.34	ME4101	0.11	TIP32A	0.59
2N639	0.58	2N2219A	0.39	2N3397	0.19	2N4061	0.19	2N5245	0.37	4D363	1.45	8C109B	0.17	8C179C	0.26	8C213C	0.17	8C547B	0.13	8D242A	0.55	8F177	0.27	8FR30	0.34	ME4102	0.11	TIP32C	0.82
2N706	0.30	2N2220	0.39	2N3438	0.85	2N4062	0.20	2N5246	0.38	4D408	0.82	8C109C	0.18	8C182	0.12	8C214	0.17	8C548	0.13	8D242C	0.62	8F178	0.27	8FR34	0.30	ME4103	0.11	TIP32D	0.76
2N706A	0.30	2N2221	0.25	2N3440	0.75	2N4064	1.35	2N5247	0.44	4D409	0.82	8C140	0.30	8C182A	0.12	8C214B	0.17	8C549	0.14	8D243A	0.65	8F179	0.33	8FR85	0.38	ME4104	0.11	TIP32E	0.76
2N708	0.30	2N2222	0.25	2N3442	1.45	2N4121	0.27	2N5294	0.44	4D411	3.10	8C147	0.13	8C182L	0.15	8C214L	0.18	8C549C	0.15	8D244A	0.70	8F181	0.37	8FR87	0.35	ME5101	0.22	TIP42A	0.86
2N718A	0.54	2N2222A	0.25	2N3638	0.17	2N4122	0.27	2N5295	0.44	4D594	0.87	8C147B	0.13	8C182LA	0.15	8C214LB	0.18	8C550	0.14	8D244C	0.87	8F182	0.37	8FR88	0.30	ME5102	0.22	TIP42C	1.08
2N720A	0.85	2N2369	0.27	2N3638A	0.17	2N4123	0.19	2N5296	0.44	4D595	0.98	8C148	0.13	8C182LB	0.15	8C214LB	0.18	8C551	0.13	8D245A	0.69	8F183	0.47	8FR89	1.37	ME5103	0.62	TIP30S	0.59
2N722	0.45	2N2369A	0.27	2N3702	0.14	2N4124	0.19	2N5298	0.44	4D673	0.80	8C148B	0.13	8C183	0.12	8C237B	0.15	8C559	0.15	8D245C	0.85	8F184	0.41	8FR90	0.27	ME5104	0.62	TIP34	1.05
2N727	0.50	2N2646	0.80	2N3703	0.14	2N4125	0.19	2N5447	0.16	4D669	1.30	8C148C	0.13	8C183A	0.12	8C238A	0.13	8C570	0.21	8D246A	0.72	8F185	0.37	8FR91	0.27	ME5105	0.62	TIP34A	1.05
2N914	0.38	2N2647	1.55	2N3704	0.14	2N4126	0.19	2N5448	0.16	AC128	0.48	8C149	0.15	8C183B	0.13	8C238B	0.13	8C571	0.26	8D246C	0.93	8F194	0.16	8FR92	0.27	ME520	0.50	TIP43	0.47
2N916	0.33	2N2903	1.60	2N3705	0.14	2N4284	0.38	2N5449	0.20	AC127	0.48	8C149C	0.15	8C183C	0.13	8C238C	0.13	8C572	0.18	8D433	0.44	8F195	0.16	8FR90	1.35	ME521	0.70	TIP90	0.22
2N917	0.38	2N2904	0.31	2N3706	0.14	2N4287	0.22	2N5457	0.38	AC128	0.48	8C157A	0.15	8C183L	0.15	8C239E	0.16	8D115	0.88	8D434	0.46	8F196	0.16	8FR101	0.55	ME525	1.65	TIP91	0.27
2N918	0.45	2N2904A	0.31	2N3707	0.14	2N4287	0.22	2N5458	0.35	AC151	0.43	8C158A	0.15	8C183LA	0.15	8C239C	0.17	8D131	0.55	8D435	0.46	8F197	0.18	8FR102	0.55	ME526	1.65	TIP92	0.33
2N929	0.37	2N2905	0.31	2N3708	0.12	2N4288	0.22	2N5459	0.32	AC152	0.54	8C158B	0.15	8C183LB	0.15	8C239D	0.18	8D132	0.75	8D436	0.46	8F198	0.19	8FR103	0.55	ME527	1.65	TIP93	0.36
2N929A	0.37	2N2905A	0.31	2N3709	0.12	2N4289	0.22	2N5460	0.65	AC153	0.59	8C159	0.17	8C183LC	0.15	8C239D	0.19	8D133	0.40	8D437	0.55	8F199	0.22	8FR104	0.55	ME528	1.65	TIP94	0.37
2N930	0.37	2N2906	0.25	2N3711	2.16	2N4347	2.20	2N5484	0.37	AC153K	0.59	8C159B	0.17	8C184	0.12	8C239E	0.19	8D136	0.40	8D438	0.55	8F202	0.22	8FR105	0.55	ME529	1.65	TIP95	0.37
2N930A	0.37	2N2906A	0.25	2N3712	2.20	2N4348	2.65	2N5485	0.40	AC176K	0.70	8C160	0.38	8C184B	0.13	8C300	0.43	8D137	0.41	8D529	0.49	8F225J	0.27	8FR106	0.55	ME530	1.65	TIP96	0.37
2N1171	0.30	2N2907	0.25	2N3713	0.15	2N4918	0.65	2N5486	0.40	AC176	0.54	8C161	0.38	8C184C	0.13	8C301	0.43	8D138	0.41	8D530	0.55	8F244A	0.38	8FR107	1.55	ME531	1.65	TIP97	0.37
2N1889	0.30	2N2907A	0.25	2N3713A	0.15	2N4919	0.70	2N5490	0.64	AC187	0.59	8C167	0.13	8C184L	0.15	8C302	0.37	8D139	0.43	8D535	0.70	8F248B	0.38	8FR108	1.37	ME532	1.65	TIP98	0.37
2N1990	0.30	2N2923	0.17	2N3820	0.39	2N4920	0.83	2N5492	0.64	AC187K	0.65	8C167B	0.13	8C184LB	0.15	8C303	0.54	8D140	0.43	8D536	0.70	8F248A	0.44	8FR109	1.37	ME533	1.65	TIP99	0.37
2N1993	0.30	2N2924	0.17	2N3821	0.39	2N4921	0.83	2N5494	0.65	AC188	0.54	8C168A	0.13	8C184LC	0.15	8C304	0.16	8D141	1.90	8D537	0.77	8F248C	0.44	8FR110	1.37	ME534	1.65	TIP100	0.37
2N2102	0.50	2N2925	0.19	2N3900	0.28	2N4922	0.60	2N5496	0.67	AC188K	0.65	8C168B	0.13	8C212	0.15	8C307A	0.16	8D182	2.20	8D538	1.43	8F251	0.35	8FR111	1.37	ME535	1.65	TIP101	0.37
2N2102A	0.50	2N2926	0.17	2N3901	0.30	2N4923	0.75	2N5627	0.64	AD161	1.00	8C168C	0.13	8C212A	0.15	8C307B	0.16	8D183	2.35	8D539	0.60	8F252	0.35	8FR112	1.37	ME536	1.65	TIP102	0.37
2N2193	0.50	2N3053	0.25	2N3902	0.20	2N4924	1.15	2N56107	0.45	AD162	1.00	8C169	0.13	8C212B	0.15	8C308	0.16	8D187	0.95	8D540	0.60	8F259	0.35	8FR113	1.37	ME537	1.65	TIP103	0.37
2N2193A	0.52	2N3054	0.22	2N3904	0.18	2N5086	0.30	2N56108	0.55	AF106	0.60	8C169C	0.13	8C212L	0.18	8C308B	0.16	8D235	0.46	8D541	1.32	8F336	0.42	8FR114	1.37	ME538	1.65	TIP104	0.37
2N2194	0.42	2N3055	0.75	2N3905	0.18	2N5087	0.30	2N56109	0.55	AF109	0.52	8C177	0.22	8C212LA	0.18	8C309A	0.16	8D236	0.44	8D542	1.32	8F337	0.42	8FR115	1.37	ME539	1.65	TIP105	0.37
2N2194A	0.45	2N3056	0.50	2N3906	0.18	2N5088	0.30	2N56111	0.49	BC107	0.16	8C177A	0.22	8C212LB	0.18	8C309B	0.16	8D237	0.44	8D543	1.32	8F338	0.42	8FR116	1.37	ME540	1.65	TIP106	0.37
2N2195	0.40	2N3057	0.45	2N3907	0.18	2N5089	0.30	2N56121	0.41	BC107B	0.16	8C178	0.22	8C212C	0.15	8C309C	0.16	8D238	0.44	8D544	1.32	8F339	0.42	8FR117	1.37	ME541	1.65	TIP107	0.37
2N2195A	0.40	2N3058	0.45	2N3908	0.18	2N5090	0.30	2N56122	0.44	BC107B	0.16	8C178	0.22	8C213A	0.15	8C309D	0.16	8D239	0.44	8D545	1.32	8F340	0.42	8FR118	1.37	ME542	1.65	TIP108	0.37
2N2197	0.55	2N3059	0.17	2N4036	0.72	2N5191	0.75	2N6123	0.48	BC108	0.16	8C178A	0.25	8C213B	0.15	8C309E	0.16	8D240	0.44	8D546	1.32	8F341	0.42	8FR119	1.37	ME543	1.65	TIP109	0.37

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GAIN CONTROL

PART ONE

THERE ARE MANY cases in signal processing where the control of the gain is necessary. Some common examples are automatic volume controls in cassette recorders and in the IF sections of radio receivers. Also in professional audio equipment there is a whole range of compressor, expander, limiter and noise gate devices which find great use in recording and broadcast studios. Maybe you have wondered how the volume of the music drops when the DJ starts to talk and then fades up again when he stops. This process, known as voice over or "ducking," uses *voltage control of gain*.

Noise reduction systems such as dolby and dBX employ voltage controlled amplifiers. Synthesizers and sound processors obtain effects such as ring modulation, automatic panning frequency shifting, dynamic filtering, tremolo and envelope shaping also by the use of this technique.

Gaining gain

There is a wide variety of methods which can be used to obtain the gain control. This can be anything from constructing the variable gain element yourself from basic parts, to buying IC or module designed specifically to solve your particular problem. Generally the solution is some sort of compromise, because unfortunately the

problem of making high performance controlled gain cells (multipliers), is rather difficult and therefore the IC's tend to be rather expensive.

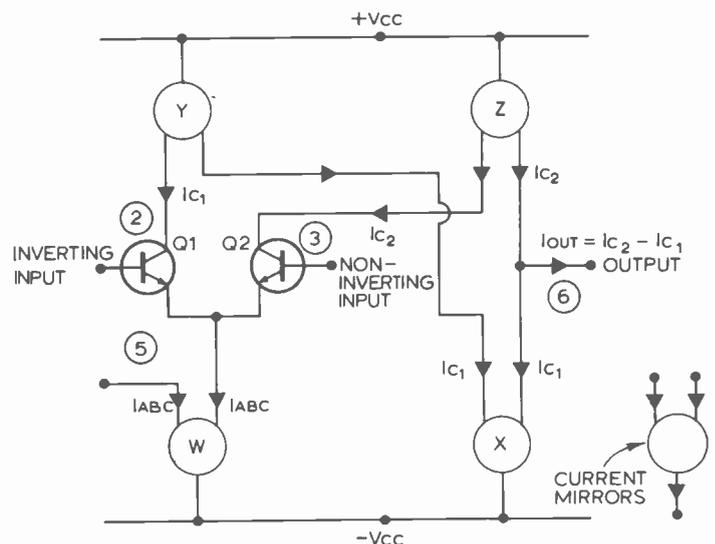
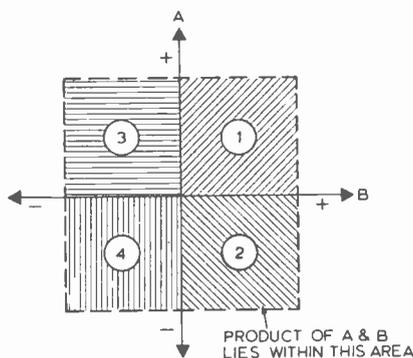
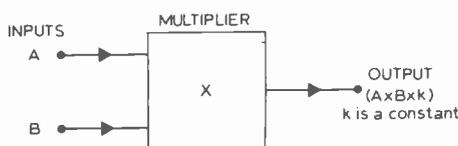
However with a bit of care a cost effective solution can usually be produced.

A good example is the AGC in a transistor radio. The transistors in the IF section have an h_{fe} that varied widely with the magnitude of their collector current. Thus, by sticking three transistors in series it is possible to vary their overall gain by about 40 dB, (x100), merely by controlling their collector currents. The AGC stops the audio output of the radio from varying as the radio reception conditions alter.

Electronic multipliers

When it is required to control the level of one signal with that of another, an electronic multiplier is used. This process is analogous to arithmetic multiplication. If input A is positive, Fig. 1, and input B is positive then the product (the output), will also be positive. If A goes negative then the product will be negative. If both A and B are negative then the product will be positive thus preserving the arithmetic rules.

If A and B are limited to be only one sign each then



Left: the principle behind electronic multipliers. The graph shows the possible outputs for a variety of combinations of input polarities.

Above: Internal workings of a CA3080, an Operational Transconductance Amplifier. Say that too fast and you'll need a new set of teeth.

Tim Orr continues his occasional series of circuits, methods and explanations with a detailed look at how gain can be controlled by another electronic signal, be it squarewave, sinewave or voice signal. This leads to some interesting circuits — from ducks to filters!

the multiplier is known as a one quadrant multiplier. That is the product can only lie in one quadrant. If A can be both +ve and -ve, and B only of one sign then the multiplier is known as a two quadrant multiplier. This is what is called an amplitude modulator. The audio signal which is bipolar is A and the control voltage is B.

If A and B can be both +ve and -ve, the product can lie anywhere in the four quadrants and hence the multiplier is known as a four quadrant multiplier. This type of device is found in frequency shifters and ring modulators.

CA3080 — An OTA!

The CA3080 is a two quadrant multiplier, or to give it its full title, it is an Operational Transconductance Amplifier. It has a differential input and a single quadrant current input known as I_{ABC} . (amplifier bias current), Fig. 2. The differential transistor pair is used to steer the I_{ABC} current between the two transistors Q2. There is a region where the input differential voltage is linearly proportional to the percentage of current steered between the two transistors. This voltage region is fairly small, being about 20 mV, but using the CA3080 in this area then a reasonably linear 2 quadrant multiplier can be obtained.

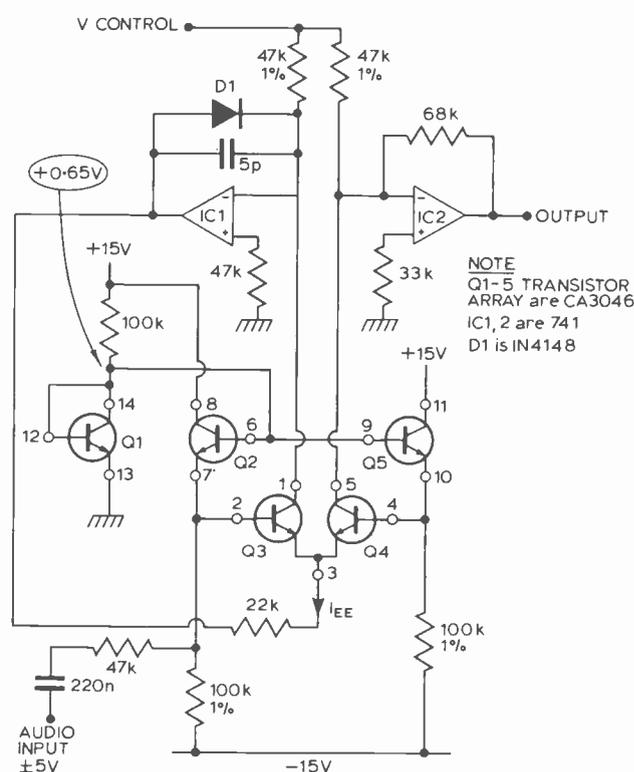
What has happened is the the I_{ABC} current has been multiplied by the input voltage. The product is the difference between the two collector currents. This difference is extracted by the use of mirrors, current mirrors that is. The current mirrors can be attached to either the +ve or the -ve supply rail.

They have two terminals, and whatever current flows into one terminal, then the same flows into the other, which is why they are called mirrors.

What we want to do is take the difference between the collector currents of Q1 and Q2, I_{C1} is reflected from mirror Y and then from mirror X and then appears at the output. I_{C2} is reflected from mirror Z and then appears at the output. The two currents are subtracted from each other and the output current is thus $(I_{C2} - I_{C1})$, which is the product of $I_{ABC} \times V_{in} \times K$, where K is a constant. Note that the I_{ABC} current is also reflected from a current mirror on the negative rail.

The CA3080 is a low cost two quadrant multiplier and can be used to perform a wide variety of multiplication functions. The linearity of the device holds true for I_{ABC} variations of over three decades. When using this device keep I_{ABC} below 0.5 mA.

VCA Using CA3046 Array



The CA3046 is an array of 5 transistors which are all well matched and relatively cheap. Q_e, 4 forms the differential transistor pair, IC1 controls the current and IC2 extracts the differential output current and turns it into an output voltage. The audio input is inserted into the base of Q_e but also connected to this node is the emitter of Q₂. Q₂ and Q₅ serve to predistort the input signal, but they distort the signal the opposite way to which the multiplier distorts it. This is known as distortion cancelling, and it allows a larger signal level to be applied to the multiplier for the same percentage of distortion at the output. The larger input signal allows a higher signal to noise ratio to be obtained. Transistor Q₁ is used to bias the bases of Q₂, 5 to a suitable operating region.

The circuit operation is as follows. The microphone signal comes via VR1. This pot sets the sensitivity of the circuit to the microphone signal. If it is too sensitive the unit will be 'ducking' every time the DJ breathes. IC5 is an amplifier and filter. The filter has been specifically tailored to fit the characteristics of speech, thus making the ducking unit less sensitive to spurious noise. IC2, 3 forms a precision full wave rectifier, the output of which is low pass filtered and then fed to IC4. This wave form is the envelope of the microphone input signal.

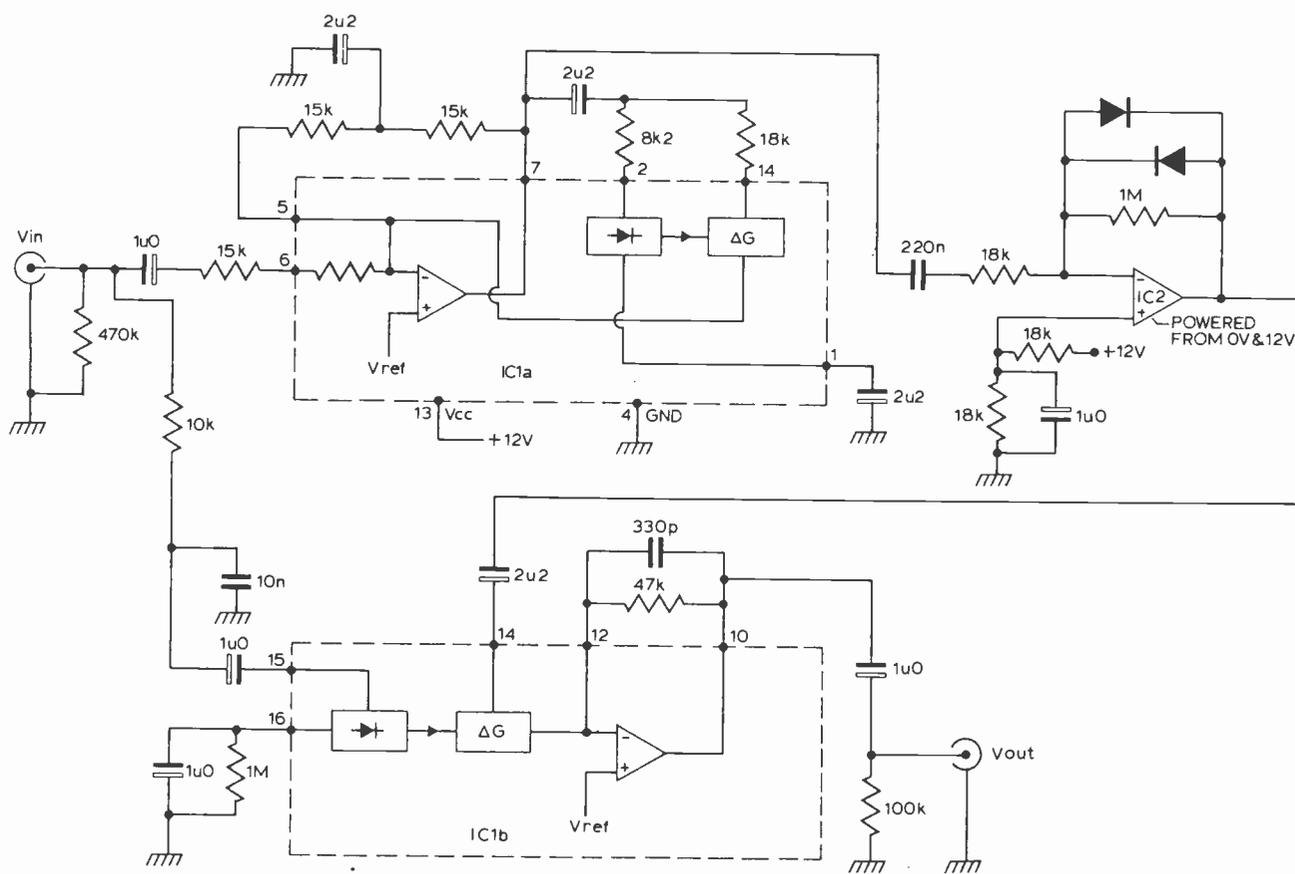
IC4 is a peak, negative going, voltage detector with a gain of x 5. When the DJ begins to speak, IC4 goes negative and in doing so pulls the base of G 1 negative. When the DJ stops speaking the base of G 1 rises back towards 0 V with a time constant determined by CA or CA + CB.

This is the release time and it controls the speed with which the faded down music comes back to full volume. G 1 is an emitter follower and its job is to rob current from the gain cells in the NE570.

This current sets the volume of the two music channels. When the base of G 1 is pulled down to the negative rail, the amount of robbed current is maximum, and when no current flows into pins 1 and 16 of the NE570 and all of it flows into g 1, then both music channels are turned off.

To set up PR1, put a large signal into the microphone channel, set RV2 so that it is a short circuit and then adjust PR1 so that the two music channels just close off. PR2 and PR3 should be adjusted so that pins 7 and 10 of the NE570 are both +6 V.

Clever Fuzz Box



Fuzz boxes are used by guitarists to produce harmonic distortion and sustain. If you want to produce only the distortion, but to retain the original envelope of the signal then this is the circuit for you.

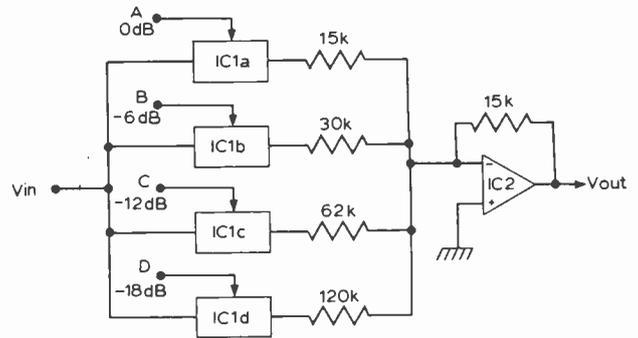
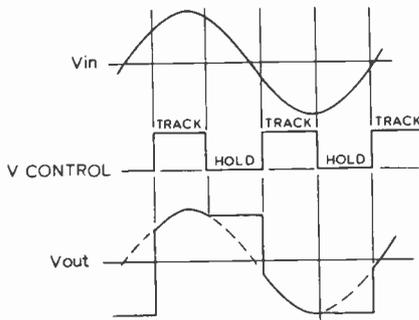
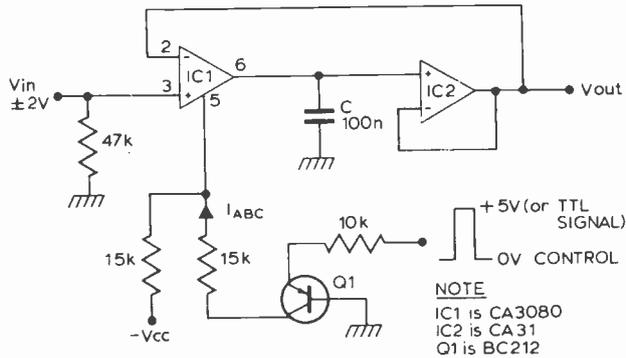
IC1 is a 2:1 compressor as described previously. This produces a relatively high level signal which then drives IC2, which is a x 50 amplifier with diode clamping. IC2 produces the distorted (fuzz) sound. This is then fed into the IC3 gain cell, the

output of which drives the op amp. This gain cell is driven by the rectified original signal (low pass filtered at 1k5 Hz), so that the distorted sound is given the envelope characteristics of the original sound.

If a fuzz sustain sound is required rather than a dynamic fuzz then IC3 could be modified (by the inclusion of a clamped high gain amplifier driving pin 15) so that it acts as a low level expander. This will squelch the noise at the end of the fuzz period.

Track and Hold

In this example the CA3080 is used as a current controlled switch. When the control voltage is high, I_{ABC} is maximum, (0.44 mA) and the OTA gain is maximum. The voltage at pin 2 of IC1 adjusts itself so that it is the same as that on pin 3, this being due to the 100 per cent feedback via the high input impedance voltage follower IC2. When the control voltage is 0V, I_{ABC} is zero and hence the gain of the OTA is zero. Therefore no current comes out of its output and so the voltage at the output of IC2 remains frozen (Hold mode). The maximum differential input voltage is 5 V and this must not be exceeded. The capacitor C should be selected to suit the speed of the operation.



0 \equiv -6V
1 \equiv +6V

A	B	C	D	GAIN
1	0	0	0	0dB
0	1	0	0	-6dB
0	0	1	0	-12dB
0	0	0	1	-18dB

POWERED BY $\pm 6V$

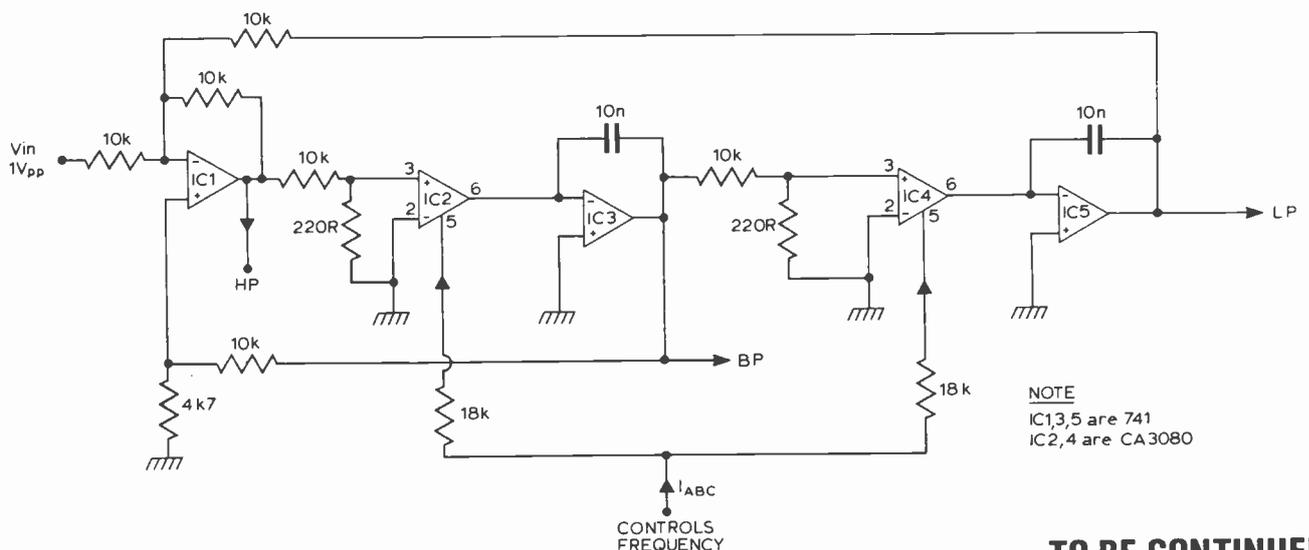
NOTE
IC1 is 4016
IC2 is 741

Voltage Controlled (Switched) Attenuator

The CD4016 is a quad analogue transmission gate. That is, it is a quad voltage controlled switch. When the control is high the switch is ON, having an effective resistance of about 400R. When the control is low the switch is off and it looks like a 100M resistor. Thus by using 4016 switches it is possible to 'Switch' the voltage gain of an amplifier. The resistors in this example are selected to give 6 dB changes in gain.

Filter

A state variable filter produces three outputs: highpass, bandpass, and lowpass. It is thus a very versatile filter structure, even more so if the resonant frequency can be varied. This frequency is linearly proportional to the gain of the two integrators in the filter. Two CA3080's, (IC2, 4) have been used to provide the variable gain, the resonant frequency being proportional to the current I_{ABC} . Using 741 op amps for IC3 a control range of 100 to 1, (resonant frequency) can be obtained. If CA3140's are used instead of 741's then this range can be extended to nearly 10,000 to 1.



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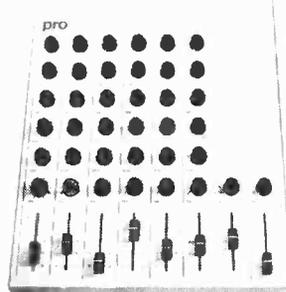
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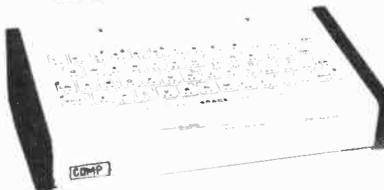
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4008	.75	7406	.25	7483	.75	74192	.75	74L02	.20	74S194	1.05
4009	.35	7407	.55	7485	.55	74193	.85	74L03	.25	74S257 (8123)	1.05
4010	.35	7408	.15	7486	.25	74194	.95	74L04	.30		
4011	.20	7409	.15	7489	1.05	74195	.95	74L10	.20	74LS00	.20
4012	.20	7410	.15	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
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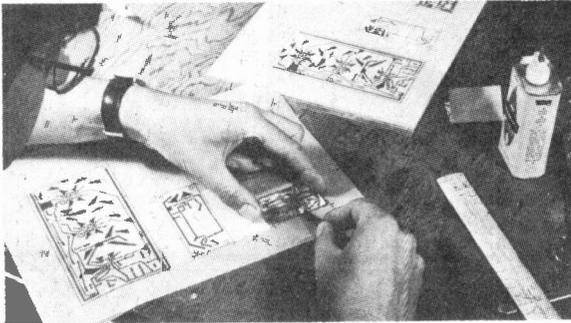
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RF POWER METER

Take a load off your mind — and put a proper and useful load on your antenna — with the ETI Project Team's venture into the realms of the short and shorter wave.

THIS REFLECTOMETER design, apart from being simple, elegant and easy to construct, covers three decades — from 100 kHz to 100 MHz, and can be constructed for RF powers as low as 500 mW or up to 500 watts.

The problem for most designs for reflectometers, or "Swar" meters as they tend to be called colloquially these days, is that they generally only cover about one decade in frequency range — usually 3 to 30 MHz or, if further, have discontinuities and drastic sensitivity variations at the extreme ends of their frequency range.

Sensitivity is a problem with the commercially available instruments also. Those with the best sensitivity — 5W full scale usually — are made for the (overseas) CB market, and while they will work over most of the HF spectrum (some extending beyond that), sensitivity is insufficient if you are working with low power solid state RF circuitry or doing a deal of antenna experimentation.

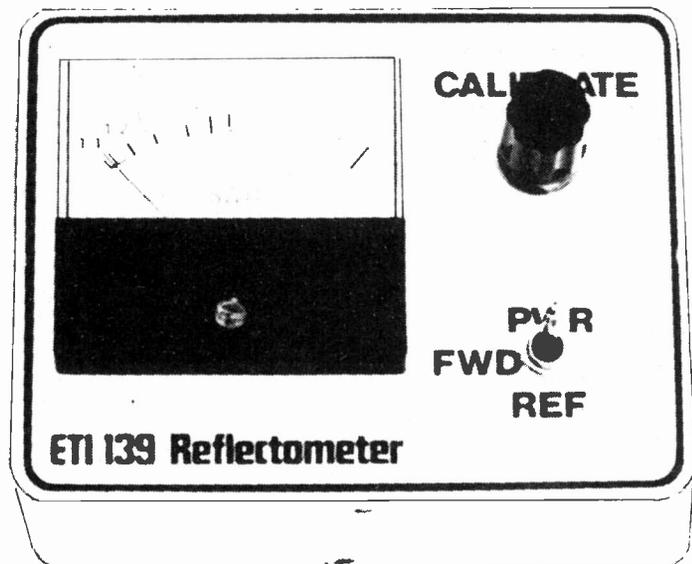
Performing antenna measurements at powers of 5W or more is discourteous to say the least, especially where sustained or many consecutive measurements need to be made.

The reflectometer / RF power meter described meets the requirements of most people involved in RF measurements requiring such an instrument and where a disparate variety of facilities are required.

This project will be extremely useful to radio amateurs, servicemen involved in communications, in laboratories, etc.

Construction

Construction is very straightforward. The printed circuit design given is recommended, as variations in layout may affect performance.



All the components are mounted on the *copper side* of the PCB, which is subsequently assembled onto the coax sockets and mounting bolts.

Commence by winding the toroid current transformer secondary turns. Refer to the circuit diagram. Cut a 45 mm length of RG58, stripping back the braid and insulation as illustrated in the component overlay and photographs. This is not all that critical, but maintain as much braid as you can to reduce problems with errors creeping in at the top end of the frequency range due to discontinuities here.

Slip the toroid over the short length of coax and mount this assembly on the PCB. Position the toroid centrally and fix it in place with a small amount of pliable plastic cement compound.

Mount all the other components next. Pay particular attention to the orientation of the diodes D1, D2, D3.

The trimmer capacitor, C2, is shown as a mica compression type. Any suitable trimmer — such as the Philips film trimmers — can be used, however, the mica compression

trimmer provides a certain amount of 'vernier' adjustment.

The PCB and major components are assembled into a suitable metal box.

The completed PCB is mounted in the following way:

Once the coax sockets are mounted, and the two mounting bolts are in position, a coax plug (with cable) should be plugged into each of the sockets in order to locate the centre-conductor pins of each socket.

The PCB is then placed into position and the input/output pads soldered to the coax socket pins. Make sure that a good fillet of solder secures the pin to the PCB pad.

Two nuts on the mounting bolts, one under the PCB, one on top of the PCB, then secure the board mechanically as well as providing a ground connection. Refer to the pictures and components overlay.

Connections to the meter, pot, and switch — located on the front panel, can then be made with short lengths of hookup wire.

Calibration

A suitable RF source, a dummy load and an RF voltmeter or a known-accurate RF power meter are required for test calibration of the instrument. Any of the standard amateur texts (ARRL, RSGB handbooks etc) provide excellent construction details of dummy loads to dissipate a variety of powers. The same texts describe suitable RF

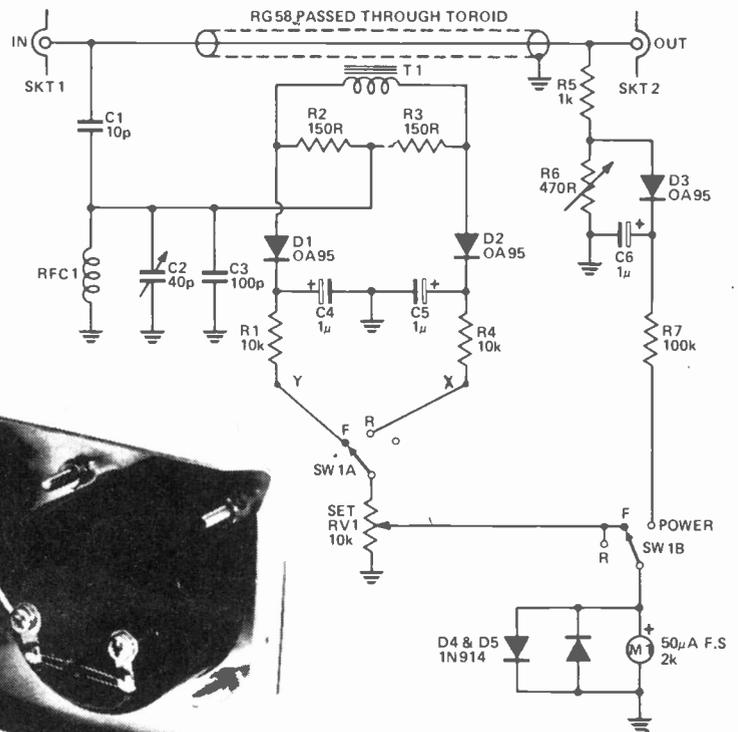
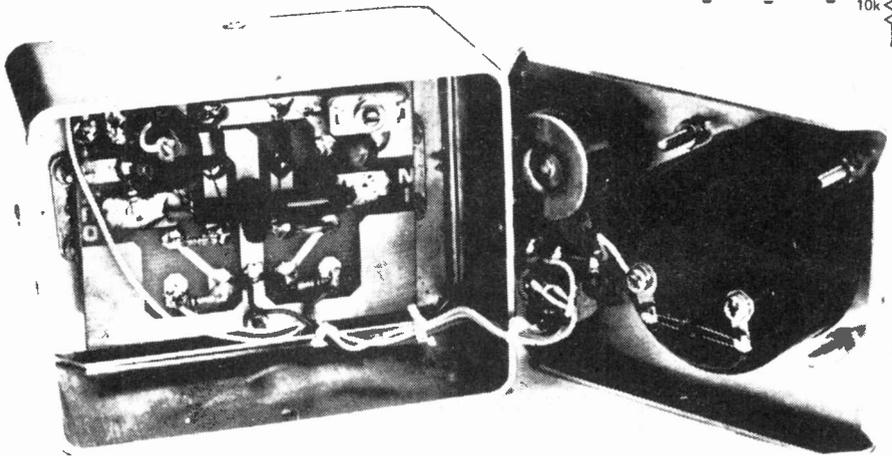


Fig. 1. Circuit diagram of the SWR power meter. Note the unusual switch configuration, using a double pole three way switch.

voltmeter probes that may be used in conjunction with a multimeter.

SWR Scale

The instrument is connected between the RF source and the dummy load. Turn the sensitivity control fully anticlockwise. Switch to read forward power.

Key the RF source and slowly rotate the sensitivity control clockwise. The meter reading should increase. If it doesn't, check wiring. If it goes in reverse, you've got D 1 back to front!

If all is well, advance the sensitivity control until the meter reads full scale. Switch to read reverse power. Adjust the trimmer C2 to obtain a minimum meter reading. It should go to zero; increase the sensitivity when a very low reading is reached to ensure that C2 is adjusted correctly.

This completes the adjustment of the Reflectometer section. The scale calibration can be obtained from Table 1.

The sale on the meter may be hand-lettered using Letraset or other 'rub-on' lettering. The original lettering may be painted over and the new SWR scale inserted beneath the original scale.

HOW IT WORKS

The reflectometer employs a "current transformer" having an electrostatically-shielded primary with a high-ratio secondary winding driving a low value load resistance.

A short length of coaxial cable, passed through a ferrite toroid, forms the primary with the braid connected so as to form an electrostatic shield.

The secondary of the current transformer consists of a winding around the circumference of the toroid, coupled to the magnetic component of the 'leakage' field of the short length of coax cable.

The secondary drives a centre-tapped resistive load (R2/R3) connected to a voltage sampling network (C1-C2/C3) tapped across the RF input such that sum and difference voltages will appear across the ends of the

current transformer (T1) secondary winding.

Diodes D1 and D2 rectify the sum and difference voltages from the secondary of T1, RF and audio (modulation) bypassing being provided by C4 and C5. The RF choke, RFC1, provides a low-resistance DC return for the signal rectifiers, D1 and D2.

The power measurement facility is obtained by tapping off a portion of the RF voltage on the line via R5 and R6, and rectifying this with D3. Capacitor C6 provides RF and audio (modulation) bypassing.

As the load on the rectifier is so light — R7 being 100 k and the meter being 2 k, peak power is measured.

Diodes D4 and D5 provide protection for the meter.

BUYLINES

As with all RF projects, some of the components will not be stock items with the majority of suppliers.

In case of difficulty with any of the

items Catronics at Communications House, 20 Wallington Square, Wallington, Surrey should be able to help.

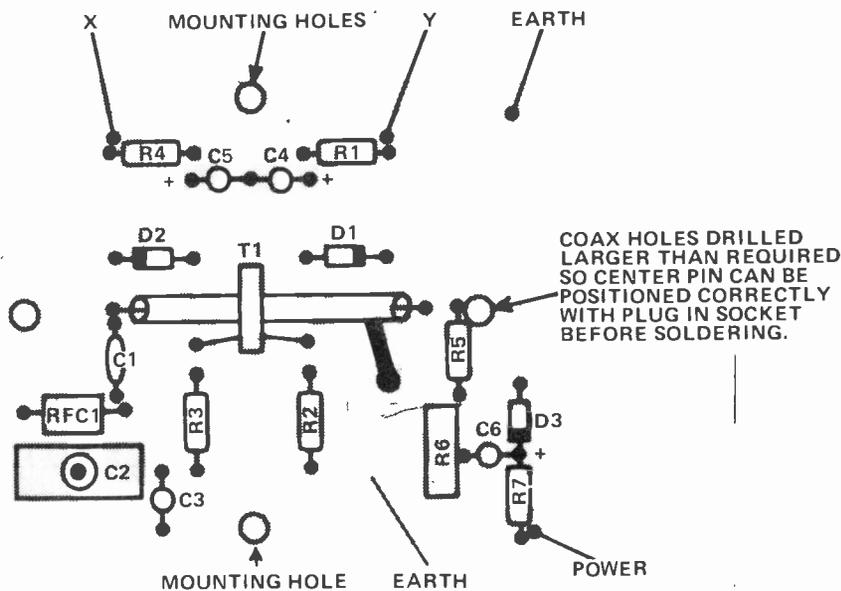


Fig. 2. Component overlay for the PCB. Note that, contrary to the usual practice, the components are mounted on the copper side of the board.

TABLE 1

SWR	Scale reading
3:1	0.5 full scale
2.5:1	0.42 full scale
2:1	0.34 full scale
1.5:1	0.2 full scale
1.2:1	0.1 full scale
1.1:1	0.05 full scale

TABLE 2

Peak Power, full scale	R2 value.
500 W	6R8
200 W	2 x 33R in parallel
100 W	33R
50 W	68R
20 W	2 x 330R in parallel
10 W	330R
5 W	680R
3 W	1k + 100R in series *

*linearity suffers

Power

The circuit (Fig. 1) shows a divider network, consisting of R5 and R6, tapped across the RF on the coax line.

The lower divider resistance R6 is shown as a variable element. A

miniature deposited carbon track trimpot was used in the prototype. The low value types seem to perform quite well over a wide frequency range and one was used here for convenience. It was set so that the full-scale reading of M1

PARTS LIST

- Resistors** all 1/4W, 5%
- R1 10k
 - R2,R3 150R
 - R4 10k
 - R5 1k
 - R6 470R trimpot or fixed
—see text
 - R7 100k
- Potentiometer**
- RV1 10k/C pot
- Capacitors**
- C1 10p ceramic
 - C2 40p trimmer
 - C3 100p ceramic
 - C4 - C6 1u solid dipped tantalum
- Semiconductors**
- D1 - D3 OA95
 - D4,5 1N914
- Miscellaneous**
- RFC1 Any moulded RF choke,
1mH or more (value not
critical).
 - SW1 Two pole three way
 - M1 50 μ A meter T.E.W. type
2k resistance.
 - T1 40 turns of 35 gauge B & S
enamelled wire, around cir-
cumference of Neosid toroid
type 28-511-31, 12.7 mm
o.d., 6.35 mm i.d., 3.18 mm
thick, F14 material (see text)
 - Coax
sockets SO239 or other type to suit
Case Horwood type 34/2/D
(100 mm x 75 mm x 50 mm).
 - PC board ETI 139
 - Two 25 mm long bolts with three nuts
and two lock washers each; nuts and bolts
for coax sockets (if required); length of
RG58 coax; 6 mm dia. sleeving; hookup
wire, etc.

corresponded to a particular peak power dissipated by the dummy load (as measured with an RF voltmeter or known-accurate RF power meter).

Fixed resistors may be substituted for a trimpot, necessitating only a check of the accuracy of the full scale peak power reading. Values for particular full-scale power readings are given in Table 2.

The power scale should be calibrated to suit the individual instrument. It will be non-linear, particularly at the bottom end.

Performance

The inherent impedance of the prototype instrument was measured using a TEK 5 W dummy load and a Hewlett-Packard vector impedance voltmeter. The results are illustrated in Fig. 4.

The impedance discontinuities introduced by the prototype are well

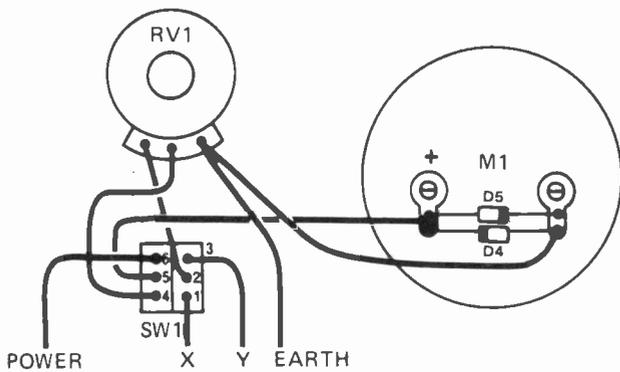


Fig. 3. The meter, sensitivity pot and switch connections. Leads X and Y go to the D2 and D1 respectively, while the lead marked 'POWER' goes to R7. Refer to Fig. 2.

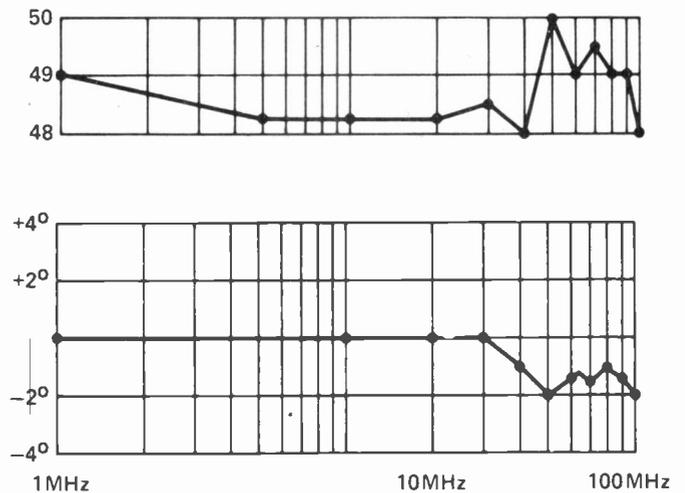


Fig 4. Top: real or resistive component of the prototype's inherent impedance. Lower: Reactive component.

inside the basic accuracy capability of the meter movement! The real part of the instrument's impedance is within 5% of the nominal 50 ohms — most of this is probably due to connectors and construction discontinuities.

The variation in the real part of the impedance is within \pm one ohm across the frequency range of the instrument, and can be essentially ignored.

The reactive (imaginary) component of the instrument's inherent impedance is negligible up to 20 MHz when it begins to become slightly capacitive.

The overall impedance decreases rapidly above 100 MHz.

Sensitivity and sensitivity bandwidth of the prototype is excellent. The half-power points of the sensitivity bandwidth of the reflectometer are at approximately 350 kHz and 25 MHz.

Full-scale deflection at 27 MHz requires 0.8 watts into 50 ohms. Mid-band sensitivity is under half a watt!

Modifications

For higher power applications, the basic sensitivity of the reflectometer can be reduced by one of several methods, or a combination.

If you are working with powers around 20 to 50 watts, R2 and R3 can be reduced to 47 ohms. For higher powers, the number of turns on the toroid can be reduced, and R2/R3 further reduced in value. As a guide, reduce the secondary of T1 to 20 turns and R2, 3 to 47 ohms.

Everything else remains unchanged. This should suit power levels of 200 watts and higher.

Other types of coax sockets can be used, such as the BNC, type N or the inexpensive Belling-Lee sockets. No modifications to the PCB are necessary, however, mounting details of the sockets and board will need to be altered to suit.

The basic reflectometer construction is so simple and inexpensive that several can be built and installed to provide remote SWR/RF-output monitoring of antenna installations.

The RF portion can be mounted at a convenient place and the reflectometer output leads X and Y taken to remote metering facilities. Power output measurement circuitry is probably superfluous in these circumstances.

Protection circuitry for transceivers and power amplifiers may be simply realised using the basic reflectometer circuit and activating protection devices by comparing the output voltages of D1 and D2.

Swept VSWR measurement can be accomplished using the basic reflectometer circuit. The differential output from D1/D2 can be used to drive the vertical axis of a CRT display (via suitable amplification), the horizontal axis being driven by the sweep voltage of a voltage-controlled signal generator. Voila! — swept VSWR measurements.

Accurate SWR measurements for

VSWR values below 2:1 can be made by driving an expanded-scale differential voltmeter circuit that measures the output difference between D1 and D2. This technique is well illustrated in reference 2.

This type of instrument is particularly useful when making VSWR performance plots of antennas over a narrow bandwidth (providing they closely match 50 ohms in the first place).

This reflectometer technique can also be used to measure power. However, the authors opted for the diode RF voltmeter method as it is somewhat more versatile, and is unaffected by the sensitivity bandwidth of the toroidal current transformer. See the two references for more details.

The sensitivity bandwidth may be shifted up in frequency by a decade or more, such that it rolls off around 1 MHz and 50 MHz, by employing a toroid for T1 of the same dimensions but made of F25 material. **ETI**

References

Whilst not the 'definitive' texts on this type of reflectometer, these two references provide good practical sources of information.

1. "Frequency Independent Directional Wattmeters"; P. G. Martin, Radio Communication (RSGB journal), July, 1972.
2. "Test Equipment for the Radio Amateur"; H. C. Gibson G8CGA, published by the RSGB, 1974.

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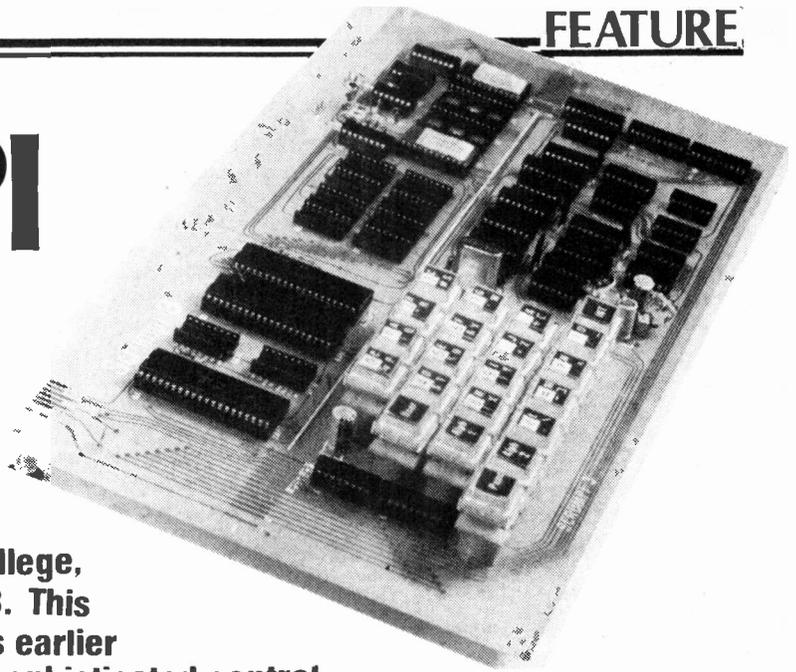
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ELECTRONICS TODAY INTERNATIONAL — OCTOBER 1978

SCRUMPI 3



Justin A. T. Halls, of Queen Mary College, takes a look at Bywood's SCRUMPI 3. This kit is an improvement over Bywood's earlier LED switch kits but is still seen as a sophisticated control device rather than a personal computer. The kit also provides an excellent introduction to the worlds of MPUs.

Scrumpi 3 is the cheapest currently available micro-processor kit with full alphanumeric input and a VDU type display. It is the successor to the Scrumpi 1 and 2, switch and LED kits and is based on the same MPU, National Semiconductor's SC/MP. The kit also provides facilities for cassette and teletype interfaces.

Scrumpi 3 is built on a 380 X 190mm printed circuit board, with plated through holes and a clearly component overlay. High quality, low profile sockets are provided for all the ICs and two 16 pin DIL sockets are provided for access to the 16 I/O ports and the UART. Access to the TTY interface is via four pins at one side of the board, while power supply lines, reset line and video signal are taken to an eight way, 0.1" edge connector. A UHF modulator is mounted on the underside of the board and provides a signal suitable for most 625 line TV sets via a standard phono socket. Data and address busses are not directly available, but test points are provided at either end of the board. Input is via a 21 key keyboard, made up of good quality switches with transparent key caps, beneath which are fitted self-adhesive labels identifying the key functions.

Three main chips are the sc/mp ii, which has the advantage over the SC/MP 1 of being faster and requiring only a single +5 V power supply, the INS8154 RAM I/O, which contains 128 bytes of memory and provides 16 individually addressable I/O ports, and the AY-5-1013 UART. Two EPROMS, protected from accidental erasure by opaque labels over the quartz windows, hold the 512 byte monitor program and 512 bytes of user accessible I/O routines. A 7MHz crystal provides a clock from which are derived the VDU control signals as well as a 3.5 MHz clock for the MPU and a 15 kHz clock for the UART. The video interface circuitry occupies nearly half the board and uses the 8675bwf character generator to provide the full 64 upper case ASCII characters in white on black or black on white, either of which may be selected as standard and which may be mixed on the screen.

Data sheets are provided for the MPU and RAM I/O chips and two handbooks provide assembly and

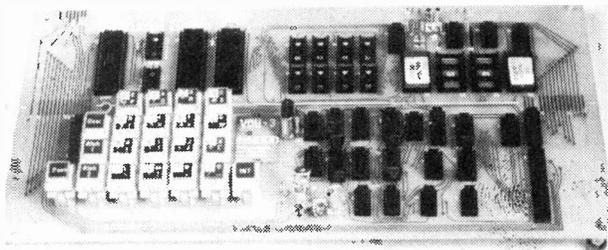
operating details. An SC/MP pocket instruction guide is also provided. The user has to provide a +5 V, -12 V power supply plus a 7.5V supply for the UHF modulator. It is also necessary to drill holes in the PCB to take mounting pillars if the kit is to be fitted in a case, or take legs if the kit is to be used naked. A reset switch is also needed.

Getting It All Together

Actual construction of the kit was quite straightforward, although the instruction manuals tended to be reminiscent of some car technical manuals, with instructions like 'all sockets, capacitors, resistors, diodes, links and keyswitches can be installed at this point', and the crystal and one of the ICs are never mentioned at all. One component that did cause some problems was the UHF modulator. The position of this is not marked on the board and the connections to it are not indicated. A phone call to Bywood confirmed that this does in fact fit beneath the board, the mounting pins having to be filed down to fit the holes provided. If the kit is not fitted in a case the presence of the modulator beneath the board means that legs must be fitted to enable the board to sit squarely on the table when in use.

When fitting the 21 keyswitches care must be taken as the holes for them are not too accurate and bending the pins too far to make them fit could damage the switch. Since many of the tracks run very close together, care should also be taken with the soldering and it is a good idea to leave the kit overnight after assembly and then re-checking very carefully for the presence of solder splashes or bridges.

To minimise the possibility of damage to delicate and expensive ICs and to ease trouble-shooting, the chips are inserted sequentially, checks being made at each stage to ensure that one part of the circuit works before proceeding to the next. Apart from TV synchronisation problems most of this setting up procedure was very simple, although some statements were a little misleading and a great deal of time was spent won-



The assembled Scrumpi 3 kit. The system's firmware is resident in the two EPROMs seen top left with their protective labels. The three presets we had to fit to get the video levels right can be seen bottom centre.

dering why the address decoding wasn't decoding before we found that the NWDS line had to be earthed first. It is in cases like this that a circuit diagram would have been invaluable. The use of the INV line as a test probe was very clever and useful; if the line is taken to logic 1, the screen remains the same, but if taken to logic 0 the screen inverts (i.e. black characters on a white background instead of white on black).

Pictures Galore

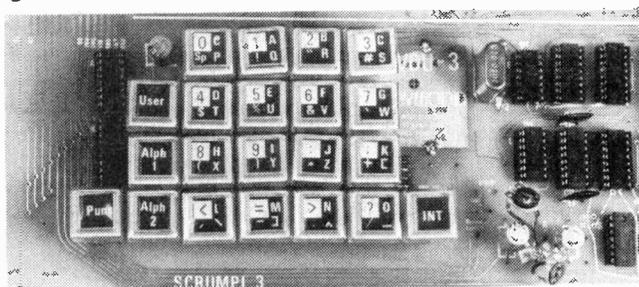
The video circuitry is basically quite simple, with a 7.02 MHz clock driving a series of dividers and a handful of gates. Two MM2112, 256X4 RMs hold the picture in a memory mapped display. The rest of the video circuitry simply consists of the character generator and a number of buffers.

The UHF modulator is pre-tuned to channel 36 and merely needs connecting to the aerial socket of a TV set. It can be run from the on-board +5 V line, but with some sets better resolution, especially when displaying black characters on a white background, is obtained by running the modulator from a separate supply of about 7.5 V. A simple, unregulated battery eliminator, set at 6 V (actual output about 7.5 V) is sufficient.

The Bywood errata sheet points out that some video monitors or converted TVs require a 4 V pk-pk video signal rather than the 1.5 V pk-pk signal provided by the kit, and that this can be obtained by adjusting the values of R3-R5. We had great difficulty in obtaining a stable picture and eventually had to resort to replacing the resistors with 470R presets; even now picture stability is not as good as it might be and it is continually necessary to adjust the vertical and horizontal hold controls. It is quite possible however that these difficulties are due to the use of a cheap portable TV which may well not be set up correctly. No problems have been found with these modulators in other applications.

Key Features

Bywood have managed to squeeze all 64 upper case ASCII characters onto a 21 key keyboard. This is achieved by the use of three shift keys. One soon gets used to using the shift keys and although it would be more convenient for entering hexadecimal code if the lower case characters were 0-9 and A-F, the current layout has presumably been chosen to ease use as a general purpose teletype.



Getting In And Out

The teletype interface, supplies and receives a 20 mA current loop and is therefore compatible with many types of TTY. Control of this interface is purely by software, using the SC/MP 'flag 0' for output and 'sense B' line for input, each bit being set or sensed individually, with a delay instruction being used to set the bit rate to 110 baud or whatever rate is required. Unfortunately, details of sending and receiving routines are not supplied, although these should not prove too onerous to write.

Parallel I/O is provided for by the INS8154 RAM I/O chip which also contains the 128 bytes of RAM supplied with the kit. 16 I/O lines are available and these may be configured as two independent eight bit ports designated A and B, each of which may be specified as an input or an output port. This provides for very versatile interfacing with the outside world.

For those who prefer a serial interface however, an AY-5-1013 UART is provided. The rate at which data is output or received by the UART is determined by an external clock, this being set to sixteen times the desired baud rate. In the Scrumpi 3, the 15.625 kHz line frequency for the VDU is used, providing a baud rate of 960 (not 9600 as stated in the manual). If a more standard baud rate is desired, the internal clock can be disconnected and an external clock provided via one of the I/O sockets; 4 800 Hz will give 300 baud suitable for a cassette interface, while 1 760 Hz will give a rate of 110 baud. No details are given of how to use the UART, but these have been published in ETI (Dec. 1977).

All of these various I/O lines, except the TTY 20 mA loops, are available from two 16 pin DIL sockets. Each socket is provided with +5 V and ground connections, as well as the UART transmit and receive lines and the MPU 'sense A' line, used by SC/MP for software interrupts. In addition socket A has the eight bits of port B, reset, and the UART clock, while socket B looks after the eight bits of port A. Unfortunately the INTR line from the RAM I/O chip, which is used in handshaking routines, is not available, but it could be connected to an unused pin on one of the sockets, as could the serial input and output lines from the SC/MP which are also unavailable.

Where Its All At

The kit comes with 128 bytes of RAM (not counting the 256 bytes used by the VDU) of which 64 bytes are

Close up view of Scrumpi's keyboard. By using the various shift functions this keypad can provide a full alpha-numeric set.

available to the user for writing programs. Of the remainder, 32 bytes are available as a user stack which may also be used by some of the Scrumpi sub-routines, eight bytes are used for storing labels and eight bytes are used as a monitor permanent area, the remainder being used as monitor stacks during various command routines. This RAM occupies the area of memory from 0F80 to 0FFF (see Fig 1). The monitor PROM takes up 512 bytes from 0000 to 01FF, with 512 bytes of I/O sub-routines in PROM at 0600-07FF. Keyboard, UART, VDU and parallel I/O takes up all the space from 0C00 to 0F80. Since the SC/MP only provides direct access to the lower twelve bits of the address bus, allowing for 4K of addressability, this leaves 2K to be accounted for. On-board sockets are available for all this, divided into 2 x 5 12 byte PROMS (5204 or 4214) and 1K of RAM as eight 256 X 4 (2112). To expand further than this the top four bits of the address bus have to be latched at NADS time, when they appear on the data bus. However since it is assumed that very few users will want to go beyond the available 1K of RAM and 1K of PROM without the aid of an assembler, access to the control lines and busses is not provided. For testing purposes however, the busses are available at test points at either end of the board and control lines could be taken out by means of wire links from convenient points.

Controlling Your Scrumpi

The monitor contains five basic commands. Typing 'I', followed by a four digit hexadecimal address and 'INT', results in the display of the address called and the data stored there. A number of alternatives now exist. Typing in a two digit hex number followed by 'INT' will cause that number to be stored at that memory location and the address and contents of the next byte of memory are displayed. Instead of entering data you can type =n, where n is an integer from 0-7. The lowest two characters of the address are then stored and can be used later, by typing '?n', which will calculate the offset required for a programme counter relative jump to the address labelled by n. When using '=n' or '?n' the address is not incremented and the offset provided or fresh data may be entered at that location in the normal way. To return from the data input mode to command level, you can either press reset or type '>'. Typing the command 'L' followed by 'INT' will result in the display of the eight bytes of memory holding the labels.

The command 'H', followed by a four digit hex address, produces a hexadecimal dump of the next 48 bytes from the address given, arranged as six rows of eight bytes, each row preceded by the address of the first byte in that row.

Having entered a program using 'I' command and having checked it using a hex dump we now want to run it. This is done simply by typing 'G' and the address at which the program starts, bearing in mind that the first byte of a program is always ignored. Software breakpoints may be inserted in a program by using an XPPC 3 instruction, exchanging the program counter for the contents of pointer register 3, which returns control to the monitor and gives a current status dump. In this the contents of the three internal pointer registers are shown, (P3 will always point to the address of the breakpoint), as well as the contents of the accumulator, extension register and status register. In addition, the 32 bytes of user stack are also displayed. The program can be continued from where it left off by typing the command 'C'

In addition to the monitor, eight I/O subroutines are provided for use by user programs. With these data may be entered from the keyboard or written to the VDU, or messages can be displayed on the VDU. Alternatively the value in the accumulator can be displayed as a hex number (rather than as an ASCII character) with or without a trailing space, or a hex number can be read from the keyboard. Finally four bytes from the user stack may be used to display a six digit number with its sign. All of these subroutines are accessed simply by exchanging the program counter and pointer 3 and most of them are re-entrantable.

If additional PROMs are used to extend the monitor, they will be automatically detected by the existing monitor, which checks for a 00 at address 0200, and used directly. One additional PROM that is available from Bywood is a disassembler, which will take a machine code program and translate it back into mnemonic form, producing a full assembler style listing.

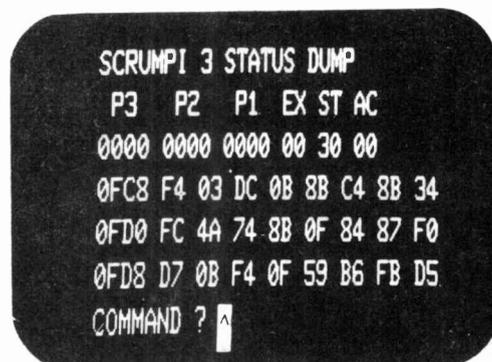
Reading It Up

The two handbooks are well and entertainingly written, starting from absolute basics and working up, so that even someone who had never heard of a microprocessor before would soon be able to use the Scrumpi. Book 1 starts with an explanation of the hexadecimal number system and proceeds to build a micro-(macro-?) processor called PC/MP (Paper and Cardboard Micro Processor) with which it explains all the happenings inside the MPU, by making you do all the internal operations yourself. In this way a deep understanding of what actually occurs within the MPU is imparted.

Having explained the workings of MPUs in general the architecture of SC/MP is considered, along with the necessary associated components such as RAMs and PROMs. Book 1 then goes on to describe the construction and use of Scrumpi 2, most of which is of little interest to the Scrumpi 3 owner, although the final section on interfacing with the outside world via UARTs and ports is of interest even if lacking in detail.

Book 2 is more concerned with Scrumpi 3 and begins by describing the rationale behind the design of this kit. Construction and testing details follow, with a circuit diagram for the VDU and a block diagram for the rest of the system. Bywood consider that 'the PCB is its own circuit diagram' and that further documentation is therefore unnecessary. Having built and tested the kit, you are taken through a series of demonstration pro- ▶

Scrumpi 3's status dump displays the current value of the SC/MP's internal registers plus a hex dump of a section of memory.



FEATURE : SCRUMPI 3

grams which display the full character set, write messages on the screen and demonstrate all the internal logical and arithmetic functions that are available. Here again the text is clearly written and we soon got to know how to use the majority of the various facilities that are available. Finally the memory assignments are given as well as a description of the monitor routines, I/O subroutines and the optional disassembler. At the end of the book is a glossary of technical terms, some useful addresses and data on the SC/MP II and the INS8154.

What there is of the handbook is excellent, well written and well illustrated and without too many errors. However, a great deal of information is lacking, such as any details of how to use the UART or how to configure and use the I/O ports. It would also have been nice if a few simple user programs could have been included, say for a cassette interface, handling the teletype link and maybe some mathematical routines.

Terminal Device

In general this kit succeeds in doing what it sets out to do very well indeed. It is nicely produced, fulfills its designers requirements and the distributor, Bywood Electronics, are very helpful in the event of any difficulties or problems.

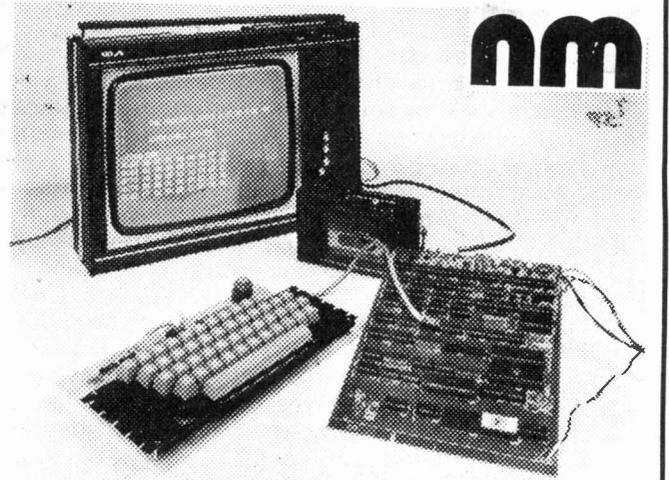
The quality of the product is let down however, on two counts. The main defect lies in the lack of information supplied with the kit and this is a very serious failing. A TTY. 20 mA loop interface is provided, with no indication of how to send data to it, or how to receive data from it and which no mention of what format the data should be in. i.e. what should be supplied in the way of start, stop and parity bits. Also, no data or information is provided on the UART and even when a data sheet has been obtained, describing how to use the device, it is necessary to trace out the tracks on the PCB in order to identify the TBMT and DAV lines. Admittedly a data sheet is provided for the INS 8154, but this is only of marginal use when attempting to use the device and such a versatile chip as this deserves far more recognition in the manuals.

The other failings of the kit are relatively minor, but seem all the more unnecessary for that very reason. Things like not using the serial input and output lines from the SC/MP. The kit already has impressive I/O facilities, but why not make use of a facility that is sitting there waiting to be used. The unused INTR line from the RAM I/O chip is another case in point, since this negates a large proportion of the power of the I/O device, especially if you want to interface to devices such as A/D converters which require a certain amount of handshaking.

Once you have found out how to use them, the I/O facilities on this kit are very good, largely thanks to the versatility of the RAM I/O chip, which gives such a varied selection of I/O modes. The keyboard is not as convenient as a full QWERTY keyboard, but it is perfectly adequate for a kit that is intended for semi-dedicated applications. The 8 X 32 character TV display may seem limited in size when compared to full VDU systems, but is quite adequate for the vast majority of applications and it has even been found possible to play Conway's Game of Life on it, although this led to some rather interesting edge effects at times.

This kit is certainly a great advance over Bywood's previous, LED and switch kits and with a price tag of around £150 is certainly good value for those who are either hooked on SC/MP or who are prepared to use the full power of the kit to make it pay its way as an intelligent terminal for a larger or more powerful system.

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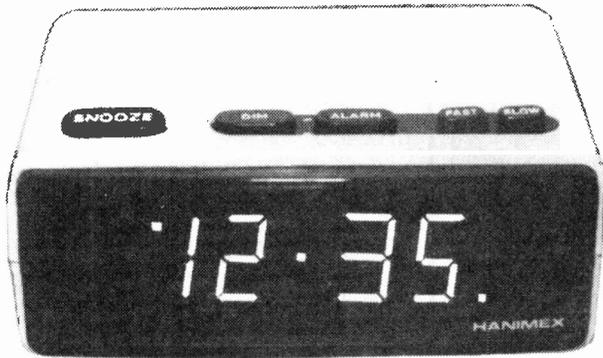
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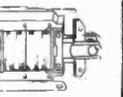
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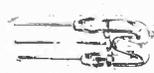
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POWER BULGE!

Astound your ears and annoy your neighbours with four times your normal sound level, courtesy of the ETI Power Bulge.

POWER AMPLIFIERS COME in all sorts of shapes and sizes, most small groups rely on 100 W types as they are widely available and relatively cheap. Even though the people next to the speakers think the sound is loud enough the performers usually want more power. The simple solution is to buy more powerful amplifiers — but it can be a lot cheaper to buy two less powerful ones.

The 'Power Bulge' is designed to be used with two low power amplifiers, and produce not just double power but four times the power of the separate amplifiers! The reason for the apparent power gain is that the voltage finally produced at the loud speaker decides the power — and power is proportional to the square of the voltage.

Construction and Use

The prototype was built into a small Verobox. As large signals are involved screening in a metal box was not needed. The box size dictated the battery type, if you want to use a PP3 or other battery obviously a larger box will be needed.

When completed you need two power amplifiers (preferably of the same type) to use the unit. A normal stereo amplifier is ideal, if it has a tape monitor switch. A signal is taken out from the preamplifier and fed back into the power amplifier section (via the tape input if fitted). The loud-speaker is connected across the two positive speaker terminals as shown.

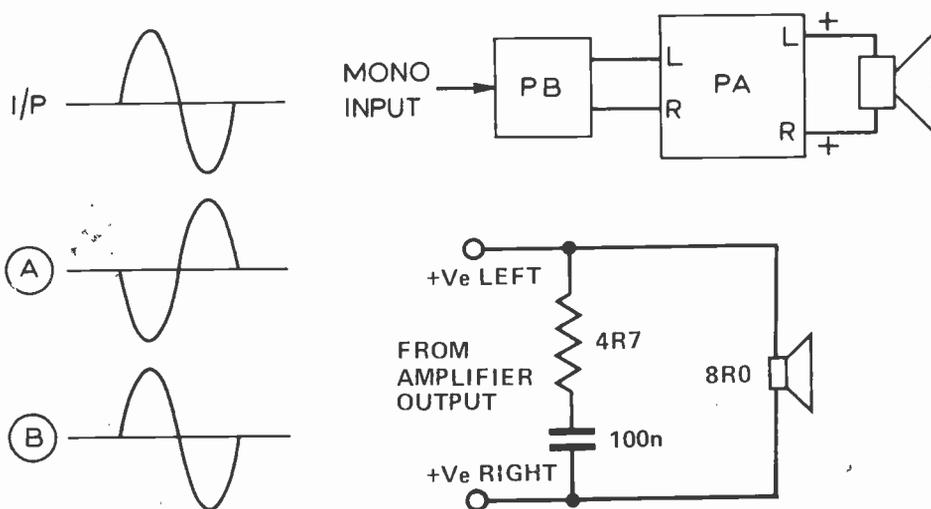
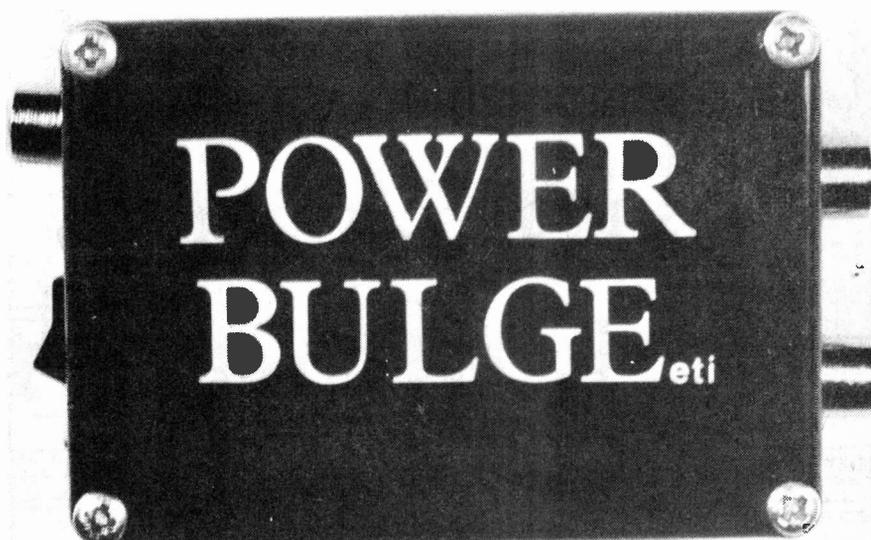


Fig 1. On the left is a diagram showing the input and output waveforms from the Power bulge, as can be seen the two outputs (A and B) are 180° out of phase with each other. Above right is how to connect the unit to any stereo amplifier, the lower circuit shows additional components suggested to stabilise the speaker load.

HOW IT WORKS

The idea of the unit is to produce two waveforms 180° out of phase. This is accomplished by Q1. The balance between the two waveforms is equalised with RV1. The three 10u capacitors are to AC couple the signal and C4 is to decouple the battery.

BUYLINES

No problems here, the case is stocked by most component outlets; the battery is available from photographic shops if not stocked by your friendly neighbourhood electronics shop.

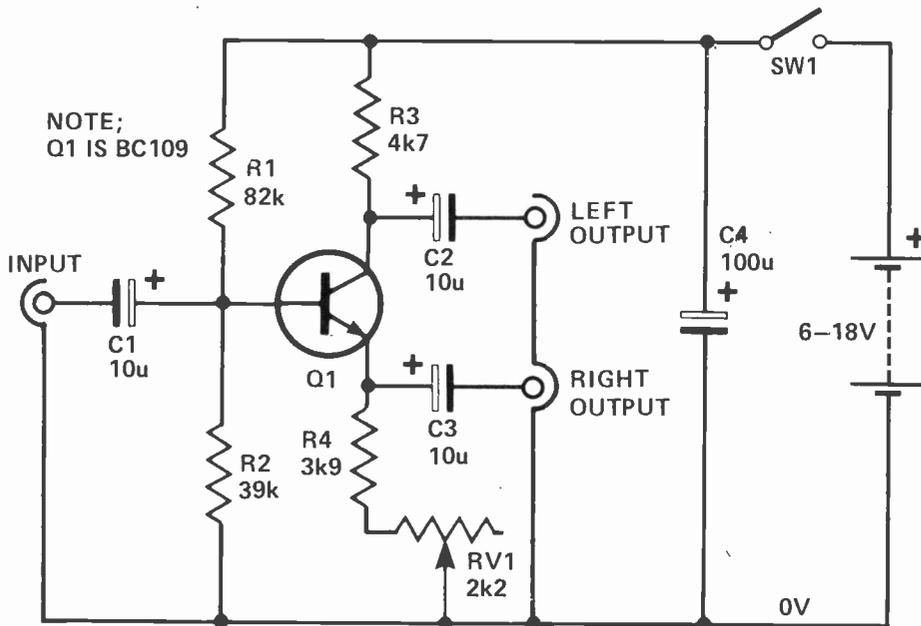


Fig. 1 Full circuit diagram

PARTS LIST

RESISTORS

R1	82k
R2	39k
R3	4k7
R4	3k9

POTENTIOMETER

RV1	2k2 preset
-----	------------

CAPACITORS

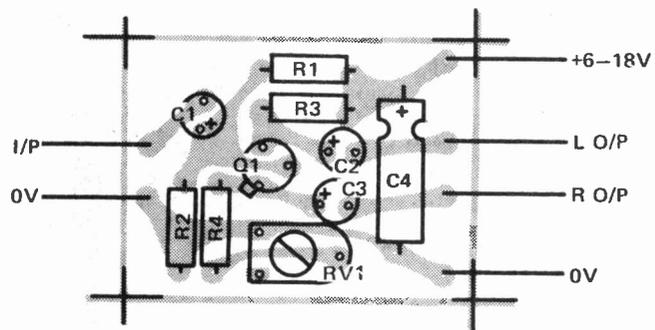
C1, 2, 3	10u 16 V electrolytic
C4	100u 25 V electrolytic

SEMICONDUCTOR

Q1	BC109
----	-------

MISCELLANEOUS

PCB as pattern, case (vero 75-1413E), battery B154, switch, phono sockets.



Above is the component overlay of the complete device, below left is the PCB pattern shown full size (45 x 34mm). Neat layout of the prototypes can be seen clearly in the photograph below.

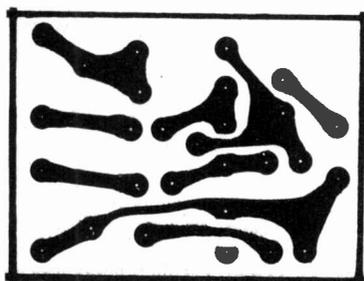
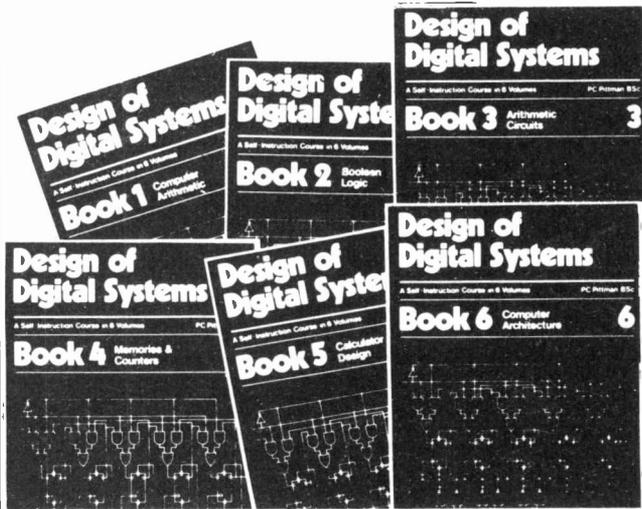


Fig. 3 PCB patterns shown full size



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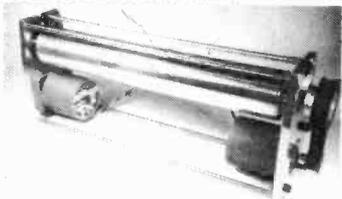
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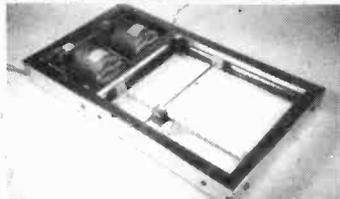
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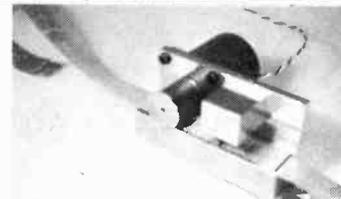
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PIRATES AND JOLLY NOTCHES!

IT WAS ONLY a few years ago that private or 'bootleg' versions of Bob Dylan's Basement Tapes and Pink Floyd's Dark Side of the Moon, sold like the proverbial hotcakes, along with a host of others.

These recordings blatantly advertised the fact that they were pirated, and thus of illegal origin — transgressing not only performer's rights but also copyright. Many people were attracted to pirate recordings for there seemed to be something rather exciting about owning a recording which the artist did not approve. Often, the pirate recordings contained material not released on genuine recordings, or were of concert performances which often differ markedly from studio performances. Quality was almost inevitably low-fi!

Through a combination of circumstances, these bootleg recordings gradually disappeared from the market. Groups employed stewards to hunt through audiences looking for tape recorders, legal prosecutions were brought against bootleg distributors etc. Finally, high prices for low-fi killed the market.

New Track

Recently, however, the pirates have changed tack and are presenting recordings that are either made to mimic legitimate releases on well know labels or to appear like legitimate competition. For example, a recording stolen from EMI may either be packaged to look like an EMI recording, or packaged in a sleeve with an authentic-sounding company label, but not that of an authorised EMI trader. In neither case does the artist, EMI or anyone else (save the bootlegger and his outlets) receive any reward.

Those recordings that mimic legitimate releases are usually a straight, undoctored copy of the original, with slightly reduced fidelity. When released on a phony label, often the recording is altered in the transfer to disguise its origin, usually by dubbing applause or extra instruments onto the copy.

The problem arises here in that both these techniques are far harder to detect and prove as bootleg than the previous methods. The British Phonographic Industry (the UK recording industry trade association) have taken numerous court actions, with some success, resulting from pure detective work.

Self-Destruct

However, the final solution to professional piracy relies on technological aids. This can be achieved by either making the physical act of illegitimate copying technically impossible, or to make the technical detection of such copying unambiguous. Unfortunately, despite considerable efforts, little real practical headway has yet been made in either of these directions.



If record companies had their way, each disc or pre-recorded tape released and sold to the public, would self-destruct, refuse to play or produce unacceptable sounds if copying was attempted.

To date, anti-copy remains an impossible dream. Inventors still tackle the problem, the cash rewards for a workable system would be enormous. Inevitably, one red-herring scheme keeps being re-invented.

Back in 1967/68, the Beatles' Electronics Company, Apple, leaked a story about three patent applications on a new anti-copy system. Any attempt at recording a disc pressed according to this system would result in a high-pitched whistle they claimed. The idea attracted a certain amount of attention, but, in time, the patent applications were allowed to die, along with the publicity and Apple Electronics disintegrated.

Although details of the idea remain a secret, the system probably involved recording an ultrasonic carrier frequency on the disc. Thus, at any attempt to put the ▶

disc material on tape the carrier on the disc would beat with the tape recorder's ultrasonic bias signal and impress an audible signal on the tape.

In this way, two inaudible frequencies are combined to produce an audible frequency which destroys the recording attempt.

A little thought shows the snags in the system. To produce an audible beat with the very high bias frequency used on tape recorders (around 70 kHz or higher) requires that a similar signal be recorded on the disc. The studio cutting machine won't cut it, the factory pressing machines won't press it and the would-be-recordingist's cartridge wouldn't reproduce it.

It is also easily filtered out at any stage of the production chain, either intentionally or otherwise, with no loss of quality, because the carrier signal is inaudible anyway. Different tape recorders have widely different bias frequencies which also defeats the system.

The drawbacks are enough to discourage further reinvention of this system and doubtless account for the demise of the Apple patents.

There is another daunting aspect to anti-copy systems. It is likely that if anyone does devise a system that will prevent the copying of a disc or tape onto existing tape recording machines, the recorder manufacturers will soon devise a defeat button or circuit to make copying possible again.

Watermarks

Anti-copy systems appear defeated for the moment. However, the concept of an indelible watermark on the recorded sound appears somewhat less fanciful.

As with anti-copy, watermark systems have gone through numerous futile reinventions. The aim is to record an inaudible identification signal along with the recorded sound. The watermark signal is inaudible to the listener when the disc or tape is played on conventional equipment, but it can be identified or decoded by special equipment.

Ultrasonic (high frequency) and infrasonic (very low frequency) watermarks have similar limitations to the anti-copy schemes. For this reason, it is essential to adopt a sledge-hammer approach to prove the origin of copied material. One such attempt, by Capital Radio who recently broadcast some previously unpublished Beatles tapes, involved putting a loud station ident ('194') over the recording every few seconds. Thus, if ever a bootleg recording is issued, its origin will be audibly stamped all over it! With the station ident so loudly intrusive there would likely to be little incentive anyway.

Notches

There is another approach which a number of recording companies are seriously considering. This is the *Audicom* system invented by Murray Crosby.

It was originally intended for collating automatically the number of times a commercial was transmitted on a radio or TV station, for accounting and statistical purposes.

The system works like this: At a frequency around 2-3 kHz, a tight notch filter with a very narrow bandwidth (around 100 Hz) bites a small chunk out of the audio spectrum. At the same time a binary code watermark signal is modulated onto an audio frequency subcarrier of the corresponding frequency and bandwidth so that it fits neatly into the window left by the notch filter. The amplitude of the subcarrier frequency is varied so that it



BSANKIN/STC

tracks the audio level of the surrounding programme. In this way, the coded identification signal is always submerged by the programme, but it is still recognisable by a decoder tuned to the narrow band notch frequency and designed to interpret the digital information modulated on the subcarrier.

Sounds like a great system for discs and tapes. However, several difficulties arise. If, for instance, the coded subcarrier is at such a low level, might it not be lost in noise after transmission or the copying process? This is one area which EMI, RIAA and others are investigating. Even if they get results, we are not likely to read, or hear about. Because, if the system is adopted, it would not be prudent for the record companies to indicate the level at which noise destroys the code.

Sub-Noise

One set of technical specifications indicates that when the programme audio level is zero, the subcarrier coded signal will be 55 dB below the peak level the carrier would be at peak audio programme level. When the programme audio is at peak level then the audio subcarrier in the notch will be 40 dB below the programme level. Thus, the subcarrier is always submerged by the programme but would still be detectable by a decoder tuned to the narrow band notch frequency so that the digital watermark code is recognisable by the digital decoder.

ETI

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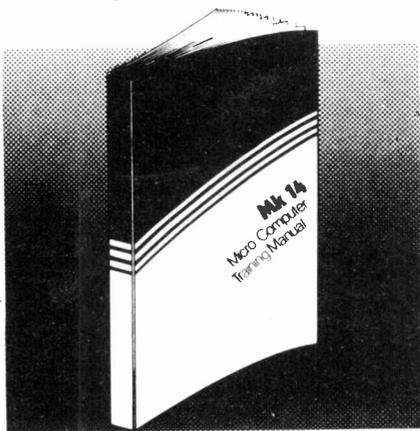
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Phil Pittman, Wireless World, Nov. 1977.

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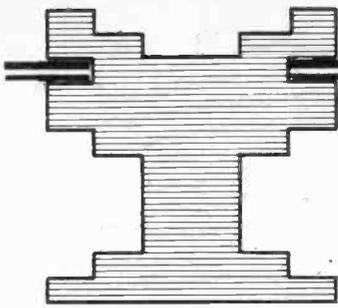
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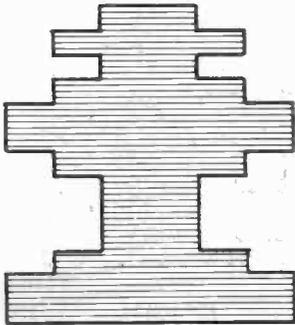
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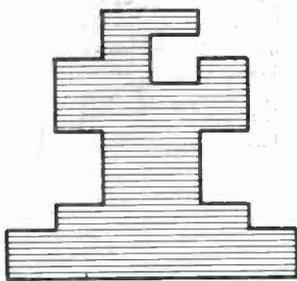
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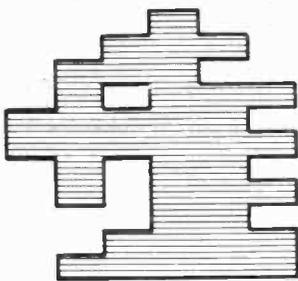
QUEEN



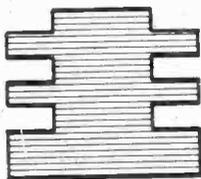
KING



BISHOP



KNIGHT



PAWN



TOLINKA IS A device which is genuinely useful to the chess-player, performing automatically all the housework of listing, analysis and filing of chess information. It is not like a TV game, nor is it one of those machines which plays chess from an internally stored programme, which is little more than chess-like solitaire.

The project is based on a SC/MP MPU, which with some RAM, ROM and various support ICs performs all the work that goes on in this chess players comfort. Don't be worried by the mention of the term MPU — to use Tolinka you won't need to think — or curse — in Hex, manipulate machine code and be generally au fait with ALUs. The machine has been designed to be both straightforward to use and to build.

Design Philosophy

Tolinka was designed with cost and availability in mind. When a function could be performed by a few, cheap readily available parts instead of one special expensive chip, the former course was taken. The chess set, for

example, appears to have been made from Lego bricks. If a character generator ROM with more bits in it had been used in conjunction with a highspeed clock, a chess set which would have met the approval of Lewis Carroll could be produced (though I suspect that gentleman would like the present one). If you have sufficient memory, then you have sufficient resolution to transmit pictures even of Raquel Welch digitally, but no intelligence would be added by this course in spite of the doubled cost — faster memories, more power, bigger box etc.

The piece design has been subjected to much consideration and choice became, in the end, a matter of taste. The intention is to represent a Staunton Chess Set without conflict of symbolism or departure from family likeness. It is true that representations are not beyond reproach and any suggestions will be welcomed.

In each square 128 bits are available, eight horizontal and sixteen vertical divisions. A border must be left around the piece —

CHESS

PART ONE

Tolinka, the name coined by Victor Korchnoi to describe this machine that can display a full chess set on the TV screen. The pieces may be moved around at will, and all the moves of a game recorded on a cassette tape for later playback and analysis. Barry Savage, the designer, describes this secret weapon of the West.

BUYLINES

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

Individual parts are also to be

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

partly so that identification of the square's colour may be made. So a six by thirteen grid is left. With the exception of the pawns it is thought more uniform if the pieces stand upon a level base. The major pieces are bilaterally symmetrical (both halves the same, if you must), the centre of each of the major pieces is therefore a double column.

The Facts Of Life, Or, How Little Computers Are Made

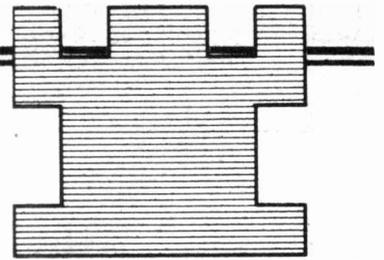
Son, it is time you were told about the birds and the bees. The creation of computers like the creation of new human beings depends upon the combination of hardware with software. Unlike humans, however, the labour involved cannot be said to be unskilled. Once Tolinka had a mother system to which it was joined by an umbilical cord of wires through which was fed power and information.

During this time of gestation Tolinka's programme was undeveloped and volatile. It was stored on cassette tape whilst the

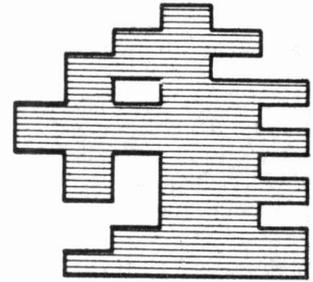
inventor was not working on it. The instructions were entered in Tolinka's surrogate memory from a hexadecimal keyboard, because little computers do not use ASCII or high level languages which do not use memory space in the most economical way. The author did not use assembly language either because continuous conversations with an MPU in machine code soon render even this mnemonic aid superfluous.

The whole purpose of parenthood lies in teaching the offspring how to manage without parents: little birds are taught to fly alone. So Tolinka's mother system eventually generated Tolinka's software package in the form of a PROM and worked herself out of a job. The umbilical cord was severed, a separate power supply constructed, and Tolinka set up house alone in a small box instead of a 19" card frame.

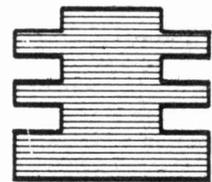
The first prototype circuit boards were made. And modified. And made again. Etc. Until a version of Tolinka was made which represented all of the most desirable features that it was possible to get into the available



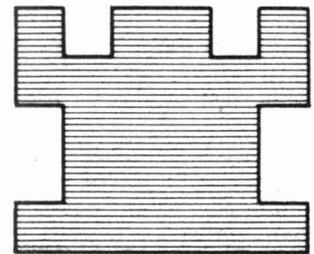
ROOK



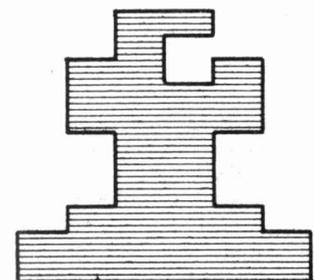
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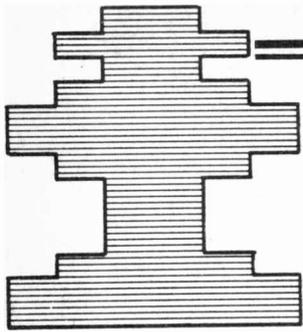
PAWN



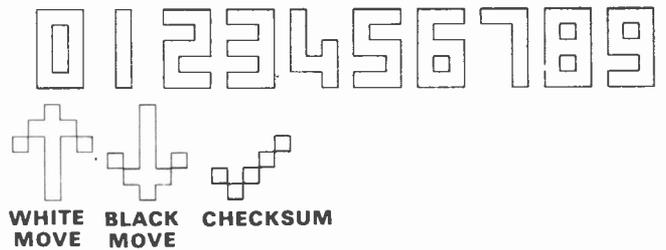
ROOK



BISHOP



The chess set and the numerals were carefully designed to ensure easy recognition without recourse to shapes that would require a high resolution character generator.



memory space. But even now there is more than one software package available and the machine which is in use by Viktor Korchnoi's team is different in certain essential respects from that which is used on the World Championship reports or on the BBC 2 late news.

Further obstetric details and examination of the parent system would form another story.

Tolinka is a Microcomputer

Tolinka is a box measuring 8" x 5" x 3" with a 12 switch keyboard, a DIN socket to interface a cassette recorder and UHF output to drive a domestic TV set.

The picture is in black and white. (Why do people keep asking if it can be done in colour? They never ask for yellow and green chessmen. Yes, it **can** be done in colour, but it isn't as experience with video games has shown that monochrome is easier on the eyes — this remark can be justified by many quotations from manufacturers. Monochrome sets also have wider bandwidth and better resolution.)

What follows is a description of how to use Tolinka — when everything else has failed you might try reading it.

When connection has been made with the TV and cassette recorder, the TV must be tuned to receive a stable picture. If there is a push button tuner, one of the buttons may be left tuned to Tolinka. The output signal Tolinka is producing is assembled from digital waveforms in a preset fashion and there are no adjustable controls. If the TV is overscanning and losing some of the picture it must be adjusted by someone who knows what he is doing. A TV which is set up correctly does not lose any intelligence, but the chessboard sits rather high in the frame and slightly right of centre so that the status information shown on the left of the board may be seen.

On switching on the pieces appear correctly set for the start of a game. On the left of the picture a two digit move number appears with an arrow indicating which player is to move. It is important to remember that Tolinka always considers the move number as having two digits. If the number is less than 10 it has a leading zero.

Making A Move

Tolinka works by moving the contents of one location in memory to another i.e. the contents of one square to another. The eight move-entry keys are divided mnemonically into two groups, kingside/queenside, and labelled both alphabetically and numerically on the standard 'alpha' chess notation system.

Moving A Piece

Four keystrokes enter a move. d2d4 is a move. b1c3 is another. When the machine has received a total of four keystrokes it will 'flash' the move on screen, moving the piece back and forth three times. This is not yet a permanent move, it is the machine inquiring about you intentions. If you are satisfied that the move which is flashing is the move you intended, the MOVE key may be pressed. Tolinka will then make the move final and update the move counter; if it was white's move the arrow will transfer to indicate black is to play next, if it was black's move the arrow will shift to white's end and the counter will increment.

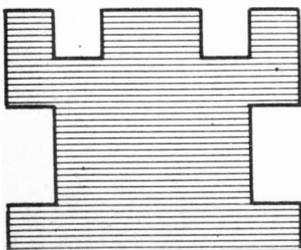
The same keys are used for letters and numbers so it is important to know where you are in the entry sequence. For this reason a STROKECOUNT appears during partial entry at the bottom left of the screen and denotes the number of entry strokes Tolinka has received. If a total entry has been received the location is blank, otherwise it contains 1, 2 or 3. The machine will not accept further instructions unless a proper entry has been made: the

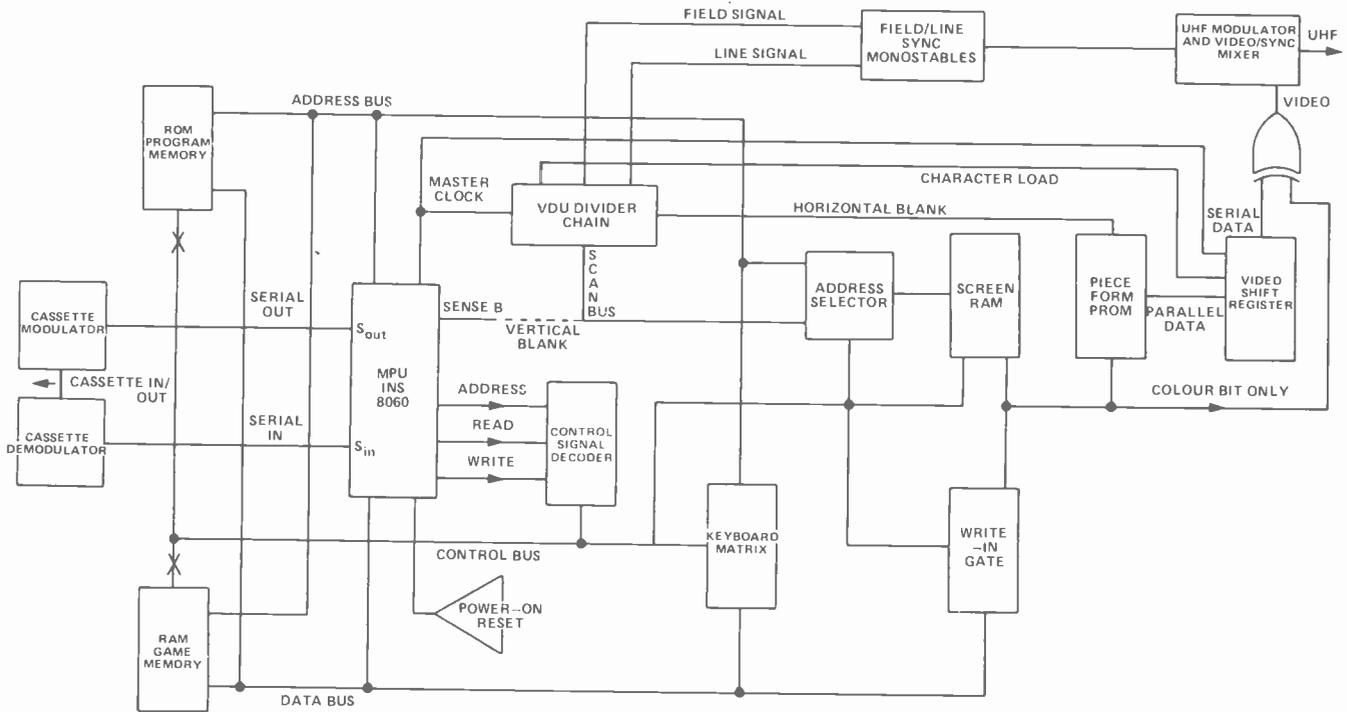
STROKECOUNT must be blank on pressing a function key. If the move which is flashed is not the one desired it may be overwritten by a correct entry of four keystrokes. The game does not progress until the MOVE key is pressed. This maintains integrity with the rules of chess, which state that a move is not made until one's hand has released the piece. If there is a partial entry any key may be pressed until the STROKECOUNT clears, then the correct sequence entered.

Tolinka will allow you to move anything anywhere and does not care whether you break every rule in the book, except in three special circumstances. It is never necessary to make more than one move, even when Castling, capturing en passant or Queening a pawn. Tolinka presumes that if you move your king two spaces you intend to castle, and completes the move for you. If you put a white pawn on the back rank Tolinka presumes that you want a queen instead. (Tolinka might not be right in all cases. You might want a knight or a rook to avoid stalemate. Of all the people who will use Tolinka for the rest of their chess lives, there are a few who might meet this eventuality once or even twice. To these unfortunate few we suggest you extend this apology: "Sorry, couldn't you think of it as a knight, just this once?") If a pawn is moved diagonally into a square where there is no piece to capture, Tolinka presumes and executes the en passant move.

It is not possible to beat Tolinka by fast entry. It is not necessary to wait for the flashing to stop. There is never any point in holding down any key because Tolinka is only waiting for you to let go. Keystrokes should not overlap: one finger entry prevents this. Touch typists should stick to QWERTY keyboards — Tolinka, like the calculator, is a woodpecker's tool.

Tolinka runs out of memory after black's move 62. If the game must





The block diagram of Tolinka. The hardware sections of the design will be described in detail next month.

be continued then it must be set up as a position — after 62 moves there are not many pieces left. Positions and Chess Problems can be set up my moving pieces without regard to the rules. There is no legal sequence of moves to the position of many chess problems anyway.

The GO TO Function

During the entry of a game the position which is current is always shown. But any other position in the game may be brought to view by pressing the GOTO key followed by a two digit move number. Do not forget the leading zero for numbers less than 10. When, for example, GOTO, 0, 9 has been keyed in the position will instantly revert to the position at white's ninth move, which will flash on screen. Remember then the flashing is interrogation, and a different move may be entered, or if the move is satisfactory the MOVE key may be pressed. Thus it is possible to step through the game, making modifications as necessary, or go instantly to any point in it.

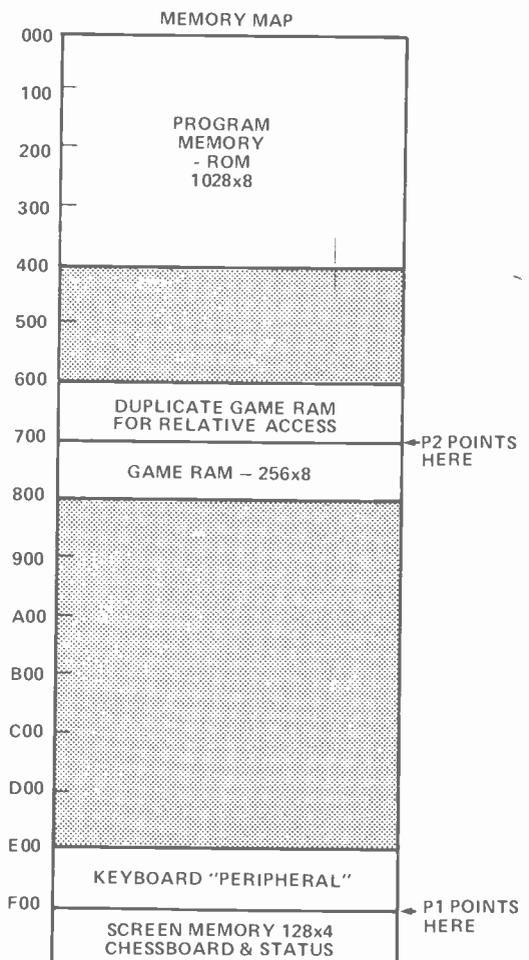
Pressing GOTO followed by a RECALL or RECORD function key brings trouble. Tolinka identifies RECALL and RECORD with a hexadecimal number greater than 10. It therefore cannot increment the decimal counter to equal it — but will willingly spend the rest of eternity trying. The only cure is to switch off.

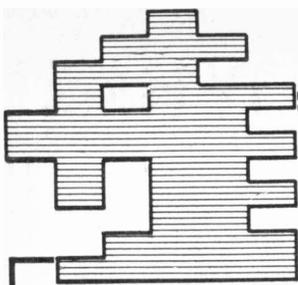
You see Tolinka starts again at the beginning of the game when the GOTO button is pressed and plays quickly through to reach the requested point. Note that the GOTO key doubles as zero and the MOVE key doubles as 9.

Tolinka Is A Videorecorder

There is no need to write down a game sequence. Tolinka records chess games on tape. It records them as a three second leader tone followed by a four second data burst which contains the complete contents of the game memory — up to 62 moves by each player. It follows that a single C60 cassette will hold about 500 games. That's a lot of chess!

Recording time is cheap, less than a penny a game, so it pays to keep two copies of all information and use some tape space between games to make them easy to find. If the tape recorder has a counter a written index should be made, if there is no counter then a single spoken number between games is the best system. To record on the tape a description of opponent, event, date, etc., isn't much help in finding a game in a long tape. These comments are for guidance only, and you will no doubt find your own system for using Tolinka.





—HOW IT WORKS Software

A detailed description of the software would fill most of this issue of ETI. What follows is an outline of the various sections that go to make up the systems software.

It is not necessary to be familiar with the detailed architecture of the SC/MP MPU on which the project is based to understand what follows. Briefly, however, the SC/MP is an eight bit MPU with a set of 46 instructions covering arithmetic, logical, data transfer and miscellaneous operations.

The SC/MP has four on board 16 bit pointer registers designed PO-P3. SC/MP forms the address of the next program (data) byte it requires by adding (or subtracting) a displacement, which may be zero, from any one of these four pointers. PO is used by the MPU as the program counter while P1-P3 are assigned by the software. A Power on Reset ensures that when power is first applied the MPU starts by examining location one in program memory, the instructions here set these pointers to indicate locations in the memory field which correspond to the chessboard and the game sequence.

The pointer P3 is reserved for subroutines, while P1 is used to indicate both the chessboard and the keyboard, it being set to the boundary between them. A positive value added to this pointer will find the chessboard, a negative value the keyboard. P2 is used to indicate the game sequence.

The first routine used is called CLEARALL which clears all locations in game RAM and board RAM. Clearall is not a subroutine because it will never be needed again. Its purpose is to overwrite the 'garbage' present in RAM when power is first applied.

Next a subroutine is called. The subroutine is referred to as DEBOX. At a location in the program memory is a table of the chesspieces which have been defined according to following codes:

000 = Blank	100 = Rook
001 = Pawn	101 = Queen
010 = Knight	110 = King
011 = Bishop	111 = Not assigned

These are the lower three bits: if bit four is high then the piece is white, if it is low then it is black. DEBOX takes the pieces from the table and places them in the 64 locations making up Board. Thus the pieces will be set up for a game. The piece codes stored in the Board RAM are used in conjunction with the piece form PROM, which stores the bit patterns corresponding to the various chess pieces, an address selector and various items of hardware to generate the game display. The operation of this section will be discussed next month.

DEBOX is a subroutine because it will be called again from another part of the programme. A part of this subroutine is to set the Move Number back to '01' and the arrow to indicate white has the move.

The next subroutine to be called is EXTRACT. This examines location one in game memory and places information about the current move in temporary storage. This information includes the 'from' square, the 'to' square, the piece being moved and the piece being captured if any. The purpose of storing this information is that it should not be lost in the move flash sequence to be described.

The SCAN subroutine is now entered. A

location called KEYWORD is cleared and SCANCOUNT is set to a predetermined value. Also FLASHCOUNT is set to a value which determines the number of flashes which will be made following a Move write-in. Three flashes are considered enough. The SCANCOUNT determines the duration of the the final byte. The serial output is placed high for three seconds to form the Leader Tone and the transmission is made. Each word does not contain eight bits but six, so an asynchronous format is made by setting the first bit in each word to zero and the final bit to one. This corresponds to a start bit and an interval between flashes. These operations are carried out regardless of whether we require a piece to flash or not.

To perform a single scan sequence the keyboard, which is matrixed from four data lines and three address lines is read, all locations at once, and the result examined for non-zero value. This result is stored in the extension register. After a delay of about seven milliseconds the keyboard is read again and the result compared to the first — this is to defeat switchbounce. If the result after the delay period is not the same as the first, or both are zero, there has been no valid keypress and control is passed back to the start of the loop. If there is still a non-zero value then the keyboard is examined one line at a time by changing the address location and adding four to the keyword on zero result, to find the row of switches which contains the valid key. When the row has been found the data is shifted out of the end of the register, adding one to the keyword for each shift, until the result is a clear register. At this point the keyword has a value unique to the individual key. Release is then awaited and debounced as before and return is made to the main programme with a keyword for processing.

When first entered the 'from' and 'to' squares will have been set to zero by the CLEARALL routine. This will mean that when the flash sequence occurs the piece corresponding to square-zero-top left hand square's rook- will be made to flash back and forth to the same square. It will thus seem as if the piece is not flashing.

The MOVE subroutine first examines the STATUS register and hands control back to the keyboard if the Strokecount does not equal zero. This is to prevent spurious moves being made. Then the serial output of the MPU is brought high briefly to record a tone on tape should the tape recorder be operating. The piece moved is examined for 'Kingship' and if it is a king the 'From' location is compared with the 'To' location for a castling situation. The castling routine is entered if necessary, the corresponding Rook being placed on the appropriate side of the King. If the piece fails the 'Kingship' test it is tested for 'Pawnhood'. If it is a pawn it is tested for a diagonal move and if there is no captured piece in a diagonal move situation an EN PASSANT move is presumed and the piece in the square adjacent to the diagonal is removed. If the pawn is moved to the final rank a Queen is substituted. A move is made by accessing the board RAM and writing a blank in the memory location corresponding to the FROM square, derived from the EXTRACT routine, and the corresponding piece

code to the TO square. The arrow which indicates the player is then moved to the opposite location and if this be white's end of the board the Move Counter is incremented. Return is then made to the main programme.

If the Keyword is GOTO the scan routine is called twice to fetch the Request Point. The DEBOX routine sets up the pieces and the MOVE routine is called until the Request Point equals the Move Counter. Control is then handed back to the keyboard.

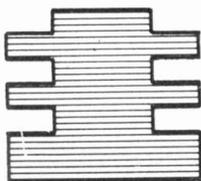
If the Keyword is RECORD the subroutine RECORD is called. This transmits all the contents of Game RAM in serial form on to cassette tape. First a digit 9 is placed in the Cassette Status location on-screen and the final locations in Game Memory are cleared. These locations are used for FLASHCOUNT and SCANCOUNT, etc. The entire contents of Game memory are added together and complemented and the complement stored in stop bit. When the transmission is complete control is handed back to the keyboard. The Baud Rate is not conventional being approximately 460 bits per second.

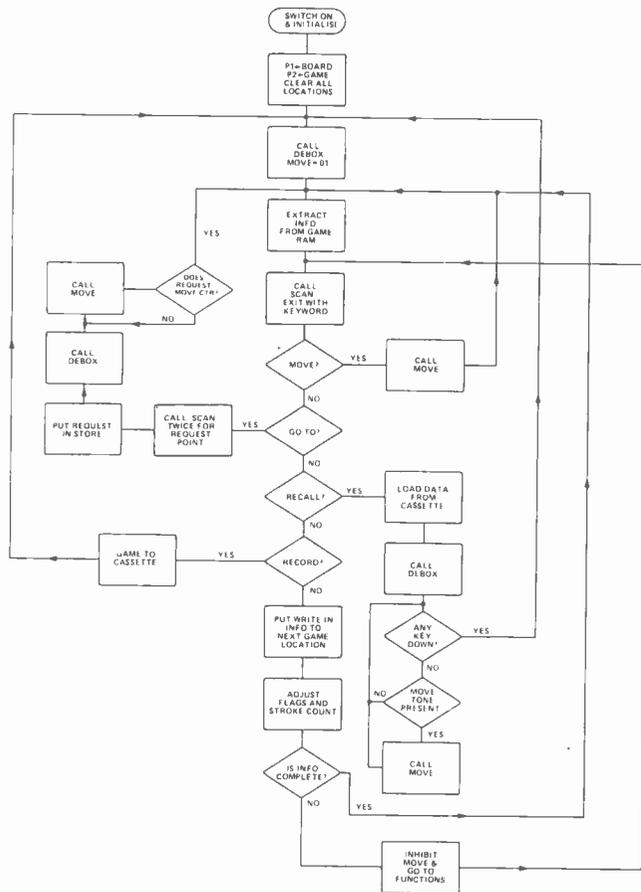
If the Keyword is RECALL then a six is placed in the Cassette Status position which forms the bitcounter. When a start bit has been received, and verified after half a bit interval, a word of six bits is clocked in at the serial input, right-justified and stored in the next Game RAM location. After a complete Game reception the whole contents of game memory is added together and tested for zero result. If the total equals zero a tick is placed in the cassette status position. Compensating errors would have to be received for a transmission to pass this test and still be incorrect. Control is retained in the Recall routine after a transmission and if a tone is received at the serial input the next move in memory is made. (The Subroutine calls other subroutines DEBOX and MOVE.) If a leader tone comes along or any key is pressed control reverts to the keyboard.

If the Keyword is not a Function, then it is Move Information which is being written-in. Bit 2 of the Status register, which keeps 'account of whether a letter or a figure was entered last, is examined and the appropriate Letter or Figure routine is chosen. The word is processed to make its binary value equivalent to the requested rank or file on the Chessboard and stored in the Game Memory in the appropriate From or To locations which are addressed alternately. The actual form in which the word is stored bears little relationship to the letters/figures code, the top left square being 00 (base 16) and the bottom right 3F. Only six bits are necessary to define the squares of a chessboard, these 'being 26 in number.

As each keystroke is entered the Status register is examined and a Tally, called the Strokecount, is entered in an offboard location on the bottom left of screen memory. The strokecount informs the user of how many keystrokes have been entered. A partial move entry transfers control back to the main routine After the "Extract" sequence so that spurious moves are not flashed. A total entry passes control to before the "Extract" sequence so that the intended move is flashed for verification.

The MOVE and GOTO operations will be inhibited until the appropriate entry sequence is complete.





The flow chart for Tolinka's software is shown above.

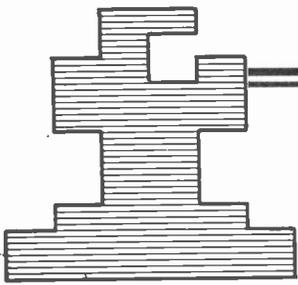
The SCAN subroutine (reproduced in full below) is one section of Tolinka's software.

SCAN — SUBROUTINE

Video Interval?	06	Copy Status to Accumulator
	D420	And Immediate 20 (Check Sense B)
	9C4E	Back to Keyscan if not zero
Examine Flash	C15D	Get Flashcount from P1 + 5D
	D40F	And OF = Strip off top 4 bits
	9848	Go to keyscan if zero
Examine From/ To	B95D	Decrement Flashcount
	06	Copy Status to Accumulator
	D401	And 01
'Forth'	9C16	Go to 'Back' if odd
	C400	Load Immediate zero
	01	Clear Extension Register
	C2FC	Load Fromloc from P2
	01	Fromloc to Extension (Zero to Acc.)
	C980	Storezero to Fromloc at P1 (Board Implied Address.
	C145	Get piece from P1 'Extract'
	01	Piece to Extension
	C2FD	Load Toloc from P2
	01	Toloc to Ext. Piece to Acc.
	C980	Store Piece in Toloc at P1 — Implied Address
	06	Copy Status to Accumulator
	DC01	Or Immediate 01. = Adjust From/To flag
	07	Copy Accumulator to Status
'Back'	901A	Back to Keyscan
	C145	Get piece from P1 'Extract'
	01	Piece to Extension
	C2FC	Load Toloc from P2
	01	Exchange Extension with Accumulator
	C980	Replace piece in Fromloc
	C146	Load captured piece from P1 Extract

Entry Point	01	Capture to Extension
	C2FD	Load Tloc from P2
	01	Exchange Accumulator and Extension
	C980	Restore Capture in Toloc
	06	Copy Status to Accumulator
	D4FE	Set last bit low
	07	Copy Accumulator to Status
	9004	Skip over Flashcount Set.
	C407	Load 7 = Flashcount
	C95D	Store Flashcount
	C430	Load 30 = Scancount
	CAFF	Store Scancount at P2
	C400	Load zero
	C94D	Clear Keyword
	C2FF	Load Scancount
	9C03	Go to Scan if not zero
Scan Keyboard	98B0	Otherwise go to 'Video Interval?'
	BAFF	Decrement and load scancount
	C1FF	Read Allkeys
	D40F	Strip off top 4 bits
	E40F	Exclusive or OF (Any down?)
	01	Result to Extension
	8F07	Delay 7 milliseconds. (Debounce)
	C1FF	Read Allkeys
	D40F	Strip off top 4 bits
	E40F	Exclusive or OF
	50	And Extension
Adjust piece	98E5	Back to Scan if zero (No key down)
	06	Copy Status to Accumulator
	D401	Examine From/To bit
	9CBE	Make move if set (Go to 'Forth')
Findrow	C4F4	Load Rowcount
	01	Rowcounter to Extension
	C180	Read Keyboard at implied address
	D40F	Strip off top 4 bits
	E40F	Exclusive of OF
	9C12	If not zero go to Rowfound
	C14D	Load Keyword
	02	Clear carry
	F404	Add 4 to Keyword
	C94D	Restore Keyword
	01	Keyword to Extension (Rowcounter to Acc)
	03	Set Carry
	1F	Rotate Accumulator right with link
	01	Rowcounter back to extension
	C4FF	Load FF (Set all bits high)
	60	Exclusive-or Extension
Rowfound	98BD	If zero No Row Found. Back to Scan
	90E6	Otherwise back to Findrow
	1C	Shift right
	9806	If zero go to Release
	01	Switchboard to Extension
	A94D	Increment Keyword
	01	Switchboard back to Accumulator
	90F7	Jump to Rowfound
Release	C1FF	Read Allkeys
	D40F	Strip off top 4 bits
	E40F	Exclusive-or OF
	01	Result to Extension
	8F07	Delay 7 millisecond (Debounce Release)
	C1FF	Readl allkeys
	D40F	Strip off top 4 bits
	E40F	Exclusive or OF
	50	And Extension — Is any Key down?
	9CEE	Go to Release if key still pressed
	C14D	Fetch Keyword
	D40F	Strip off Top 4 bits
	01	Keyword to Extension
	3F	Exchange Pointer Register with Program Counter
		Exit from Subroutine with keyword in Extension

(Why is the Subroutine entered in the centre? It is because jumps relative to the Program Counter may only be — 128 or + 127 locations and it is therefore politic to keep the main decision lines central to the block).



Recording A Game

To record a game the recorder is started in the recording mode, and then Tolinka's RECORD button is pressed. Some tape recorders have a monitor, which means one can hear what is being recorded, and some do not. During the recording time a 9 appears in the 'Cassette Status' position at the top left of the screen. When the 9 disappears recording is complete and the game resets to the opening move. The game in Tolinka's memory is not destroyed by the recording process and it may be recorded as many times as is required. The game may also be modified, other versions tried, and these be recorded as well.

If the move key is pressed whilst the tape is still recording, a tone will be recorded on tape which indicates to Tolinka that it should make a move when the tape is replayed in the RECALL mode. The tone does not contain any information other than to tell Tolinka to make the next move in its memory.

Recalling A Recorded Game

First the game to be recovered must be found on tape, by means of one of the indexing systems previously described. When the leader tone is heard the RECALL key must be pressed. The leader tone has two purposes: to overcome any noise problem leading into game data and to allow the tape recorder's internal Automatic Volume Control to stabilize. The RECALL key must be pressed **and** released during the three second continuous leader, to transfer control to the cassette recorder.

A 6 will then appear in the 'Cassette Status' position and should remain stationary for the rest of the leader, change to a running digit during the data transmission and be replaced by a tick if the game is received correctly. The tick denotes that a 'Checksum' appended at transmission time has been correctly received. A Checksum is a way of

checking data transmissions. Simply all the words in the data are added together and the total complemented. This complement is then transmitted as the last byte. When the data is added together it should total zero and the tick denotes that the contents of game memory has been totalled and does, in fact, equal zero.

If a recall is executed when there is no signal connected the machine will check in an all zero game — this is a useful way of clearing game memory. It is also the reason that zero was chosen as the checksum, so that one could be aware that memory was cleared without further checking.

If there is any symbol in the Cassette Status position it means that the Cassette has control, and move tones on tape will cause moves to be executed as they occur. It is also possible to record speech on the tape between the move tones, and explain to anyone who is willing to sit and watch how cleverly you demolished your opponent, blow by blow. Pressing any key such as MOVE or GOTO etc. causes control to revert to the keyboard and tones on tape will be ignored. The only time control may be passed to the Cassette Recorder is during the leader tone. If the Recorder is left playing and another game comes along the leader will pass control back to the keyboard. Operation of the controls is nearly foolproof and almost everyone becomes expert in ten minutes.

Reliability Of The Recording system

For absolute reliability a high quality studio recorder and data certified cassettes should be specified. In practice any recorder which works properly and a good quality audio tape will be quite all right. If possible the same recorder should be used for recording and replay because differences in motor speeds can introduce errors.

When acquaintances in pubs air their ability to read and learn new words tell you about 'dropouts' thank them admiringly. It costs little to spread happiness and they might buy you a drink. The author has never had any problem with dropouts but this may be the influence of fraternity.

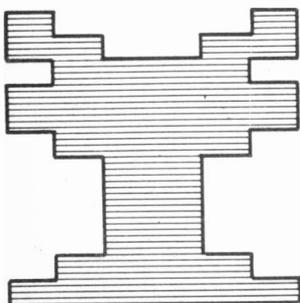
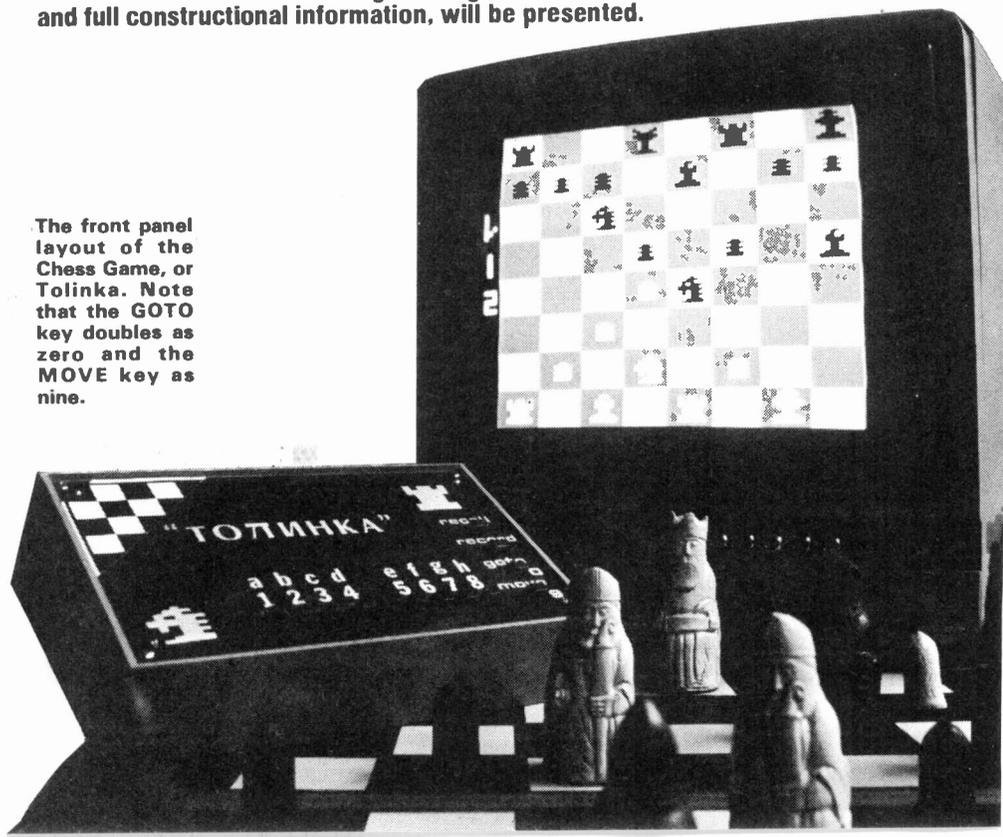
Useful Example

Here is an example of use: the French Defence has been decided upon as this season's reply to e2e4, and a tape will be kept of all French Defences played. The same information will be recorded perhaps on other tapes which are chronological or event files. It only takes a few seconds to record a game and the process may be repeated at will. The French Defence tape begins with analysis from the precedent in literature: standard lines are recorded as an aid to learning the strategy. Later in the tape the actual games are listed followed by their post-mortems, in the light of hindsight. This is a powerful aid to learning.

ETI

Next month the full circuit diagram, together with Hardware How It Works and full constructional information, will be presented.

The front panel layout of the Chess Game, or Tolinka. Note that the GOTO key doubles as zero and the MOVE key as nine.





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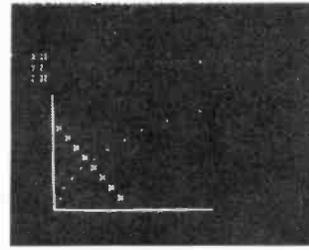
We are proud to announce the

ETI-TRITON ONE-BOARD COMPUTER

WE'VE BEEN WORKING on this project for a considerable time with the designer, Mike Hughes and the kit suppliers, Transam Components Ltd; we think we've got a winner.

The ETI-Triton is a powerful single-board computer based on the 8080 MPU. It features a very powerful 2K integer TINY BASIC as well as a versatile monitor to allow machine code programming. Used with a standard TV and cassette recorder it forms a powerful computing system especially designed for domestic and educational applications. A unique VDU function, together with 64 graphic characters provides the ETI-Triton with excellent graphic handling capacity as well as cursor control.

Practically everything is on one board which will hold up to 3K of RAM and from the start we've co-operated with Transam Components to have a kit available from square one. ETI is taking a major step forward by giving all constructional details in one-month—there'll be no hanging about for months to see the end of the article. The cost will be around £300.



AND

A new, regular 24-page supplement in ETI

computing today

NO 1 november 1978

The ever increasing activity in the field of personal computing and MPUs over the past year has been reflected by an ever increasing number of pages devoted to these topics in ETI.

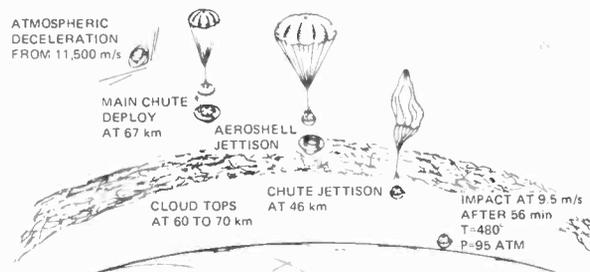
The time has come however when we can no longer devote enough space in the magazine to cover all aspects of personal computing as well as keeping up with the world of electronics in general with all our regular features.

From next month we shall be including a brand new magazine—Computing Today—within ETI. It is not being produced by cutting down on the regular size of ETI—in fact the November issue will be about 140 pages with the new supplement.

Computing Today will be devoted to personal computing and the first issue will contain the first part in a series on BASIC programming techniques, an article on machine code programming with the TRITON, a report on the US East Coast computer show, a review of the NASCOM 1, a CUTS encoder project plus news and Softspot, our software section.

**What to look for
in November's ETI
On Sale October 6th**

PLUS Venus Spacecraft



IN December two 'Pioneer' spacecraft will arrive at our closest neighbouring planet. One will orbit Venus, collecting data on the atmosphere etc whilst the second will send down several probes to the surface where the temperature is known to be about 500° C.

Although we now know that the Mekon (remember him?) is unlikely to live there, we know very little indeed about Venus. Next month Brian Dance describes this programme which will increase our understanding of the 'Evening Star'.

Autochord Project

A really neat project which is being published in conjunction with Maplin. Basically designed around a new SGS chip set, the Autochord has its principle use with electronic organs—the name describes its function pretty well. It can also be used as a self-standing rhythm generator.

Audio Oscillator

A genuinely new design with a digital readout makes this project a really attractive piece of test gear.

It has a range of 10Hz to 100kHz with either a sine or square-wave output with a 1V output plus 10 dB steps down to 1 mV. Sinewave distortion is better than 0.1%. The readout is LCD and resolution is 0.1/Hz on the lowest range.



Snob Project-of-the-Year

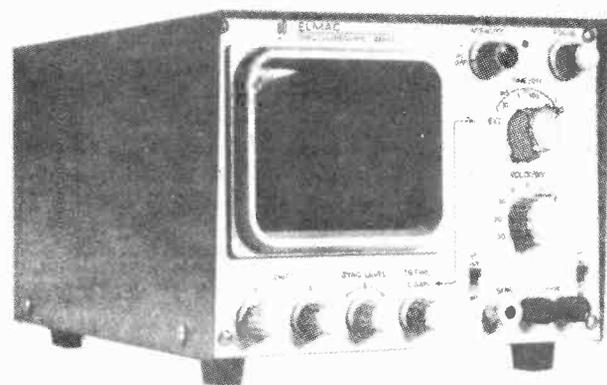
Steal a march on the wine-snob! Whilst he nurses his Chateau bottled Burgundy, you can be one-up even with your Spanish plonk—why? Because, as an ETI reader, you will have your own electronic wine temperature indicator which will be described in the November issue.

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

ELECTRONICS TODAY INTERNATIONAL — OCTOBER 1978

AS RECOMMENDED
BY ELECTRONICS TODAY
INTERNATIONAL JULY 1978

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Input Voltage — Max
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Deflection Sensitivity
Bandwidth (between 3dB points)
Gain Control
Input Impedance
Input Voltage — Max
TIME BASE
Sweep Range (calibrated)
FINE Control

Blanking
SYNCHRONIZATION
Selection
Synchronization Level
POWER SUPPLY
— 115/220V AC ± 10% at 50/60Hz
Power Dissipation

CRT DATA

PHYSICAL DATA

Dimensions
Weight
Stand
Case
Front Panel

— 100m V/division
— DC — 5MHz
— 9 step 0.1, 0.2, 0.5, 1, 2, 5, 10.20 50V/div
— 1 Meg/40 pf in shunt
— 600V P.P
— 0-400mV/division
1Hz-350KHz
— Continuous, when time base in EXT position
— 1 Meg
600V P.P
— 100msec/div to 1µ sec/div in 5 steps
— Variable between steps — includes timebase calibration position
— Internal — on all ranges

— Internal, external
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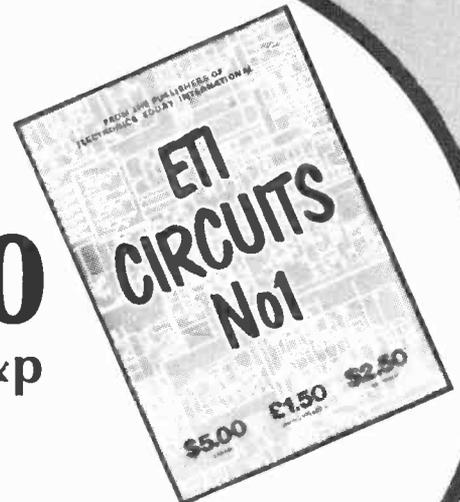
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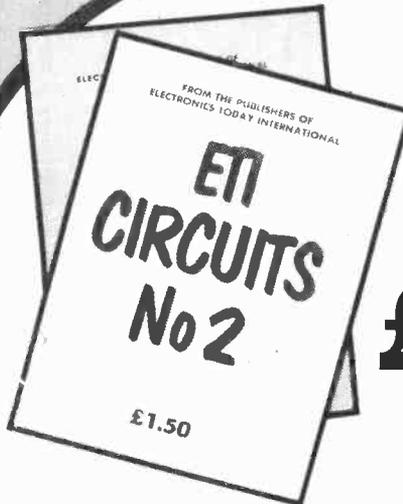
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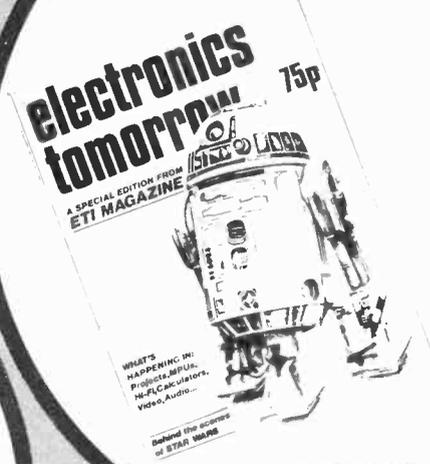
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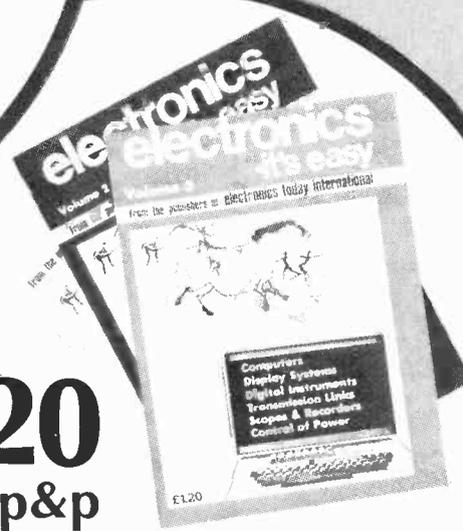


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This book is rather an unusual reprint from the pages of ETI. The series appeared a couple of years ago in the magazine, and was so highly thought of by the University of New England that they have re-published the series splendidly for use as a standard textbook. Written by Peter Sydenham, M.E., Ph.D., M.Inst.M.C., F.I.I.C.A., this publication covers practically every type of transducer and deals with equipment and techniques not covered in any other book.

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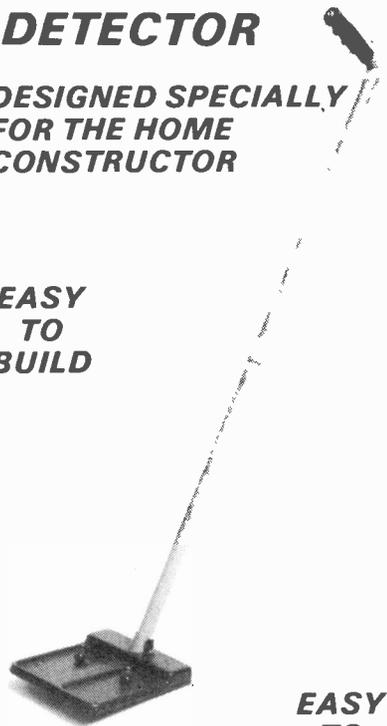
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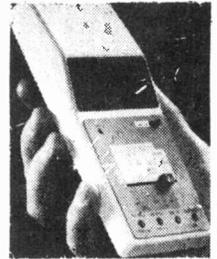
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ICM 7217/7227 SERIES

INTERMIL

The ICM 7217 and ICM 7227 are four digit, presetable up/down counters with an onboard presetable register continuously compared to the counter. The ICM 7217 versions are intended for use in hardwired applications where thumbwheel switches are used for loading data and simple SPDT switches are used for chip control. The ICM 7227 versions are intended for use in processor-based systems where presetting and control functions are performed under processor control.

These circuits provide multiplexed seven segment LED display outputs, with common anode or common cathode configurations available. Digit and segment drivers are provided to directly drive displays of up to 250mm character height at a 25% duty cycle. The frequency of the onboard oscillator (and thus the multiplex frequency) may be controlled with a single capacitor, or the oscillator may be allowed to free run. Leading zeroes are blanked, and the display drivers may be disabled allowing the display to be used for other purposes. The data appearing at the seven segment and BCD outputs is latched; the content of the counter is transferred into the latches under external control by means of the Store pin.

The ICM7217/7227 (common anode) and ICM1721A/7227A (common cathode) versions are decade counters, providing a maximum count of 9999, while the ICM 7217B, 7227B (common anode) and ICM7217C/7227C (common cathode) are intended for timing purposes, providing a maximum count of 5959.

These circuits provide three main outputs; a carry/borrow output which allows for direct cascading of counters, a zero output which indicates when the count is zero, and an equal output which indicates when the count is equal to the value contained in the register. Data is multiplexed into and out of the device by means of a tri-state BCD I/O port, which acts as a high impedance input when loading, and provides a multiplexed BCD output. The carry/borrow, equal, and zero outputs, and the BCD port functioning as an output, will drive one standard TTL load.

In order to permit operation in noisy environments and to prevent multiple triggering with slowly changing inputs, the count input is provided with a Schmitt trigger.

The carry/borrow output is a positive going signal occurring typically 500nS after the positive going edge of the count input advancing the counter from 9999 to 0000 counting up and from 0000 to 9999 counting down. This output allows direct cascading of counters.

The equal output assumes a negative level when the contents of the counter and register are equal (i.e., for the duration of one period of the count input until the count is changed by a positive going edge on the count input).

The zero output assumes a negative level when the content of the counter is 0000.

The digit and segment drivers provide a decoded seven segment display system, capable of directly driving common anode LED displays at typical peak currents of 40mA per seg. This corresponds to average current of 10mA/seg with the 25% multiplex duty cycle. For the common cathode versions peak segment currents are 12.5mA, corresponding to average segment currents of 3.1mA. The display control pin controls the display output using three level logic. The pin is self-biased to a voltage approximately half way between rails which corresponds to normal operation. When this pin is connected to V+, the segments are inhibited, thus disabling the display and reducing power. When this pin is connected to V- the leading zero blanking feature is inhibited. For normal operation (display on with leading zero blanking) the pin may be left open. The display may be controlled with a 3 position SPDT switch as in the test circuits.

The BCD input/output port provides a means of transferring data into and out of the device in BCD format. The ICI 7217 versions self-multiplex data into the counter or register via thumbwheel switches in response to inputs at the load counter or load register pins, while in the ICI 7227 versions input/output control and timing must be provided externally. When functioning as outputs, the BCD I/O pins will also drive one standard TTL load.

The onboard multiplex scan oscillator has a nominal free-running frequency of 10kHz. This may be reduced by the addition of a single capacitor between the Scan pin and the positive supply, or the oscillator may be directly overdriven to about 20kHz.

FEATURES

Four decade, presetable up-down counter with parallel zero detect.

Setable register with contents continuously compared to counter.

Directly drives multiplexed seven segment common anode or common cathode LED displays.

On-board multiplex scan oscillator.

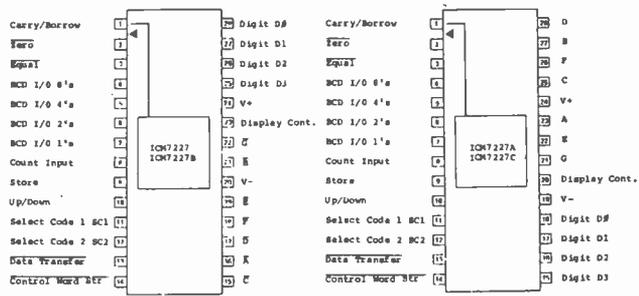
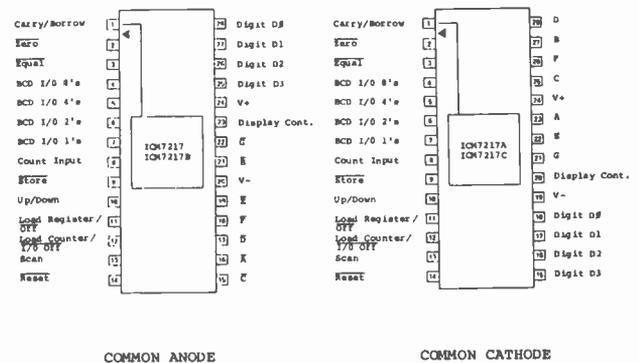
Schmitt trigger on count input.

TTL compatible BCD I/O port, carry/borrow, equal and zero outputs.

Display blank control for low power operation; quiescent power dissipation less than 5mW.

Display off control to allow use of display for other purposes.

7217 numbers refer to hardwired control versions of the device, while 7227 numbers refer to the processor control versions.



The Store pin of the 7217 will allow the output latches to be updated only if it is held low. The device will count up if the Up/Down pin is high and down if low. The Reset pin will allow normal operation when high, resetting the device when taken low. The Load Counter pin has three states. When high the counter is loaded with BCD data, when floating normal operation is selected and when the pin is low the BCD port is forced to a high impedance. The Load Register pin also has three states. High loads the register with BCD data, floating allows normal operation while low disables the display drivers. The three state Display Control disables the segment drivers when high, allows normal operation when floating and inhibits the leading zero blanking when low.

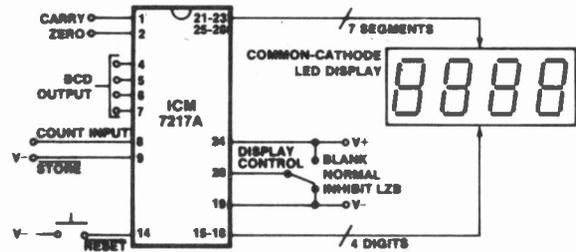
The 7227 pin configurations are somewhat different. The Data Transfer pin will allow normal operation when high, and when pulsed low will cause a transfer of data as directed by the select code set up on pins Select Code Bits 1 and 2. If these are set to 00 there will be no data transfer, 01 will latch the output data, 10 will preset the counter while 11 will preset the register. The Control Word Strobe will allow normal operation when high and when pulsed low will cause the control word set up on the Store and Up/Down pins to be written to the control latches. The Store pin will update the latches if high during CWS's active period, not allowing updates if low. The counter will count up if Up/Down is high, down if low. The display control is a three state input, blanking if low and allowing normal operation if left floating, blanking if low and allowing normal operation of left floating.

The ICM 7217/7227 series provides in one easy to interface circuit (1) a high speed four decade up/down counter with carry out and parallel zero detect (2) setable register and comparator; (3) output latches for (4) a multiplexed LED display decoder/driver system and (5) multiplexed (or directly addressed in the ICM7227) BCD outputs. These five subsystems can be used together or separately to provide a large number of circuit configurations.

A few possible applications are shown below.

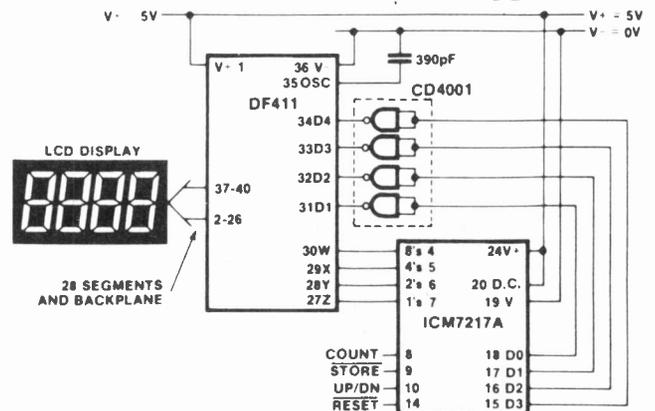
TIMER DISPLAY COUNTER /

ICM7217	Common Anode	Decade/9999
ICM7217A	Common Cathode	Decade/9999
ICM7217B	Common Anode	Timer/5959
ICM7217C	Common Cathode	Timer/5959
ICM7227	Common Anode	Decade/9999
ICM7227A	Common Cathode	Decade/9999
ICM7227B	Common Anode	Timer/5959
ICM7227C	Common Cathode	Timer/5959



UNIT COUNTER WITH BCD OUTPUT

The simplest application of the ICM217 is as a four digit unit counter. All that is required is an ICM7217, a power supply and a four digit display. Add a momentary switch for reset and an SPDT centre-off switch to blank the display or view leading zeroes. One more SPDT gives up/down.



LCD DISPLAY INTERFACE

The low-power operation of the ICM7217 makes an LCD interface desirable. The Siliconix DF411 four digit BCD to LCD display driver easily interfaces to the ICM7217A with one CD4000-series package to provide a total system power consumption of less than 5mW. The common-cathode devices should be used since in these versions the digit drivers are CMOS, while in the common-anode devices the digit drivers are NPN devices and will not provide full logic swing.

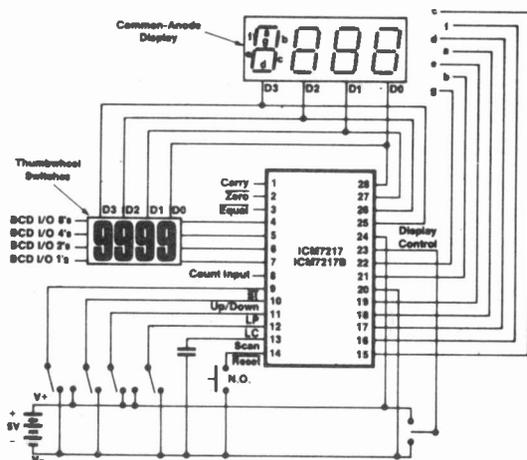


Fig. 1. The 7217 (common anode) version. The display and power connections are the same for the 7217B, 7227 and 7227B.

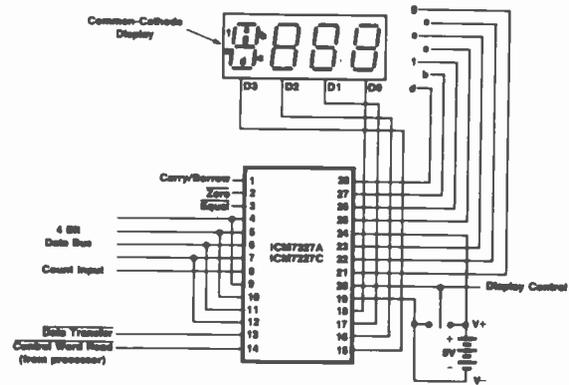
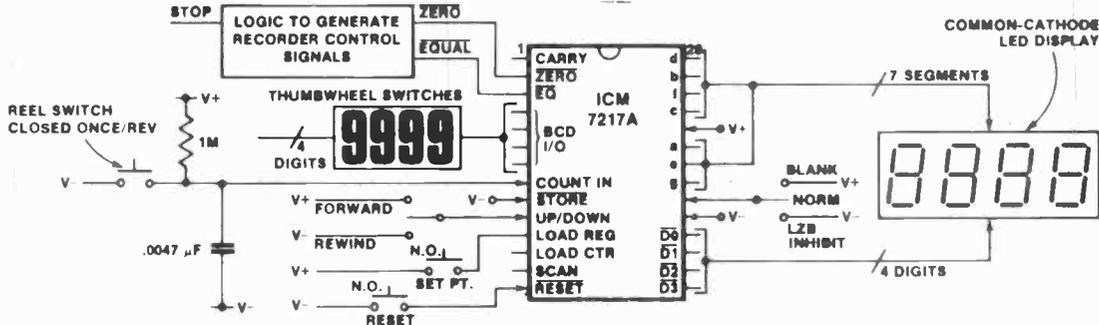
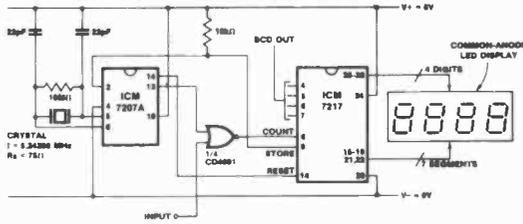


Fig. 2. The 7227A (common cathode) version. The display and power connections are the same for the 7227C, 7217A and 7217C.

PRECISION FREQUENCY COUNTER/TACHOMETER

This circuit is a simple implementation of a four digit frequency counter, using an ICM7207A to provide the one second gating window and the store and reset signals. In this configuration, the display reads hertz directly. With Pin 11 of the ICM7207A connected to V+, the gating time will be 0.1 second which will give tens of hertz in the least significant digit. For shorter gating times an ICM7207 may be used (with a 6.5536 MHz crystal), giving a 0.01 second gating with Pin 11 connected to V+ and a 0.1 second gating with Pin 11 open.

To implement a four digit tachometer, the ICM7207A with a one second gating should be used. In order to get the display to read directly in RPM, the rotational frequency of the object to be measured must be multiplied by 60 (or 600 using a 0.1 second gating for faster update). This can be done electronically using a phase-locked loop or mechanically by using a disc rotating with the object with the appropriate number of holes drilled around its edge to interrupt the light from an LED to a photo-detector.



TAPE RECORDER POSITION INDICATOR/CONTROLLER
This circuit shows an application which uses the up down counting feature of the ICM7217 to keep track of tape position on a tape recorder. This circuit is representative of the many applications of up/down counting in monitoring dimensional position.

In the tape recorder application, the preset register, equal and zero outputs can be used to control the recorder. To make the recorder stop at a particular point on the tape, the register can be set with the stop point and the equal output used to stop the recorder (either on fast forward, play or rewind).



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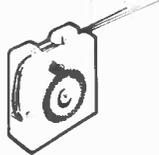
HOBBY WRAP Model BW 630



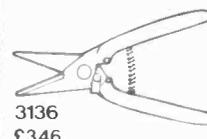
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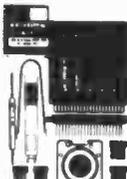


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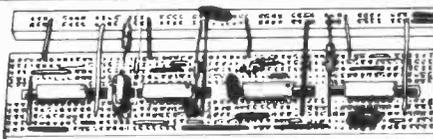
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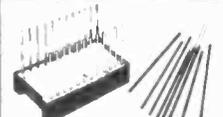
FROM 80p TERMINAL AND DISTRIBUTION STRIPS
Bread boarding building blocks with universal matrices of solderless plug-in tiepoints.
• Facilitate quick, solderless circuit build-up and check-out on universal 1" x 1" matrix.

- Are offered in ten configurations.
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HOBBY WRAP TOOL
Wire-wrapping, stripping, unwrapping tool for AWG 30 on .025 (0.63mm) Square Post.
A £4.74 B £5.07

Regular Wrap	A	WSU-30
Modified Wrap	B	WSU-30M



DIP SOCKET
Dual-in-line package, 3 level wire-wrapping, phosphor bronze contact, tin-inlay finish pins .025 (0.63mm) sq., .100 (2.54mm) centre spacing.
14 Pin Dip Socket 14 Dip
16 Pin Dip Socket 16 Dip
FROM 29p

RIBBON CABLE ASSEMBLY £2.92
With 14 Pin Dip Plug 2' Long DE 14.2
With 14 Pin Dip Plug 4' Long DE 14.4
With 14 Pin Dip Plug 8' Long DE 14.8
With 16 Pin Dip Plug 2' Long DE 16.2
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ELECTROVALUE Buying Guide

Section 4

If you have bought before from Electrovalue, you know just how large and varied our stocks are and how good our service is. For those who have yet to know us, we are publishing a series of five ads. month by month to give up-to-date information and prices on much of the stocks we carry. These ads. are appearing in rotation in E.T.J., Elektor, Practical Wireless, Practical Electronics and Everyday Electronics so that the complete series will appear each month. So no matter which journals you read, BY DETACHING AND SAVING THESE PAGES YOU WILL ACQUIRE A VALUABLE AND COMPREHENSIVE MONEY SAVING CATALOGUE.

Resistors

(Prices in pence)

Type	1+	10+	100+
CR25	●1Ω to 3Ω 9.5% E12		
.33W	3p	2p	1.76N
UPM033	●4Ω 7 to 1M 5% E24		
.33W	2p	1.6	1.43N
CR25	●1M2 to 10M 10% E12		
.33W	3p	2p	1.76N
MR25	5Ω 1 to 300K 2% E24		
.4W	5p	4p	3.60N
UPM050	●4Ω 7 to 4M7 5% E12		
.5W	2p	1.6	1.43N
CR37	●1Ω to 3Ω 9.5% E12		
.5W	3p	2p	1.87N
UPM075	●4Ω 7 to 10M 5% E24		
.75W	2p	1.6	1.43N
UPM100	●4Ω 7 to 4M7 5% E12		
1W	5p	4p	3.27N
UPM100	●5M6 to 10M 10% E12		
1W	5p	4p	3.27N
TR5	10Ω to 1M 2% E24		
.5W	5p	4p	3.20N
TW1	0.22Ω to 0.47Ω ± 0.05Ω E12		
1W	15p	13p	11.8N
TW1	0.56Ω to 3R9 10% E12		
1W	15p	13p	11.8N
GWS3	0.47Ω, 1Ω to 10Ω 10% E12		
3W	18p	14p	11.0N
GWS3	12Ω to 10K 5% E12		
3W	18p	14p	11.0N
GWS7	1Ω to 10Ω 10% E12		
7W	18p	14p	11.0N
GWS7	12Ω to 10K 5% E12		
7W	18p	14p	11.0N

Net prices apply for complete 100s only. Bulk prices available.
E12 values: 1.0, 1.2, 1.5, 1.8, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8, 8.2.
E24 values: as E12 plus 1.1, 1.3, 1.6, 2.0, 2.4, 3.0, 3.6, 4.3, 5.1, 6.2, 7.5, 9.1, and their decades.

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One-pole change-over SDC.1	42p
Two-pole change-over SDC.2	78p
Three-pole change-over SDC.3	£1.08
On-off 2-pole SDC.2	42p
On-off 6-pole SDC.6	£1.08
On-off 4-pole SDC.4	78p
On-off 8-pole SDC.8	£1.32

Multi-type one-pole 8-way Type DS16A-8 99p
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(These types colour coded)
For fuller range of switches, see section 5 in our current ads.

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£197.50 + VAT

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- Retail buyers invited

Pots.

CARBON TRACK, ROTARY

Long spindle, without flat, 0.25" 0.375" B.S. bush, nut and washer
P20 lin 1-gang 23p
P20 log 1-gang 23p
P20 lin + switch 67p
P20 log + switch 67p
JP20 lin 2-gang 67p
JP20 log 2-gang 67p
JP20 lin + switch 1.11
JP20 log + switch 1.11
DP20 2-gang £1.17
(separate spindles)
DP20 + switch £1.67

Resistance values stocked:

P20 lin: 100Ω to 4M7
P20 log: 220Ω to 2M2
JP20 lin: 1K, 4K7 to 2M2
JP20 log: 4K7 to 2M2
DP20: made to order in any values available in P20. State front (near bush) and rear tracks clearly.

CARBON TRACK, SLIDER (58mm travel)

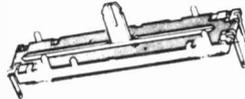
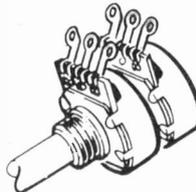
For knobs, see JV-slider

PG58 mono 35p
C1PG58 mono 63p
C1PG58ST stereo £1.03

Resistance values stocked:

PG58 lin: 4K7 to 1M
PG58 log: 10K to 1M
C1PG58 lin: 4k7 to 1M
C1PG58 log: 4K7 to 1M
C1PG58ST lin: 4K7 to 1M
C1PG58ST log: 4K7 to 1M

Log stereo matching ± 2dB @ 10%R
± 3dB @ 3.2%R
± 4dB @ 1%



NEW — JOYSTICK TWIN POT. UNIT

Pan pot assembly comprising two carbon track pots mounted at right angles on rigid plastic box and operated individually by joystick control. 100K or 220K per section

£2.25

BOXES

ALUMINIUM

AB7	133 x 70 x 38	60p
AB8	101 x 101 x 38	60p
AB9	101 x 70 x 38	60p
AB10	133 x 101 x 38	62p
AB11	101 x 64 x 51	60p
AB12	76 x 51 x 25	50p
AB13	152 x 101 x 51	77p
AB14/2	127 x 89 x 64	74p

DIECAST

992	89 x 35 x 30	1.05
993	114 x 64 x 30	1.32
998	114 x 64 x 55	1.40
994	114 x 89 x 55	2.10
999	171 x 121 x 55	2.68
974	171 x 121 x 106	3.77
PLASTIC	116 x 77 x 36	48p
PB1	122 x 67 x 43	66p
PB01		

(PB301 is "double U" type and has vent and various holes)

Knobs

All screw fitting

ALUMINIUM (plastic inner)

EV18A 18mm	56p
EV22A 22mm	64p
EV32A 32mm	73p
EV38Amm	78p

BULGIN

K107 pointer 32mm black or white	22p
K108 pointer 57mm black only	35p

"Modern range"

K491 29mm	46p
K492 37mm	46p
K493 32mm	46p
K382 dial 270° 0-10	22p
K389 dial 300° 0-10	22p

SI FAM COLLET KNOBS

Caps must be ordered separately

15mm diameter:	
S150B short	27p
K150B	28p
W1508B winged 22mm diameter	32p
S210B short	35p
K210B	36p
W210B winged	39p

Caps 15mm:

C150	3p
C152 w. spot	5p
Caps 21mm:	
C210	3p
C212 w. spot	5p

Nut covers 15mm only

N150B	5p
N151B with line	10p
Dials 15mm	17p
Dials 21mm	18p

Types available

D151, D211 0-11	
D152, D212, 1-12	
D158, D258 wedge	
D159, D259 white arrow	

Caps in black, red, yellow, green, blue and grey.
All other items black only.

JV SERIES

Plastic cylindrical — black, red, yellow, green, blue, light or dark grey, white

JV18 18mm	27p
JV23 23mm	27p

The following pair are designed for DP20 pots, and have 4mm and 6mm bores.

JV18/4	40p
JV23/6T	40p

JV Slider knobs for Radiohm mono and stereo pots. In eight colours as above

JVS + colour 8p

BLACK PLASTIC

K1 25mm S	13p
CK1 25mm SM	18p
K2 35mm S	15p
CK2 35mm SM	20p
K3 27mm P	12p
K4 32mm P	12p
K5 19mm	20p
K6 25mm	25p
SK6 41mm SK	30p
K7 19mm B/W	20p
K8 25mm S	20p

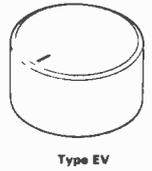
S skirted

M metal insert

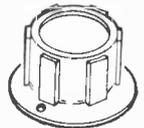
P pointer

SK skirt, 0-10

B/W black or white



Type EV



Type K/CK



K5



K6



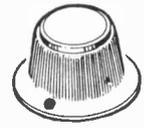
NK



K3



Si Fam Collet



K8

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Extend Buzby's influence with our

TELEPHONE BELL EXTENDER

MANY TIMES WHILE you're working in the garden the phone may ring and by the time it is heard, if it is at all, it is often too late to reach the phone. While the GPO will install a remote bell for you it has to be rented and for people who are hard of hearing it may not be loud enough.

This bell extender will allow you to add, without touching the phone, an external bell, buzzer or speaker anywhere it is desired. When using a horn loaded speaker the sound level is high enough to be heard over high ambient noise making it ideal for the industrial environment.

Adjustment

There are two controls to be set, these being sensitivity and volume. The volume can be set first by rotating RV1 until the tone starts then adjusting RV2 to give the desired volume. To adjust the sensitivity first tape the sensor coil to the underside of the phone and then adjust RV1 until the sound stops. Note however that it should be rotated slowly as C3 gives a delay on switch off. Check that picking up and replacing the phone does not operate

the alarm then get someone to ring you to check that the phone tone does. It may be necessary to experiment with the position of the pickup coil to get the best results.

Construction

While any construction method could be used we recommend that the PCB board be used and the overlay in Fig. 2 be followed. The pickup coil was made out of 0.125 mm enamelled wire, although the gauge is not important, with about 200 turns wound around a former about 50 mm diameter. The former can then be removed, the wires terminated in some thin plastic insulated wires (twin "bell" wire is ideal) and then the complete coil wrapped with plastic insulation tape.

We built our unit into a small plastic box using an external speaker. The unit can be mounted anywhere suitable, taking care however with the 240 V wiring. The speaker used will depend on the volume required with a larger speaker producing more sound. If a horn speaker is used a very high sound level can be produced.

If it is required only to operate a buzzer the second IC can be altered to be an on-off device by deleting C5, R5, R6, D2 and RV2 and fitting a link in place of C5.

BUYLINES

All the components used in this programme are freely available from component stores and mail order firms.

As the text points out the pick up coil is by no means critical, and most enamelled wire will do, the number of turns being adjusted to achieve a satisfactory performance.

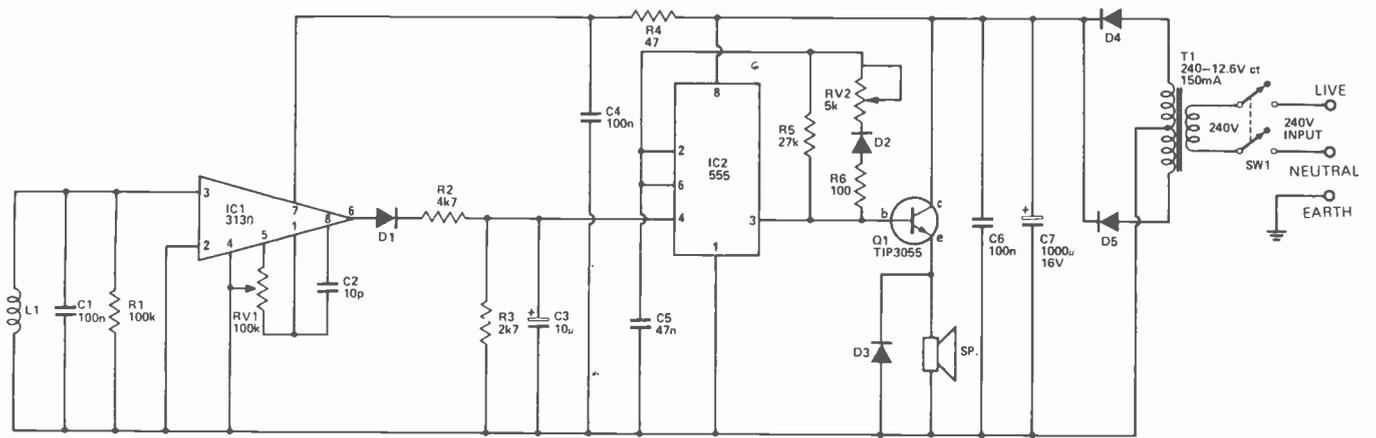


Fig. 1. Full circuit diagram of the tele bell extender.

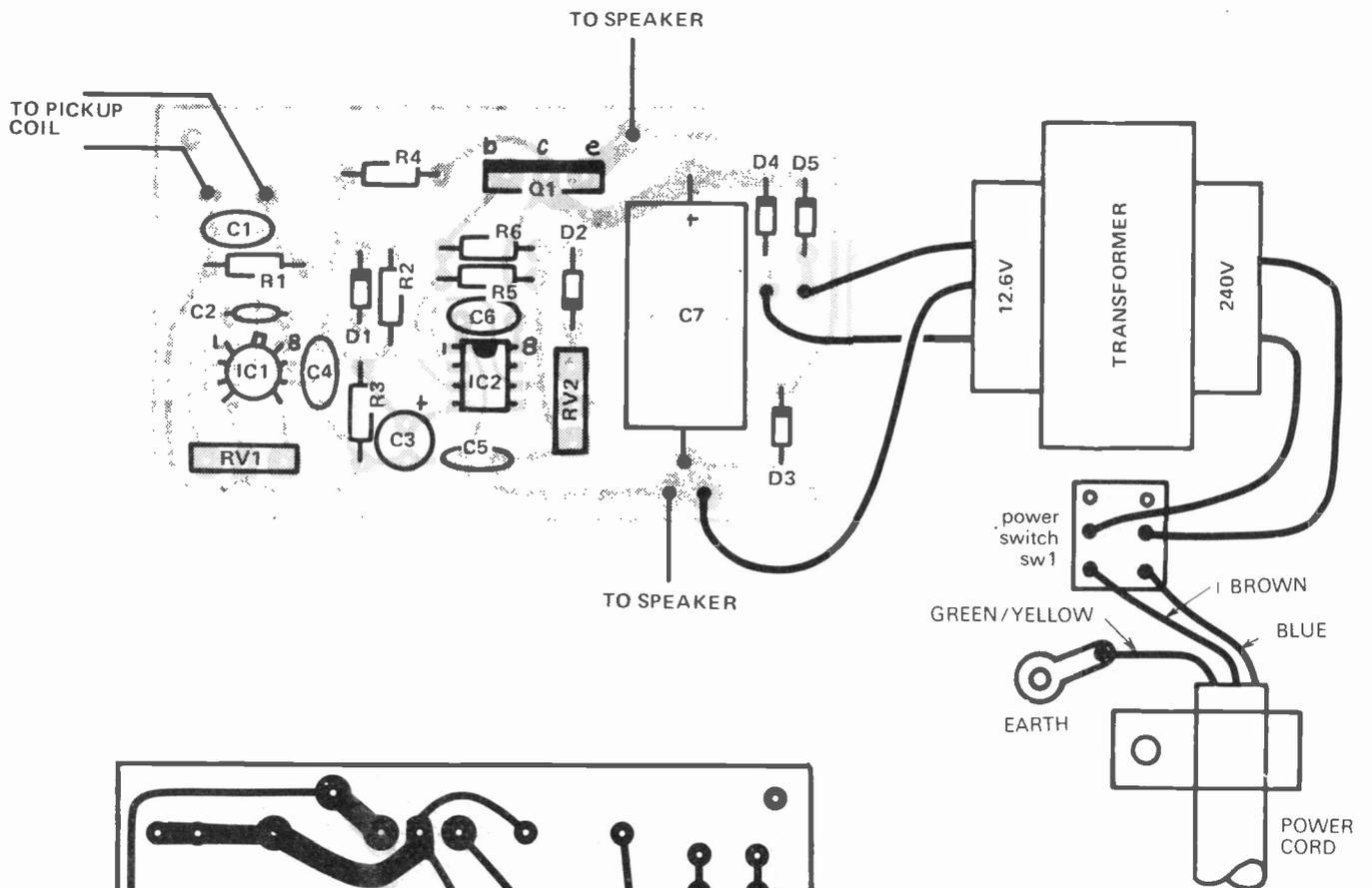
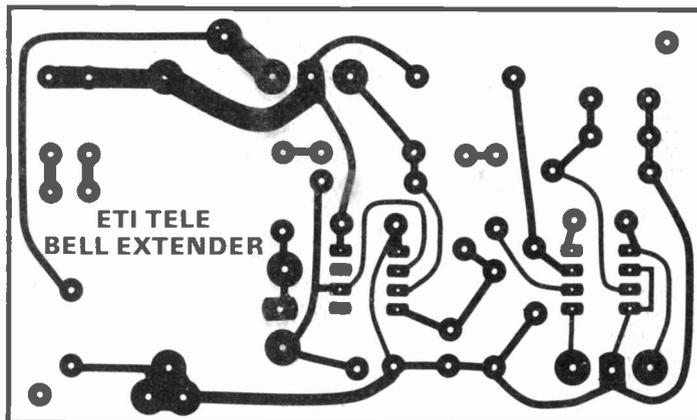


Fig. 2. (above) overlay for the extender's PCB

Fig. 3 (left) full size foil pattern for the telephone bell extender printed circuit board.



HOW IT WORKS

Inside the telephone there is a solenoid which operates a striker which hits a pair of bells to give the ring tone. When it operates there is a high magnetic field generated and we detect this field to give the indication that the bell is ringing. To do this we use a coil wire under the telephone and use an IC to detect the presence of a signal. IC1 has its offset voltage adjusted by RV1 such that a slight positive voltage is needed to make the output go high. It is used in the open loop mode as a comparator only. The capacitor C1 is used to remove the unwanted higher frequency signals.

The oscillator used to operate the speaker is simply a 555 timer with a TIP3055 to buffer the output. The frequency is determined by C5 and the volume by RV2. Changing the volume does change the frequency slightly. Oscillation can however only occur if the voltage at pin 4 is greater than 0.6V. If the output of IC1 is low, R3 ensures that pin 4 is less than this voltage. However when the bell rings the output of IC1 oscillates high and low in time with the ring tone of the bell. This lifts pin 4 high, allowing IC2 to oscillate and C3 holds pin 4 for a short time to prevent the oscillator turning on and off at the ring tone frequency.

The power supply is a simple full wave rectifier with no regulation with IC1 being decoupled further by R4 and C4. Batteries could be used but the drain is reasonably high.

PARTS LIST

RESISTORS all 1/2W 5%

R1 100k
R2 4k7
R3 2k7
R4 47R
R5 27k
R6 100R

POTENTIOMETERS
RV1 100k trim
RV2 5k trim

CAPACITORS
C1, C4 100n polyester
C2 10p ceramic
C3 10u 16V electrolytic
C5 47n polyester
C7 1000u 16V electrolytic

SEMICONDUCTORS
IC1 CA3130
IC2 NE555
Q1 TIP 3055
D1-D5 1N4001

MISCELLANEOUS
PCB as pattern
Transformer 240V — 12V 6V ct
Mains switch, 3 core flex
Box, speaker, pickup coil

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ALARM CHRONOGRAPH WITH DUAL TIME ZONE FACILITY

In a superb stainless steel case with mineral glass face. THIS MUST BE THE ONE YOU HAVE BEEN WAITING FOR!

If you could write the specification for your own ideal watch you would probably want everything this one has. As for styling, without a close inspection nobody is going to be able to tell the difference between this watch and that world famous James Bond classic selling for £145. However, this one goes one better and has 1/100 second timing of net, lap and 1st and 2nd place times, with dual time facility.

- Constant LCD display of hours and minutes plus optional seconds or date display plus day of the week and am/pm indication.
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- 1/100 second chronograph measuring net, lap and first & second place times.
- Dual time zone facility. Night light.
- Fully adjustable stainless steel bracelet.
- Stainless steel case. Mineral glass face.

This watch should not be confused with cheaper models with chrome plated cases and plastic lens. Manufactured by National Electronics, it runs a close second to Casio. Citizen and Seiko for quality and reliability, with undeniable value for money. It is fully guaranteed for 12 months, with first-class service back-up.

The first very limited quota will be available in mid-September with another small consignment in October, so order now to avoid disappointment. We will quote you a delivery date by return of post.



£39.95

NATIONAL low cost watches (or similar)

PH-ALARM WATCH. Similar to above but without stopwatch and dual time. Chrome plated case. Plastic lens.

£29.95

PH-CHRONOGRAPH

Hrs, mins, secs. Month, date, day
1/100 sec. Net
lap, 1st & 2nd
place. Light

£18.50



PH-ANALOGUE

Step motor,
sweep secs
Day, Date

£24.95

ST-24 CARD TIME

Stopwatch from 1/10 second to 10 hour, then seconds to 24 hours. Or 24 hr. clock. Net, lap, 1st & 2nd place. Two alarm/timers. Calculator. Full memory
K% 1/8x3 1/2x2 1/2ins

£24.95) £19.95



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Two AA batteries last for 10,000 hrs (1 year) LCD 6 digit clock, large angled display, 24 alarm, also two 24 hr Alarm/Timers with countdown (one self-clearing, one repeats). Full memory, constants %, √, 1/x, 2/x, x 5

RRP £22.95

£17.95



THE INCREDIBLE FX-8000

43 Scientific funct. 1/100th sec Stopwatch. Five Alarm/Timers, sequential (self-clearing) or repeat. 2 level parenthesis Memory Deg. Rad. Gra. Standard deviations. Fractions. Sexagesimal Rect/Polar convert. LCD 1300 hr batteries. 1/4 x 2 3/4 x 5 3/4 2.7 oz

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AQ-1000. CALCULATING ALARM CLOCK PLUS 3-WAY STOPWATCH

Hours, minutes, seconds, am/pm, 24-hour Alarm with sign. Stopwatch: Net times, Lap times. 1st & 2nd Place times from 1/10sec. to 10 hrs with ST & LAP signs. Calculator: 4 key memory, %, √, 1 year batteries, ± 20 seconds/month. 1/4 x 2 3/4 x 4 3/4 (RRP £26.95) £21.95

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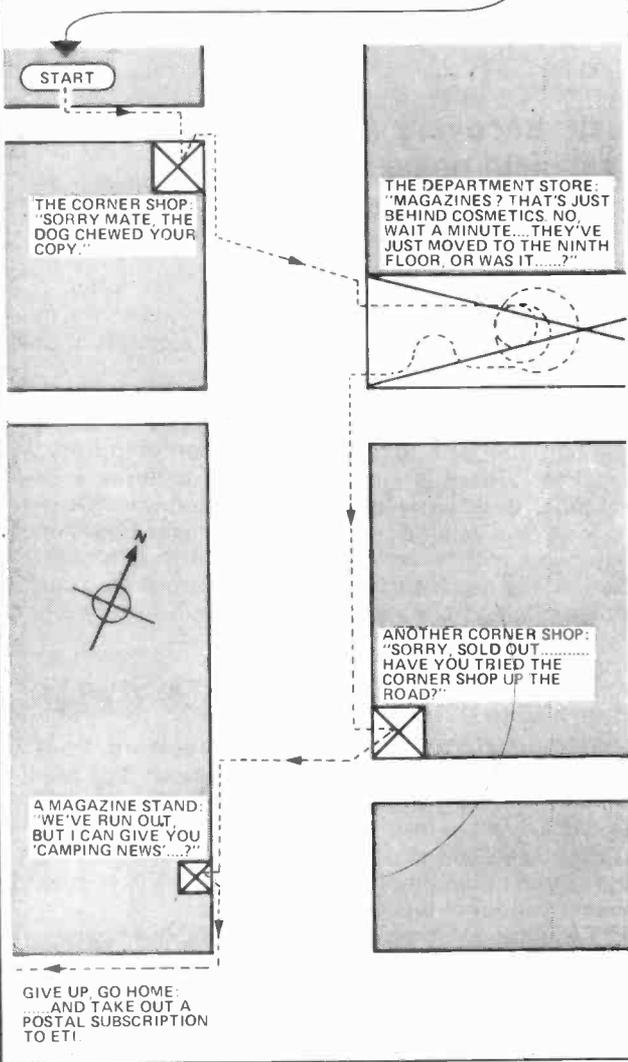
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GARRARD MRM 101

MUSIC RECOVERY MODULE

GORDON KING examines the new Garrard Music Recovery Module for ETI. This machine is designed to remove the transient noise created by damaged grooves on an LP. How effective is it and how does it work? Read on

THIS INTERESTING BRITISH innovation is a small, self-contained, mains-powered unit designed for connecting between the left and right outputs of a magnetic pickup and the left and right auxiliary or tuner inputs of a hi-fi amplifier. The unit processes the signals passing through it so that the disconcerting clicks produced by badly scratched records are virtually eliminated. In other words, the unit can be regarded as a record 'scratch remover'.

Basic principle of operation is fairly straightforward. The clicks are processed to form large amplitude pulses which are then applied to an electro-optical fader which, at the precise moment of the clicks, severely attenuates both audio channels, thereby exchanging the clicks for very short periods of 'silence.' Record clicks have a fast rise-time and the effective slewing-rate is determined by the primary parameters of the cartridge, which are the effective tip mass, compliance and, to some extent, the mechanical resistance or damping of the cartridge.

Provided that the attenuation is large enough, that it switches on and switches off swiftly enough just to straddle the periods of the clicks and that it is accurately synchronised to the occurrence of the clicks in the audio channels, then the effect is singularly dramatic — the loss of information during the time of the attenuation appears to be of little subjective moment.

The effect is akin to tape dropouts, but it appears to be less affected by the accompanying S/N ratio impairment of these. Experimental work has suggested that provided the period of program loss or attenuation does not exceed about 10 ms, then the result is not unduly obtrusive subjectively. The attenuation period of the MRM-101 is a trifle above 2 ms hence the 'gaps' come and go unnoticed.

Built to A Standard

The unit is built into a shallow enclosure and the front forms a brushed aluminium fascia carrying three controls and three light emitting diodes (LEDs). One control is for power on/off, another for suppressor on/off and the third provides a continuous threshold adjustment for the suppressor action. In use, this is set for the best subjective improvement in reproduction.

If the control is too far advanced music peaks as well as scratch clicks may be processed; if insufficiently advanced only very large amplitude scratch clicks will be processed. It is easy to determine the most desirable setting because one of the LEDs flashes each time a scratch is detected. Thus, when playing a record of given mutilation the control is slowly turned up until the suppressor activity LED flashes on all the significant scratches yet remains unaffected by high-frequency

music peaks. Another LED merely glows when the mains is switched on, while the third LED signifies that the suppressor mode switch is on.

The rear is equipped with 'phono' type and DIN input and output sockets, making it a simple matter to connect the unit to virtually any contemporary hi-fi amplifier. There is sufficient output to drive a power amplifier direct, but to control the volume this would need its own volume control. Not all power amplifiers are equipped with a volume control, so it is a pity that Garrard did not see fit to include an output gain control. When driving from the unit direct to our power amplifier high quality reproduction was achieved.

Operations

Operation of the unit can be appreciated from the diagram in Fig. 1. This is partly schematic and partly in *simplified* block format. With the suppressor off, the signal is directed from the output of the front-end, which is a partly equalised preamplifier composed of Q1-Q4 to the output buffer amplifier (RC4136DB), which provides the remainder of the RIAA equalisation.

Equalisation of the front-end is provided by the usual frequency-selective feedback arrangement which gives the 'bass boost' requirements of 3180 and 318 μ S. The 75 μ S. de-emphasis equalisation is provided by the 51k resistor and 1n5 capacitor in the feedback path of the output buffer. The circuit as a whole is also engineered to cater for the more recent IEC-98/4 specification corresponding to a 20 Hz additional turnover, equivalent to a time-constant of 7950 μ S.

A Gain Gained

Front-end gain is about 34dB at middle frequencies, and an extra 1.6 dB is provided by the output buffer. The circuit has some desirable aspects, including the differential input stage Q1, 2 and the 'Darlington' Q3, 4 stage which provides a high input impedance and low output impedance from Q4 emitter. Operating in the 'suppressor off' mode extremely good quality pickup signals are obtained.

The split equalisation, where the de-emphasis is provided at the output, helps to provide a high S/N ratio, and the circuit overall demonstrates an input overload threshold of about 37 dB at 1 kHz ref. 2 mV input.

Accuracy of the overall RIAA equalisation is revealed by the pen chart response in Fig. 2. This is maintained within 0.25 dB between the left and right channels over the entire spectrum. With the suppressor on the accuracy is almost the same, but our sample did exhibit a very

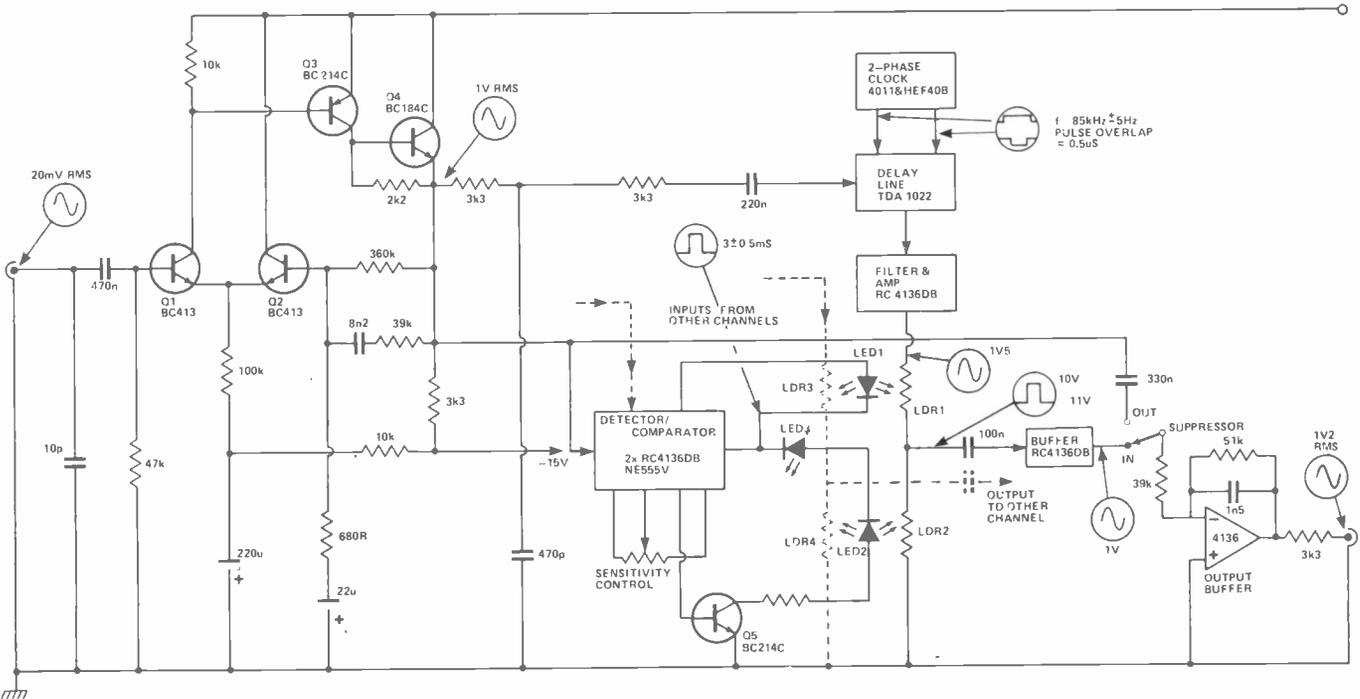
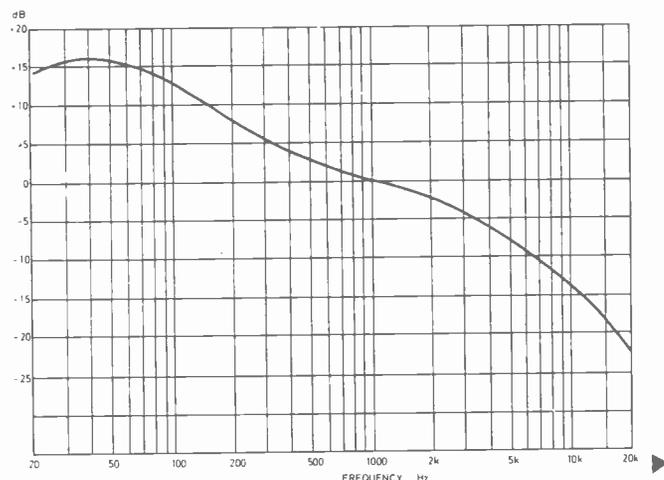


Fig. 1 (Above) The block diagram of the Garrard click eliminator MRM 101. The pickup amplification and equalisation stages were found to give a very high quality signal output. Note the use of quad op-amp 4136.

Fig. 2 (Right) RIAA equalisation curve for the unit. Channel balance was an excellent 0.25dB!

mild error round 15 kHz which was subsequently proved to be caused by a poor tolerance component. The tolerance in this area is being tightened by the manufacturer.

To the onset of peak clipping the amplifier is capable of providing an output of 9 V RMS at middle and low frequencies, with adequate reserve up to 20 kHz, resulting in an output slewing rate of round 0.15V/μsec., which will accommodate all disc material played on top-flight pickups. With the suppressor active the output is reduced by approximately 10 dB, but this is still more than adequate, even when driving direct to a power amplifier. The measured S/N ratio was 75 dB (CCIR/ARM weighting) ref. 7 mV RMS input.



Lines of Frequency

The spectrogram in Fig. 3. gives an excellent impression of the spectra purity with a 200 Hz signal of *2V RMS output level*. Ripple components are below our measuring floor of -90 dB, and the only harmonic of significance is the 2nd at -79 dB, corresponding to 0.0112%!! With the suppressor active the distortion is greater, as shown by the spectrogram in Fig. 4, again at 2V RMS output. The 2nd harmonic again predominates, but this time it is -50 dB (0.3%). The 3rd harmonic is down at -59 dB (0.112%), while all subsequent harmonics are at levels of insignificance.

The relatively high value of 2nd harmonic distortion is not disconcerting. Indeed, recent tests have suggested that a controlled amount of even-order non-linearity can, in fact, enhance rather than detract from the reproduction.

There seems to be a tendency for it to 'disguise' the heavy odd-order distortion carried by some program signal sources, including gramophone records, and that this can lead to improved auditioning of some highly specified transistor amplifiers — owing to the resulting 'valve type sound,' no doubt!

Circuitous Examination

Looking now at the circuit in Fig. 1 with the suppressor active, it will be seen that the signal from the front-end is directed two ways. One way is to delay line (TDA1022) and the other way is to the detector/comparator (2xRC4136DB and NE555V).

The detector recognises the whole waveform of a scratch and isolates it from the peaks of the recorded music. Two monostables (one in the NE555V and the other the bipolar transistor Q5) are switched by the scratches to generate pulses of about 3 mS. duration and 10 V amplitude (shown on the diagram). These pulses are then caused to operate LEDs 1 and 2, which are optically-coupled to two pairs of light dependent resistors (LDRs). One pair relates to the right channel and the other pair to the left channel.

Just one channel is shown in the diagram.

The LDRs associated with the other channel are drawn in broken line, as also are the inputs and output of the other channel.

Each pair of LDR forms an attenuator (called a fader) and is arranged to control the level of the audio signal emanating from the delay line prior to the signal arriving at the first buffer (RC4136DB). This part of the circuit is deliberately simplified for the sake of description, but in practice the degree of attenuation amounts to some 50 dB in the audio signal channels each time a pulse occurs.

Now, since it takes a little time for the pulses fully to develop, the signals in the audio channels proper need to be delayed slightly so that the scratch pulse on the music signal arrives at the fader at exactly the same time as the pulse created by the detector and associated circuits.

Hold it a Minute

The delay is provided by a 256-stage TDA1022, which is two-phase-clocked by a pair of ICs HEF4011 and HEF40B. The clock is running at 85 kHz, and the overlap of the two associated waveforms (shown in the diagram) ensures the required delay time. The net result is that each time a scratch click occurs the audio channels are

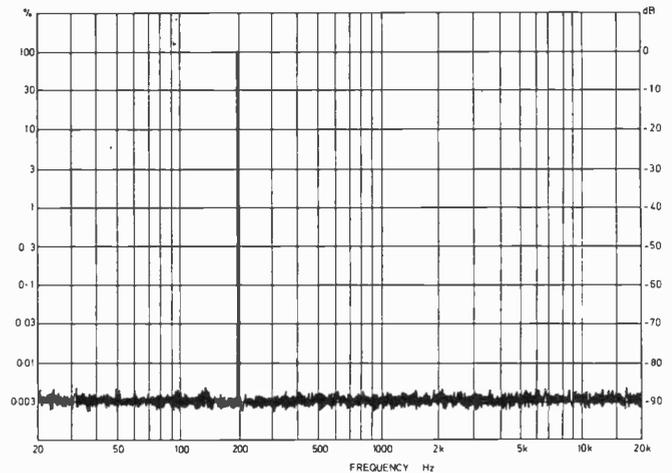


Fig. 3 Spectrogram of the 200Hz drive signal, suppressor switched out.

faded by about 50 dB for a period a shade over 2 mS.

This straddles the time of the 'real' scratch click, thereby eliminating it.

LED3 is the suppressor activity indicator on the fascia which, being in series with a fader LED, flashes in sympathy with the suppressor action.

The detector circuit includes auto and manual threshold control, while a filter in the amplifier IC, RC4136DB, following the delay line eliminates the spikes and spurious signals produced by the delay line action. It should be noted that although the maximum clipping output is less in the suppressor mode than in the direct mode, the gain of the amplifier sections remains the same in both modes.

It is thus possible to achieve A/B comparisons without level change by switching between the two modes.

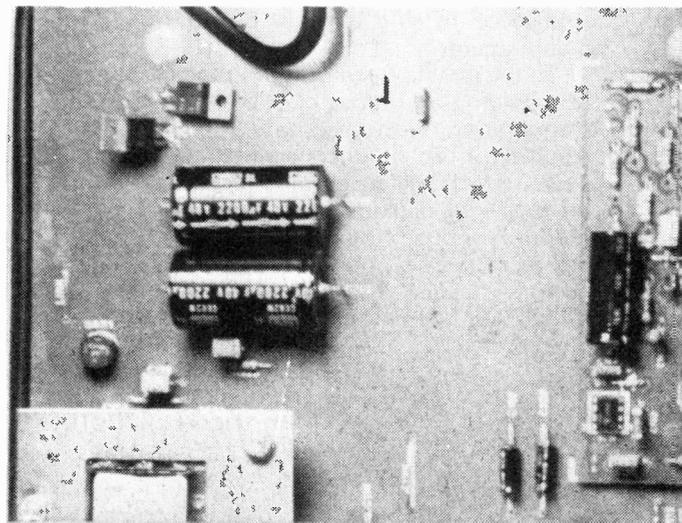
House Training

The sample unit has been operating very successfully for several months under typical domestic conditions in our test hi-fi system. It certainly removes the very disconcerting staccato clicks caused by badly scratched records.

It does not, however, remove the general background noise from worn or dirty records.

Such noises occur in almost continuous manner, so advancing the threshold control to achieve a response to these noises would lead to the elimination of a substantial proportion of the music.

Operated as the designers intended, the unit constitutes a valuable item of record playing hardware which, at the probable selling price of £80 or so, would soon pay for itself, records costing what they do today.



FEATURE : MRM 101 Review

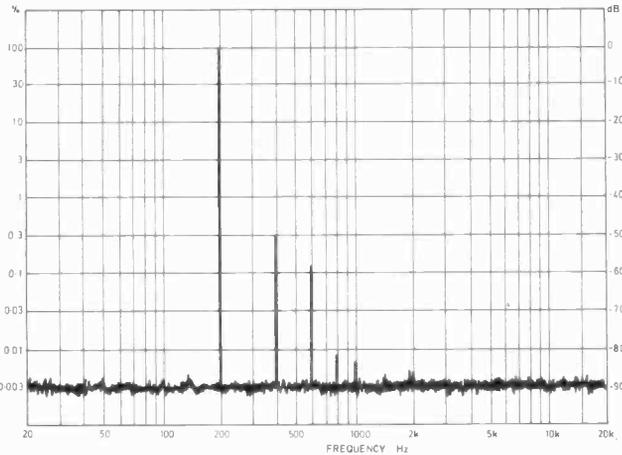


Fig. 4. Spectrogram of the 200Hz drive signal with the suppressor active.

In spite of the rise in distortion with the suppressor active, the reproduction is very satisfying provided the threshold control is not over-advanced.

In the suppressor off mode, the unit can be regarded as a top-flight RIAA-equalised preamplifier of potentially high audio output which could, if required, be connected direct to a power amplifier, thereby bypassing the circuits and tone controls of conventional preamplifiers, which are regarded by some enthusiasts as an impairment to 'musicality.'

A Cabled Reason?

Although acoustical feedback (below the howl-round threshold) is currently being blamed for one aspect of adverse auditioning of some record decks, we have recently isolated other, probably more important, causes of auditioning differences.

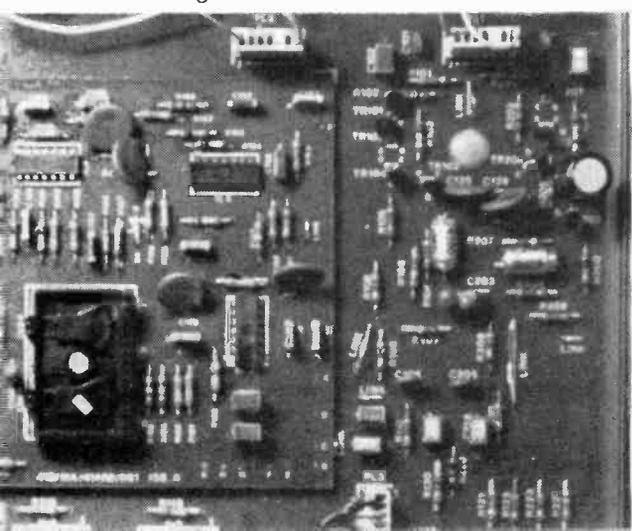
We have discovered that signal from the power amplifier section can get back to the high gain pickup input via a common impedance or by magnetic induction (from the loud-speaker cables, for example) or electrostatic coupling somewhere.

The degree of response to the delayed spurious signals of this nature can be as great as, if not greater than, the spurious and delayed signals attributable to mild acoustical feedback!

Perhaps this is one reason why the 'special' loud-speaker and source cables are receiving acclaim, because the improved shielding of these cables is reducing the amount of signal back-coupling.

Anyway, during experiments with the MRM101 we found that by using this unit for disc signal amplification the degree of back-coupling was substantially reduced with respect to certain integrated power amplifiers. Food for thought, at least

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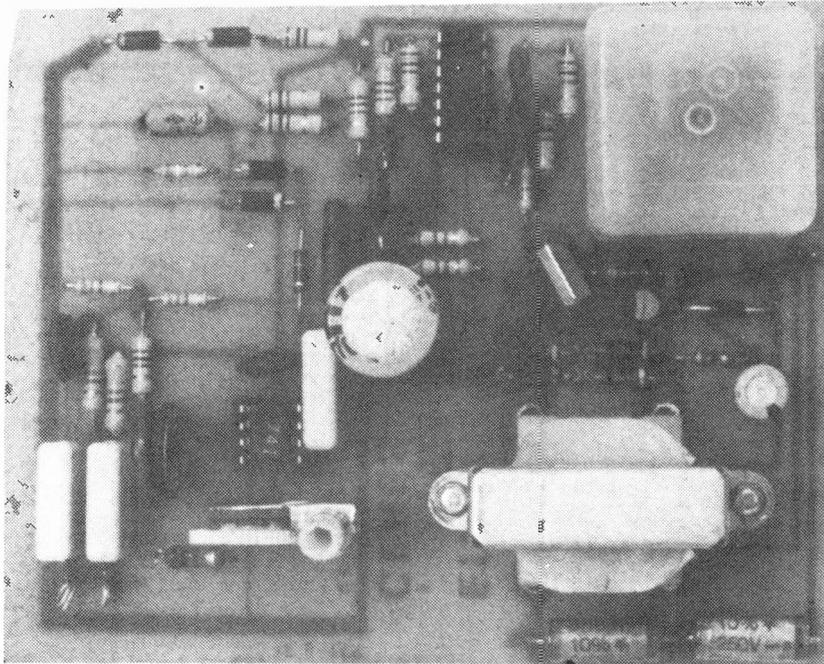
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- K042** As above but 5 of each value **£8.70**

7400 TTL	7401	2.36	74196	.90	74LS153	.50	4024	.66	4515	1.02	400mW ZENER	80133	.50	TP418	.70	2N4058	.12	ELECTROLYTICS	
7400	.12	74100	.94	74197	.90	74LS154	1.20	4025	.15	4518	.90	80135	.44	TP41C	.80	2N4062	.12	uf 16v 25v 40v 63v	
7401	.12	74104	.40	74198	1.48	74LS155	.86	4026	1.28	4519	.50	80139	.46	TP42A	.72	2N4124	.16	1 .045 .015 .055 .06	
7402	.12	74105	.40	74199	1.48	74LS156	.86	4027	.50	4520	1.05	80140	.48	TP42B	.78	2N4126	.16	2.2 .045 .05 .055 .06	
7403	.12	74107	.28	74221	1.30	74LS157	.47	4028	.87	4521	2.00	80189	.60	TP42C	.86	2N5133	.16	3.3 .045 .05 .055 .06	
7404	.12	74109	.45	74273	2.15	74LS158	.33	4029	.85	4522	1.85	8F241	.25	TP3065	.30	2N5136	.16	4.7 .045 .05 .055 .06	
7405	.13	74110	.46	74279	1.25	74LS160	1.22	4030	.48	4527	1.60	8F256	.24	TP3065	.22	2N5142	.19	6.8 .05 .055 .06 .07	
7406	.28	74111	.70	74283	1.70	74LS161	.89	4031	1.24	4528	.92	8F334	.85	ZT107	.10	10 .05 .06 .07 .08	2N5458	.28	22 .06 .07 .09 .13
7407	.28	74116	1.60	74284	1.65	74LS162	1.22	4033	1.25	4529	1.10	8F385	.23	ZT1304	.20	33 .07 .085 .10 .15			37 .08 .10 .12 .19
7408	.14	74118	.82	74293	1.35	74LS163	.89	4034	2.00	4536	3.96	8F386	.24	ZT4500	.20	47 .08 .10 .12 .19			100 .10 .13 .16 .23
7409	.14	74119	1.30	74296	1.92	74LS164	1.20	4035	1.80	4553	4.20	8F387	.22	ZT4502	.20	150 .11 .15 .20 .28			150 .11 .15 .20 .28
7410	.13	74120	.82	74390	1.92	74LS168	2.00	4036	2.40	4555	.85	8F388	.22	ZT4504	.25	1A 100V .25			1A 200V .30
7411	.18	74121	.25	74393	2.12	74LS169	2.00	4037	.99	4556	.85	8F390	.20	ZT4550	.20	1A 500V .35			1A 600V .35
7412	.21	74123	.53	74LS TTL		74LS170	1.78	4038	1.00	4558	1.25	8F391	.20	IN821	.28	6A 100V .72			6A 200V .78
7413	.25	74125	.44	74LS00	.19	74LS171	1.12	4040	.88	4559	.75	8F392	.18	IN823	.30	6A 200V .78			6A 500V .85
7414	.54	74126	.45	74LS01	.19	74LS172	1.05	4041	.77	4560	1.00	8F393	.20	IN824	.36	25A 100V 1.80			25A 200V 1.80
7415	.27	74128	.82	74LS02	.19	74LS173	1.12	4042	.72	4561	1.00	8F394	.20	IN825	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7417	.27	74132	.68	74LS03	.19	74LS174	1.05	4043	.82	4562	1.00	8F395	.20	IN826	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7420	.13	74135	.68	74LS04	.20	74LS175	1.05	4044	.82	4563	1.00	8F396	.20	IN827	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7421	.28	74136	.75	74LS05	.20	74LS176	1.12	4045	1.40	4564	1.00	8F397	.20	IN828	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7422	.17	74137	.94	74LS06	.19	74LS177	1.05	4046	1.32	4565	1.00	8F398	.20	IN829	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7423	.25	74141	.58	74LS09	.19	74LS178	1.12	4047	.96	4566	1.00	8F399	.20	IN830	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7425	.25	74142	2.00	74LS10	.19	74LS179	1.20	4048	.80	4567	1.00	8F400	.20	IN831	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7426	.25	74143	2.00	74LS11	.19	74LS180	1.20	4049	.42	4568	1.00	8F401	.20	IN832	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7427	.25	74144	2.00	74LS12	.19	74LS221	1.12	4050	.42	4569	1.00	8F402	.20	IN833	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7428	.34	74145	.64	74LS13	.46	74LS247	.97	4051	.84	4570	1.00	8F403	.20	IN834	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7430	.13	74147	1.30	74LS14	1.10	74LS248	.97	4052	.84	4571	1.00	8F404	.20	IN835	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7430	.30	74148	1.18	74LS15	.19	74LS249	.97	4053	.64	4572	1.00	8F405	.20	IN836	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7432	.24	74150	.99	74LS20	.19	74LS251	1.00	4054	1.10	4573	1.00	8F406	.20	IN837	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7433	.32	74151	.80	74LS21	.19	74LS252	1.05	4055	1.00	4574	1.00	8F407	.20	IN838	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7437	.24	74153	.80	74LS22	.19	74LS257	1.05	4060	.98	4575	1.00	8F408	.20	IN839	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7438	.24	74154	1.05	74LS26	.24	74LS258	1.05	4066	.48	4576	1.00	8F409	.20	IN840	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7440	.13	74155	.63	74LS27	.40	74LS266	.39	4067	3.50	4577	1.00	8F410	.20	IN841	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7441	.52	74156	.63	74LS30	.19	74LS273	2.50	4068	.24	4578	1.00	8F411	.20	IN842	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7442	.55	74157	.63	74LS32	.25	74LS279	.50	4069	1.17	4579	1.00	8F412	.20	IN843	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7443	.90	74159	1.70	74LS37	.27	74LS283	1.00	4070	.17	4580	1.00	8F413	.20	IN844	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7444	.80	74160	.80	74LS38	.27	74LS290	2.85	4071	.17	4581	1.00	8F414	.20	IN845	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7445	.70	74161	.80	74LS40	.19	74LS293	.90	4072	.17	4582	1.00	8F415	.20	IN846	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7446	.70	74162	.80	74LS42	.53	74LS298	1.60	4073	.17	4583	1.00	8F416	.20	IN847	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7447A	.84	74163	.80	74LS47	.87	74LS352	.92	4075	.17	4584	1.00	8F417	.20	IN848	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7448	.80	74164	.89	74LS48	.97	74LS353	1.09	4076	1.05	4585	1.00	8F418	.20	IN849	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7450	.13	74165	.89	74LS49	.97	74LS365	.50	4077	.46	4586	1.00	8F419	.20	IN850	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7451	.13	74166	.99	74LS51	.19	74LS366	.50	4078	.22	4587	1.00	8F420	.20	IN851	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7453	.13	74167	2.70	74LS54	.19	74LS367	.50	4081	.17	4588	1.00	8F421	.20	IN852	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7454	.13	74170	1.68	74LS55	.20	74LS368	.50	4082	.20	4589	1.00	8F422	.20	IN853	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7460	.13	74172	4.00	74LS73	.30	74LS386	.37	4085	.72	4590	1.00	8F423	.20	IN854	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7470	.28	74173	1.18	74LS74	.34	74LS370	2.00	4086	.76	4591	1.00	8F424	.20	IN855	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7472	.22	74174	.89	74LS75	.45			4089	1.55	4592	1.00	8F425	.20	IN856	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7473	.26	74175	.68	74LS76	.32			4090	.85	4593	1.00	8F426	.20	IN857	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7474	.26	74175	4.70	74LS78	.32			4091	1.80	4594	1.00	8F427	.20	IN858	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7487A	.56	74176	.88	74LS83	.78			4092	1.10	4595	1.00	8F428	.20	IN859	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7475	.30	74177	.88	74LS85	.90			4096	1.10	4596	1.00	8F429	.20	IN860	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7476	.26	74178	1.20	74LS86	.35			4097	3.50	4597	1.00	8F430	.20	IN861	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7480	.45	74179	1.10	74LS93	.95			4098	1.12	4598	1.00	8F431	.20	IN862	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7481	.90	74180	.80	74LS95	1.10			4099	1.90	4599	1.00	8F432	.20	IN863	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7482	.80	74181	1.92	74LS107	.36			4100	1.00	4600	1.00	8F433	.20	IN864	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7483	.72	74182	.75	74LS109	.36			4101	.30	4601	1.00	8F434	.20	IN865	.36	4700 .20 .29 .41 .56			4700 .20 .29 .41 .56
7484	.90	74182	2.30	74LS112	.38			4102	.80	4602	1.00	8F435	.20	IN866	.36	2200 .38 .46 .85 .95			2200 .38 .46 .85 .95
7485	.88	74183	.99	74LS113	.36			4103	1.50	4603	1.00	8F436	.20	IN867	.36				



It was touch and go with ETI's project team this month during the design of this project

PROXIMITY SWITCH

ALTHOUGH THIS PROJECT may look a bit complicated for a 'mere' switch, it has some unique features, both in design and function, as will be clear from the following:

1. It is a true proximity switch. You do not have to actually touch anything to operate it.
2. There are no light beams, sound waves etc. While radio frequencies are used, switching action results solely from the capacitance of 'approaching bodies.'
3. The sensor may be some distance away from the device, and also may extend several feet in length.
4. The sensor — and, if you want to mystify your friends, the switch itself — can be completely concealed from view.
5. The switch latches ON or OFF each time it is operated. No special re-set provision is needed.
6. Since a relay is used for the actual switching, the 240V circuit and the 'electronics' are isolated from each other.

Making Magic

In our application, the 'Magic Switch' was installed so that when one walked through a doorway a light in the further room automatically went on. Also, the sensor extended close to the floor, so

that even the family dog was able to 'light the way'.

(Admittedly, this at first struck terror and bewilderment into the mind of the canine, but, as usual, he soon came to accept the miracle as just one more example of human omnipotence!) Other applications could well include burglar alarms etc., all of which is to say nothing of its main function, which is to impress your friends.

Construction

Use of the PCB of Fig. 4 is recommended, though three prototypes were built using different layouts, and all worked well. Note that this PCB has space for the power transformer and relay, but is left blank as far as the foil pattern for those units is concerned. This enables you to use whatever components you happen to have, or which may be available to you. You can either fill in your own foil pattern, or hard-wire the units into the circuit. Beyond this, no special comments are necessary, except to mention that it is preferable to use IC sockets. Since 240V AC will be present on-board, the unit should be housed in a suitable cabinet such as a 7- $\frac{3}{4}$ " x 4- $\frac{3}{8}$ " plastic utility box. An AC outlet receptacle could be mounted to the box, plus a main switch if desired.

Adjustment

The success of the project depends on the oscillator being just, but only just, within its tolerance limits, and the operating point is set by RV1 (coarse) and RV2. This adjustment is critical, but as a rule RV1 can be preset on the bench and RV2 adjusted at the time of installation. The exact operating point, and hence sensitivity, depends on the length of sensor used.

In a very few cases, RV1 needs to be more than 2k Ω . The easiest thing is to pad the control with a 0 to 0 series resistor. This can easily be mounted on board and the existing track connecting RV1 to RV2 broken, the additional resistor being 'tapped in' in its place.

When you have completed wiring the switch, and have carefully checked your work, plug it in and clip a length of wire 200-300mm to the sensor input at point A. Set RV2 to mid-rotation, and adjust RV1 until you hear the relay clicking. This is an approximate adjustment, but at some nearby setting you will find that the relay clicks every time you approach the sensor wire with your hand. If you clip the sensor wire to point B you will find the circuit somewhat less sensitive; since sensitivity increases with sensor length, this is

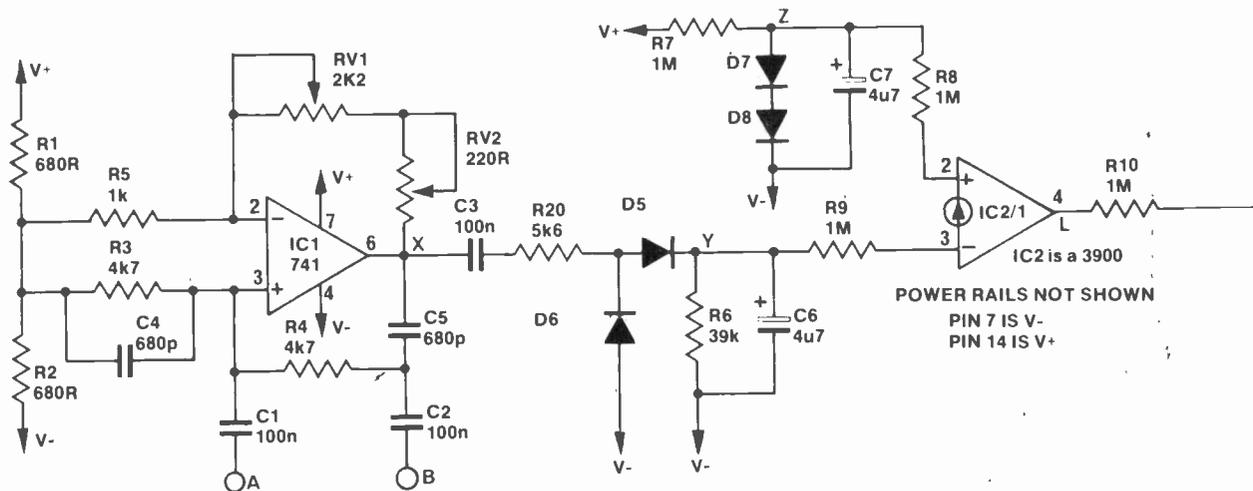


Fig. 1. Main circuit diagram of the proximity switch.

useful where long sensors are to be used.

You can trace the sequence of events using an ordinary voltmeter. Point Y, the rectified oscillator signal, should read about 3 V, and drop to 0 V every time the sensor is approached. The reference voltage can also be measured at point Z. If you have a 'scope, you can display the waveform at point X, and see it 'collapse' when the switch is operated. Further tracing can be done at point L (comparator output), M (shaper) and N (flipflop), which makes it easy to pinpoint problems should they arise.

Installation

This will depend on the purpose for which your 'Magic Switch' is intended, but the following hints and observations will apply.

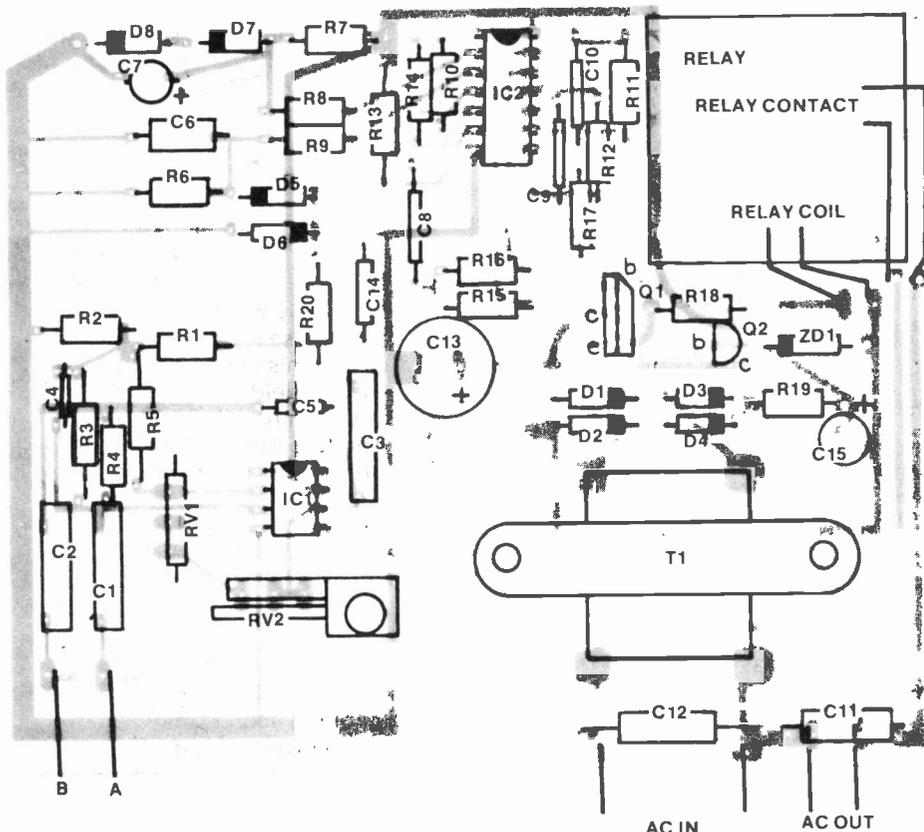
1. Aluminium foil strip (30mm wide) makes a good sensor. It can be 3m or even longer, and is easy to conceal behind vinyl decorator tape, wallpaper, tile etc. If the switch is to be some distance away from the sensor, a length of wire can be used to connect it, but this will add to the effective length.

2. The longer the sensor is the more sensitive the switch will be, and you will find the provision of two inputs helpful. While it is true that you do not have to actually touch the switch to operate it, long sensors and

HOW IT WORKS

IC1 is a standard LM741 Op Amp configured as an oscillator operating at a supersonic frequency. The circuit is adjusted so that it is 'on the edge', and the capacitance effect of a body approaching its sensor causes it to "drop out." The rectified signal is fed to section 1 of IC2 (an LM3900 quad 'current differencing' amplifier) where it is compared with a reference voltage obtained from the R7-D7-D8 network. When the oscillator drops out, the signal voltage falls below the reference level, causing the comparator to produce a pulse at its output. This is 'squared up' by section 2 of IC2 to positively trigger a flipflop, composed of sections 3 and 4, and the output of this is used to operate a relay via driver Q2.

Because the relay draws enough current to cause a change in supply volts every time it is ON, and this would de-stabilise the oscillator, a simple voltage regulator of the series pass transistor type is used. This works like an emitter follower, in which the circuit as a whole is the load. The emitter of Q2 tracks the base, which is clamped by a zener diode to 15 V. In addition we reap the advantage of 'capacity multiplication,' since C11 smooths any ripple etc. present in the base supply. Though C11 is small, the filtering effect is impressed on the output, and in practice the value of the capacitor is multiplied by the gain on the transistor.



PROJECT : Proximity Switch

main fuse). If your room lights dim every time the 'fridge goes into action, you will appreciate the magnitude of this type of surge. Experience has shown that the 'Magic Switch' can cope with most things — SCR dimmers, tape recorders, vacuum cleaners, to name but three which we have operated off the same 240V line — but in a few cases special precautions are necessary. Mains surge suppressors may be fitted, but generally it is simplest just to run the 'Magic Switch' off a different AC circuit.

ETI

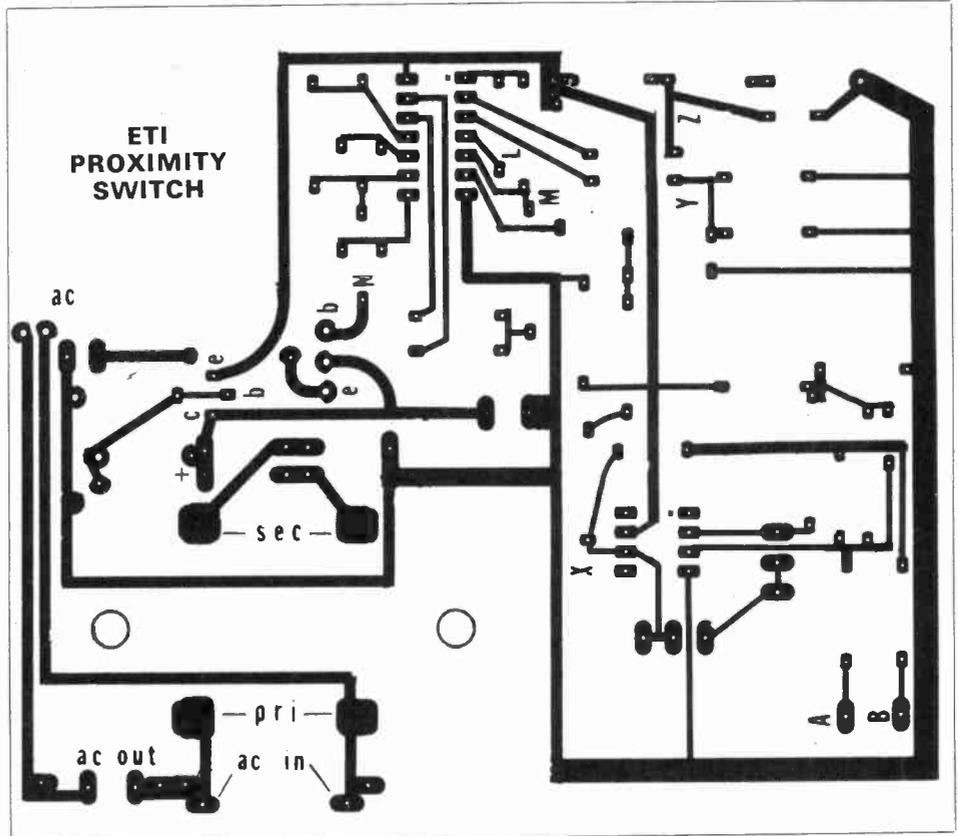


Fig. 4. Full size foil pattern for the switch's PCB.

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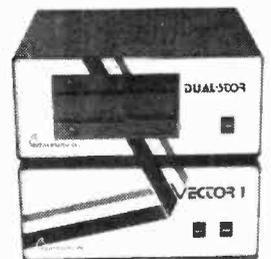
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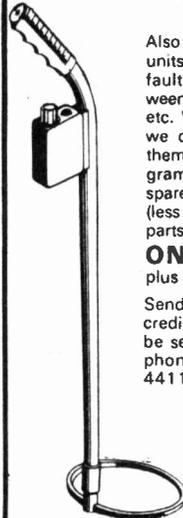
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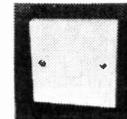
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EASY BUILD SPEAKER DIY KITS

Specially designed by RT-VC for cost-conscious hi-fi enthusiasts, these kits incorporate two teak simulate enclosures, two EMI 13" x 8" (approx.) woofers, two tweeters and a pair of matching crossovers.

Supplied complete with an easy-to-follow circuit diagram, and crossover components. Input: 15 watts rms, 30 watts peak, each unit. + p & p £5.50 Cabinet size 20" x 11" x 9 1/2" (approx.)

SPEAKERS AVAILABLE WITHOUT CABINETS.

It's the units which we supply with the enclosures illustrated. Size 13" x 8" (approx.) woofer (EMI), 2 1/2" app. £17.00 per tweeter, and matching crossover components. stereo pair Power handling 15 watts rms, 30 watts peak + p & p £3.40

BUILT AND READY TO PLAY

SPEAKERS Two models - Duo IIb, teak veneer, 12 watts rms, 24 watts peak, 18 1/2" x 13 1/2" x 7 1/2" (approx.). Duo III, 20 watts rms, 40 watts peak, 27" x 13" x 11 1/2" app. Duo IIb £17 PER PAIR p & p £6.50 Duo III £52 PER PAIR p & p £7.50

EASY TO BUILD



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for the D-I-Y man who requires a stereo unit at a budget price, comprising ready assembled stereo amp module, Garrard auto/manual deck with cueing device, pre-cut and finished cabinet work. Output 4 watts per channel, phones socket and record/replay socket including 2 SPHERICAL HI-FI speakers

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AM/FM STEREO TUNER AMPLIFIER CHASSIS COMPLETE

Ready built. Designed in a slim form for compact, modern installation. Rotary Controls Vol On/Off, Bass, Treble, Balance. Push Buttons for Gram, Tape VHF, MW, LW and 5 button rotary selection switch.

Power Supply Selenium Bridge—350V DC from 210-250V AC, 50Hz input. Aerial Ferrite 8" x 1/2" built into chassis for LW and MW plus flying lead for FM aerial.

Power Supply Selenium Bridge—35V DC from 210-250V AC 50Hz 7 watts speech and music.

Tape Sensitivity Playback 400mV/30K OHM for max output. Record 200mV/50K output available from 25KHz (150mV/100K) deviation FM signal. Frequency Range (Audio) 50Hz to 17 KHz within ± 1dB.

Radio FM sensitivity for 3dB below limiting better than 10 uV. AM sensitivity for 20 dB S/N MW 350 uV/Metre LW 1mV/Metre. Size approx. length 16" x height 2 1/4" x depth 4 1/4". P & P £2.50

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IMF TLS 80 Monitor loudspeaker cabinet size approx. 43 1/4" x 15 1/2" x 15 1/2" £24.95

DECCA 20w Stereo speaker kit comprising 2 8" approx. bass units + 2 3 1/2" approx. tweeter inc. crossovers £20.00

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Mullard

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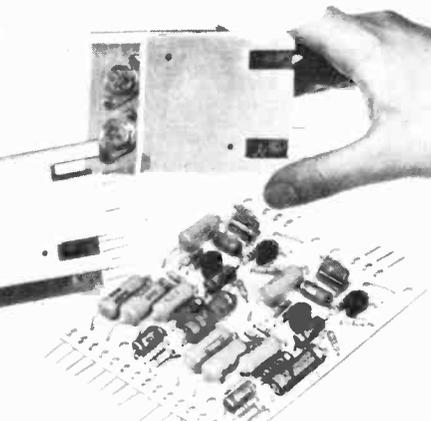
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Suitable power supply parts including mains transformer, rectifier, smoothing and output capacitors. Recommended set of rotary stereo controls comprising BASS, TREBLE, VOLUME and BALANCE. £1.00 p+p **£1.95** p+p 50p **95p**

THIS MONTH'S OFFER

added to our bargain packs. When you buy Pack 3 at £9.95, together with a mains transformer at £1.95 and a set of controls for 95p you receive FREE a Mullard LP1400 Decoder to match. Listed at **£11.95** p & p £2.50 **£12.85**

TRADE ENQUIRIES INVITED



20 x 20 WATT STEREO AMPLIFIER £29.90
Superb Viscount IV unit in teak-finished cabinet. Silver fascia with aluminium rotary controls and pushbuttons, red mains indicator and stereo jack socket. Function switch for mic, magnetic and crystal pick-ups, tape, tuner, and auxiliary. Rear panel features two mains outlets, DIN speaker and input sockets, plus fuse. 20 x 20 watts rms. 40 + 40 watts peak. p & p £2.50

* SPECIAL OFFER: PACKAGE PRICE WITH 30x30 KIT.

Mk II version operates into 4 to 15 ohms speakers. Specially designed by RT VC for the experienced constructor, complete in every detail. Same facilities as Viscount IV amplifier 60 + 60 peak, supplied with 2 GOODMANS COMPACT 12" Bass woofers with cropped sides, 14,000 Gauss magnet, 30 watts rms handling + 3 1/4" approx. tweeters and crossovers. £49.00 + £4.00 p & p

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Designed for the experienced D.I.Y. man. This kit comprises of a tape transport mechanism, ready built and tested record/replay electronics with twin V.U. meters and level control for mating with mechanism. Specifications: Sensitivity - Mic. 0.85 mV ± 20K OHMS. Din 40mV ± 400K OHMS. Output 300mV RMS per channel ± 1KHz from 2K OHMS source. Cross Talk - 30db. Tape Counter - 3 Digit. Resettable. Frequency Response 40Hz - 8KHz ± 5db. Deck Motor - 9 Volt DC with electronic speed regulations. Key Functions - Record, Rewind, Fast Forward, Play, Stop & Eject. £19.95 p & p £2.50. Opt. extras: Mains transformer to suite £2.50 + £1 p & p



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£29.95 p & p £2.50
Size approx. 13 1/4" x 5 1/2" x 6 1/4"
50 watts rms
100 watts peak output
Big features include two disc inputs, both for ceramic cartridges, tape input and microphone input. Level mixing controls fitted with integral push-pull switches. Independent bass and treble controls and master volume. SPECIAL OFFER: The above 50 watt amp plus 4 Goodmans Type BP 8" speakers. Package price £45.00 + £4.00 p & p.

70 & 100 WATT MONO DISCO AM

Size approx. 14" x 4" x 10 1/2"
Brushed aluminium fascia and rotary controls.
Five vertical slide controls - master volume, tape level, mic level, deck level. PLUS INTER DECK FADER for perfect graduated change from record deck No. 1 to No. 2, or vice versa. Pre fade level control (PFL) lets YOU hear next disc before fading. 140 watt peak. p & p £4.00
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Record changer with cue, stereo ceramic cartridge. p & p £2.00
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BSR MP 60 type, complete with magnetic cartridge, diamond stylus, and de luxe plinth and cover. p & p £4.50
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PORTABLE DISCO CONSOLE

Here's the big-value portable disco console from RT-VC! It features a pair of BSR MP 60 type auto-return, single play professional series record decks. Plus all the controls and features you need to give fabulous disco performances. Simple connects into your existing slave or external amplifier. p & p £6.50 **£64.00**

microfile.....

Go north young man they said and Gary Evans did this month to see Liverpool's new Personal Computing store.

TAKING LIFE, LIMB and day return ticket in hand, I headed North this month. The carrot that induced this seemingly irrational behaviour was the fact that a new computer store was to open in Liverpool, which for those of you whose sense of direction is as bad as mine, is north of London.

Microdigital is Liverpool's first Computing Store and, as far as I know only the second shop in the country to sell a broad range of low cost computing equipment (the other being the Byte Shop). The range of items Microdigital will sell you is indeed large, everything from that dreadful MPU door-chime, through video games and chess machines to PETs and APPLES taking in the MK14 and NASCOMI on the way. The reason for this wide range, which includes items that many of us would not associate with personal computing, back to the door-chime, is quite straightforward. The aim is to hook people with these items that can be considered impulse purchases in the hope that when installed in the family home they will promote the idea that the computer does have a place in the home.

The site of the shop, like the items stocked, has also been chosen with care. The site is not what would be considered prime by the likes of Dixons, being situated in the business area of the city. The idea behind siting Microdigital here was again to do with hooking potential customers, but here the potential victims are the City Gents of Liverpool. A shop in the "jean jungle" that now

Gary Evans, to photography what Cyril Smith is to the world of ballet, took this photo of Liverpool's new computing store on its opening day.



forms the heart of Liverpool would not have exposed the shops name to this market. The site in Brunswick Street will mean that many of the aforesaid business men will not be able to avoid the name of Microdigital and it is the hope of the company that some of them may even walk through the door. Don't get the idea that the shop is too far from the centre of the city, it's just a few moments walk away so those interested in the novelty value of the shop will still make the trip as well as the already converted Computer Hobbyist.

The staff at Microdigital will offer advice and as one of them comes from a background as an accountant, it should mean that the advice given will be formed with an appreciation of the businessman's needs. The shop will also sell a wide variety of literature and software to enable the best use to be made of the different hardware packages available.

The firm's range of systems is detailed in their catalogue and an SAE to them should secure a copy of same. Better still, why not call in and pick one up in person, you'll probably find chatting to the staff very helpful.

**Microdigital
25 Brunswick Street
Liverpool 2**

Disk-O-Spec

Floppy disk drives will probably be one of the items that will fall in price considerably over the next year, they have to. The cost of producing a drive will fall as the volumes demanded by the world markets increase, after all if you want a handmade cassette deck expect to pay the earth for it, buy 100,000 and the price comes down to a reasonable figure. As we see the price come down we'll also see more people offering hardware/software packages to enable you to hook the drive up to your particular breed of machine. At the present floppies for even the most popular of machines are hard to find, but I've heard of a couple of people who might be able to help.

James Clarke and Co Ltd are interested in developing a 512K or 1.2M drive which they see as having some additional memory and, of course, an operating system. They are interested in hearing from anyone who might be interested in such a product.

The other company, Ocean Electronics, have a single card controller for the Shugart SA400, suitable for interfacing this drive to the PET (the company can also offer controllers for 6800 and 8080 based systems).

The card is expected to sell for £120, and with the SA400 at around £225, this seems like an attractive package.

The companies can be reached at the addresses shown below.

James Clarke and Co and
7 All Saints Passage
Cambridge
CB2 3LS

Ocean Electronics
3 Pavillion Parade
Brighton
BN2 1RA

See The Show, Join The Club

A couple of quick items now. First the Personal Computer World Show will be held at the West Centre Hotel between September 21 and 23. The last day will be devoted to home systems but the whole three days should be worthwhile. Next the North London polytechnic Department of Electronic and Communications Engineering are to form a computer club. The inaugural meeting will be on Wednesday the 5th of October, I hope to be there in room 47 of the old building (their reference not mine) in the Holloway road just opposite Holloway Road tube for the event. With three PETs and four SWTPC systems available for playing with the club will hopefully prove a fruitful activity for all concerned.

An update on the MK14 review of last month. I have received the new monitor PROM for this machine and as well as making the entry of data far easier, the RPOM contains an offset calculation routine as well as the software to drive the cassette interface for the MK14. A single step mode of operation is also possible with a small amount of additional hardware.

An update to the TRS-80 review as well. Phil Cornes, one of the panel who reviewed the machine has discovered a few memory saving tricks that can be used with the computer.

1. Whenever the last character of a PRINT statement are the final inverted commas of a printed message, those inverted commas may be omitted so that, for example —

10 PR.; "GALLONS USED"
could be abbreviated to —
10 PR.; "GALLONS USED"
2. The abbreviation IN for the INPUT statement can be abbreviated still further to I so that —
45 I.X,Y,Z
becomes an acceptable INPUT statement.
3. This abbreviation is the most interesting of the three, and deals with the setting and resetting of flags within programs.
For example, suppose the following appears in one of your programs.

```
20 F=0
200 IF A=B THEN F=1
```

This could staggeringly be reduced to the following single statement:

```
200 F=A=B
```

In this example the second = is being used as a comparison operator and not as an arithmetic operator. Put into English, this statement would therefore read —

Let the value of F depend on the result of comparing the equality of A and B.

If A does equal B so that the result is a logical "TRUE" then set F to 1 or if A does not equal B (logical "FALSE") set F to 0.

The same type of statement can be made to work with any of the comparison operators, >, <, >=, <=, >=, <=; so that —

```
200 F=C>B
```

would set F to 1 if C were greater than B otherwise it would set F to 0.

ETI

INTRODUCING TWO WORLD FAMOUS MICROPROCESSOR BASED GAMES UNITS

ETI PROJECT

'TOLINKA' CHESS REPORTER —FULL KIT OF PARTS

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

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

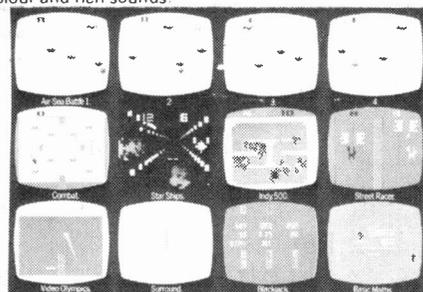


192 GAMES

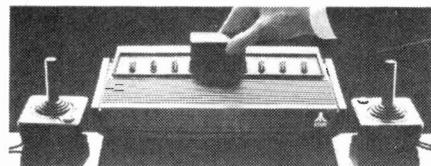
'ATARI' VIDEO COMPUTER —READY BUILT CARTRIDGE SYSTEM

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

Just look at a few of the many games available in full glorious multi-colour and rich sounds.



The Video Computer (based on Signetics 2550) comes complete with the 27 Game Combat Cartridge, multifunction joysticks mains adaptor and aerial switching unit. Fully guaranteed for 12 months **£169.95★**
Total of 9 Cartridges available — 192 games plus many more on the way, priced from **£14.95★**



Full colour brochure available on request.

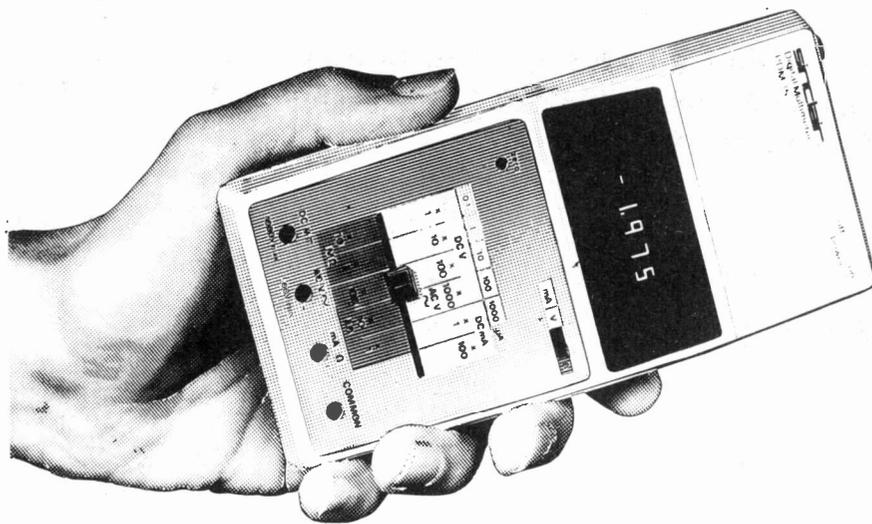
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The Sinclair PDM35.

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 μ A).
- Direct reading of semiconductor forward voltages at 5 different currents.
- Resistance measured up to 20 M Ω .
- 1% of reading accuracy.

Operation from replaceable battery or AC adaptor.
Industry standard 10 M Ω 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.

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ET 110

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This month Ron Harris lends an ear (and an eye) to a new turntable aid that you can see through immediately; what could be the ultimate in DIY pre-amps and takes note of news about an amplifier in a class of its own.

FIRST — the brickbats. My prize for most inappropriate act of the month goes to Discount Audio in Tottenham Court Road for having the atheistic gall to use an SME Series III as a display stand for a £5 transistor radio. May your fuses continually blow.

It was also amusing to note a Pioneer SA9500 offered for sale nearby, in the window of a large establishment of some repute. Nothing wrong with that you might say — except that it is upside down. No doubt a new-fangled output stage is in use here — the electrons are propelled across the junction by gravity — only someone somewhere put the chips in the wrong way round.

Enough To Make You Blush!

For some time now Crimson Elektrik have enjoyed a good reputation based upon the excellence of their power amp modules. And quite right too. The amps are well designed and if assembled carefully offer very good sound reproduction.

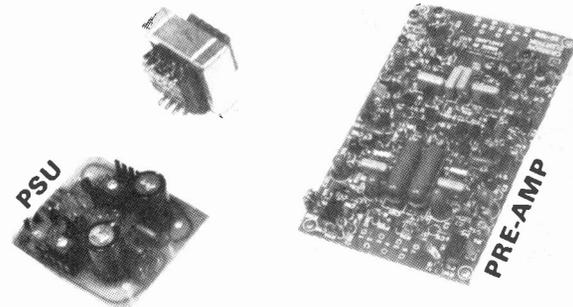
The appearance of a pre-amp from the same stable thus aroused the editorial interest and a sample procured. The photo shows the board sat sitting alongside its PSU, and as is evident the PCB is built to a very high standard. The specs are faultless and well detailed, and also too long to give here. Versions are available for both moving coil and moving magnet cartridge types.

To say they come with instructions is probably misleading. Application notes in the best sense of the word are provided, and good detail on usage (and abuse) are given to enable the customer to adapt the modules to his own requirements.

All that's left to tell you is how they sounded — and that I'm afraid I cannot do properly until next month, simply because, as always, the modules arrived very late in the month and there was simply no time to conduct the tests demanded by a product of this pedigree. Initial impressions, however, are very very favourable. Sorry folks but I'm saying no more till next time. Same time, same page — November!

Raise Your Glasses

One of the latest 'tuning' aids to appear on the hi-fi market are various types of turntable mat, which claim to improve the sound quality by offering more nearly ideal conditions for information retrieval from the LP. One of these that has risen to my eye from a small British firm, GA Audio, is composed of glass.



The collection of items which make up one Crimson Elektrik pre-amp. The large board on the right is the actual stereo pre-amp, the smaller one is the PSU stabiliser. To construct a separately powered pre-amp you need all three, but normally the pre-amp would be added to a Crimson power amp to produce an integrated unit.

With the success of the Planar 3 vaguely in mind, experiments with this refugee from a window frame were to prove interesting. It didn't take much to interest some other folks with inclination in this direction, and so a variety of turntables were available at various times to carry the mat.

Glass does have quite a few advantages for this sort of work if you think about it. It is extremely rigid, of good even mass distribution and of course easily kept clean. The felt mats which appear around so many spindles these days gather dust easier than booze attracts ETI staff and are infernally difficult to clean (as are ETI staff!)

By changing turntable mats around the overall sound from a system can be markedly altered — more so in my experience than with these 'super-cables' much vaunted of late as a cheap upgrade.

Turning Tables

The first machine we tried the 'Sound disc' glass mat on was a Technics SL 120 — a unit not much in favour with the musical mites of this world. However if the machine is properly sited on a wall mounted shelf, then its only real disadvantage is overcome that of being more sensitive to outside vibration than is perhaps needed. Used like this the SL 120 turns in a good all round performance and one that is not improved by use of a felt mat instead of the thick rubber platter provided. ▶

However, the Soundisc *did* offer an improvement. The image was clearly improved and better defined. Best without the thin felt circle supplied by GA Audio, who would save themselves some money — and improve the product — by losing that completely and improving the instruction sheet instead. Spelling bass with an 'e' is just not *musical* lads, you can do better than that.

On a variety of other turntables, including the dreaded Linn, we found the Soundisc to offer variable results. On the Linn it seemed to make things worse, while it improved a Transcriptor Reference out of all recognition, to the extent that with the Soundisc mounted atop its little black blobs, the Reference came out sounding better than any other deck we tried (including you-know-what!)

A Painful Gain

Overall then the Soundisc is a good investment, unless you own a Linn or a Rega 3 where no gains can be expected. By supporting the LP properly the glass does appear to bring more information forth from the grooves, and to bring it forth more precisely. At its price of £10.30 I feel it's worth a try if you're unhappy with your present record playing system for reasons of clarity — but make sure it isn't the cartridge at fault first eh? Address: GA Audio, 82 Bromsgrove Road, Redditch, Worcs. B97 4RN.

H-bomb

From the States comes news of the first class H amplifier (Did I hear groans of "Oh no" from that weary music lover in the back row?) Like class G of Hitachi parentry H operates on the PSU.

This time, however, what is described as 'variable proportional analogue logic circuitry' (??) is employed to sense the line voltage needed by looking at the output power required at that time. A second power supply is also present, and is used to help beef up transients. If I were Hitachi I'd be looking pretty closely at this little lot. Soundcraftsmen are guilty of class H, and the model number is MA 5002.

Is it now eyes down for I?

The Write Way To Do It

To all you nice people out there who have written in with questions for the Audiophile service — thank you and I hope I've answered you! Replies have been taking up to four weeks because there were so many of you. I've cleared the backlog now and replies should normally be return of post unless I get kidnapped, shot by bandits attacked by Felicity Kendal etc. (If the latter occurs allow 10 yrs for reply).

The service is still operating (just) so for newcomers: it is intended to be an enquiry service for matters relating to hi-fi. Please include full details of the system you're running and be as specific as possible. Address your envelopes to 'Audiophile,' ETI, 25-27 Oxford Street, London W1R 1RF.

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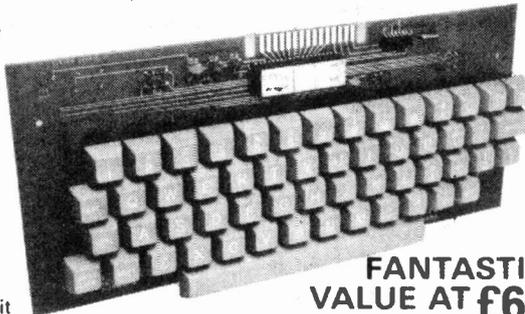
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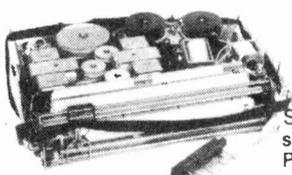
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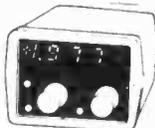
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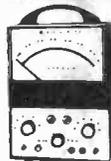
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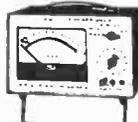
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electronics tomorrow.....

by John Miller-Kirkpatrick

SOME months ago I mentioned a form of multi-voltage logic which was being developed by an American company. Recently I was discussing microprocessors with somebody, and they "invented" multi-voltage logic on the spot, after I told them that it had been done before they went on to discuss the ideas they had and with a few ideas of my own we came up with a logic system for the 1990s.

One problem with multi-voltage logic is that it is alien to the TRUE or FALSE logic used with binary or boolean logic. It seems that a logic system expressed in ten different voltage levels would be represented by 10 levels of possibility ranging from FALSE at zero volts to TRUE at 10 voltage units passing through REASONABLY TRUE at say 7 voltage units and SNOWFLAKE-IN-HELL at perhaps 1 voltage unit. Problems arise when you try to carry out logical operations such as ANDing 7 units with 1 unit — is the result $(7+1)/2$, $7/1$, $1/7$ or what "?" arithmetic is simple, it is even in decimal, for example 7 ADD 1 is undoubtedly 8 and 1 minus (Complement and ADD) 7 is 3 isn't it?

If you want to play with multi-value logic try using some CMOS devices run off about a 10v supply, CMOS switches from 0v to the supply voltage (near enough) and thus a CMOS output on this supply will switch from 0v to 10v. If the outputs in question are outputs from a 74C42 1 of 10 decoder then the outputs can be connected to a series of 9 resistors (all say 1K) arranged as a potential divider so that a common point will have a voltage of between 0v and 9v in 1v increments when the 74C42 inputs are driven from a BCD input. You now have a boolean to decan (?) logic converter, there are several methods of going the other way. One of the simplest methods is probably to use a set of transistors which will switch on at 10 different voltages (0-9) and then encode this with binary logic gates to give a 1 of ten and this BCD result.

Of course, you could simply use a variable power supply or two coupled to voltmeters, but somehow this seems to be cheating. Anyway, when you have your generator and readout device you can start to work out some of the rules involved in ten level logic — your ideas are probably just as valid as anyone else's. Perhaps you would like to send in any circuits or ideas to us at ETI so that we can publish them and start a whole new revolution in electronics.

Battery Logic

The logic generators described above could be run from a 9V battery and as they are simply CMOS, resistors and meters the current consumption would be very low. If you simply use some 9V batteries, switched potentiometers and meters as in the second example above you would not require any binary logic gates at all. Consider what is happening in this case (taking into account that I just passed "O" level physics and failed chemistry). The voltage in the battery is generated because of one of several types of chemical reaction, some alterations to this voltage may then be caused by logical or arithmetic operations and the result is used to activate a mechanical lever on an analogue voltmeter.

Would it be possible to use chemical reactions as logic elements and thus cut out some or all of the electrical interface. My knowledge of chemistry becomes obvious when I try to recollect the number of ways a chemical can be classified, one way is acid and alkali which I seem to remember are opposites. Surely a mixture of a percentage acidity could be mixed with another of a different acidity under certain conditions to create some form of logical combination which would be accurately repeatable? In which case the resultant could be used in another reaction to give a voltage output and/or a mechanical reaction?

If you consider the reactions of two complex chemicals such as hydrocarbons, nucleic acids, DNA and other things that I know little about, then the complexity of the logic operations which could be handled seems very varied. Having mentioned DNA perhaps I should point out that I see such chemical reactions taking place and being measured on a very small scale, nearly molecular rather than with 100ml beakers.

The microprocessor of the future may require feeding with sugar rather than any form of electricity, temperature and humidity may become more important factors than they are at present and it could get very upset if you spill hot tea on it. The output devices would of course be such things as a chemical print head working on pre-sensitised paper or tape (or screen), the input devices would measure chemical reactions on treated plates which would react to external chemicals such as the human skin. Increasing the memory capacity could be as simple as buying 1lb (500g) of fillet steak or even digging up a few carrots from the garden.

Although this may seem like mid-summer madness it could be a feasible alternative at some future date, after all, if you can operate on things like sugar, fillet steak and carrots (not necessarily together) then why not a microprocessor. Now there is a project for the NEB to invest £50million in!

Data Catalogues

When I first became interested in electronics as a hobby one of my main reference books was Henry's catalogue which was full of useful and seemingly useless items. The main attraction of the catalogue was the fact that there were many small but understandable circuit diagrams showing various applications of some of the more complex components. I based my very first digital clock circuit on the circuit by Dave Hunt in one of their catalogues and learnt a lot about digital electronics from what was effectively a sales catalogue.

Recently several manufacturers have donated their latest data books/catalogues to the JMK library (writing Electronics Tomorrow has hidden advantages). These data books are available (at a price) to anyone who cares to contact the manufacturers or their agents and together form a very comprehensive library of LSI components in and around micros, TV games, calculators and telecommunications. I can recommend all of the following books which are the ones I use now and are the latest in a series which I have used for several years now. I realise that several manufacturers other than those mentioned have similar books but these seem to cover a wide range and anyway I get these for free!

GIM produce a very comprehensive range of MPU, memory, clock, calculator, TV series, communications and industrial chips. The 1978 catalogue contains data on all of the TV games and interface circuits from the simple bat and ball to the complete home entertainment system. To take an example try looking up the data on the AY-3-1013 UART, the data, descriptions and applications for this IC goes on for about 15 pages and just when you think you have finished and just about exhausted UARTs you turn the page to find that GI also make a 1014, 1015, 1016, etc, with multitudinous options and alternatives on the basic design. The GI 1978 Data Catalogue costs £3.00 from General Instrument Microelectronics Ltd, 1-4 Warwick Street, London W1R 5WB. Tel. 01-439 1891.

Arming Intel

After a lost of arm twisting Intel were finally persuaded to part with their 1977 Data Catalogue which has a price of 2.50 dollars printed on it. This includes data on RAMs (including 2114), PROMs (including 2716), CCD memory, four MPU chips and associated components, Microcomputer systems and development systems. This book is a must for MPU addicts as Intel uses the "Microbus" approach on MPU add-on ICs which makes them usable on most MPU chips not just those made by Intel. After speaking to a young lady at Intel I am now informed that the 1978 catalogue is now available at £4.00 and that they can handle a few hundred orders easily but if everybody wants one . . . Intel are at: Intel Corporation UK Ltd, Broadfield House, 4 Between Towns Road, Cowley, Oxford OX4 3NB. Tel (0865) 771431.

Naturally National

National Semiconductors would probably claim that their 1977 data books are so far ahead that their contents will remain current during 1978. Natsemi have a range of data books to cover their vast range of products including specialist books for linear, transducers and data acquisition. My library includes the 1976 Linear and 1976 TTL books and the 1977 issues of MOS/LSI (clocks, counters, watches, calcs, CB, COPS, displays, etc); Memory (you name it) and CMOS. The Natsemi CMOS book includes a 4000 series, the 74C TTL compatible series, some applications of these and also data and applications on many unique devices in the CMOS/LSI category. These latter include telephone diallers, TV clock/channel units, DVMs, A/D converters, display and keyboard controllers and 7 seg to BCD converters amongst many other clever and low-cost circuits which have the additional advantages of CMOS.

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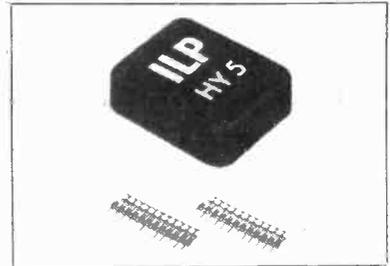
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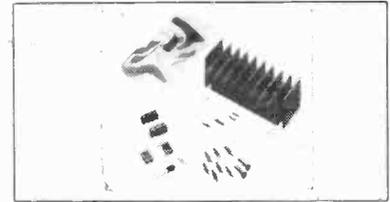
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APPLICATIONS: Medium Power Hi-Fi systems — Low power disco — Guitar amplifier

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INPUT SENSITIVITY 500mV, OUTPUT POWER 25W RMS in 8 Ω LOAD IMPEDANCE 4-16 Ω , DISTORTION 0.04% at 25W at 1kHz

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APPLICATIONS: Hi-Fi — High quality disco — Public address — Monitor amplifier — Guitar and organ

SPECIFICATIONS:

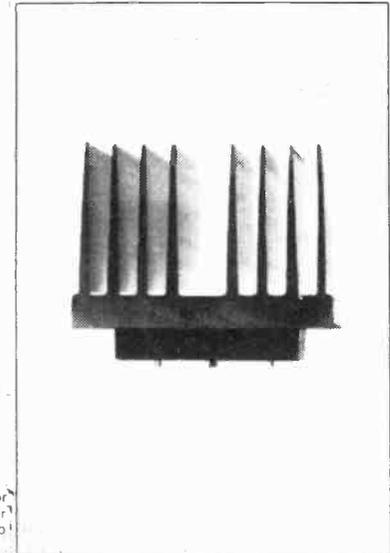
INPUT SENSITIVITY 500mV

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SPECIFICATIONS:

INPUT SENSITIVITY 500mV

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

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HY400 240 Watts into 4 Ω

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FEATURES: Thermal shutdown — Very low distortion — Load line protection — No external components

APPLICATIONS: Public address — Disco — Power slave — Industrial

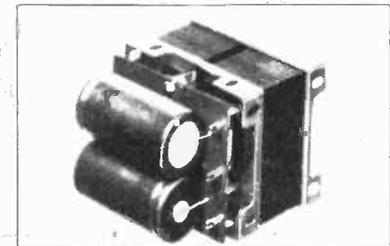
SPECIFICATIONS:

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

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

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

Price **£38.61 + £3.09 VAT. P&P free.**



POWER SUPPLIES

- PSU36 suitable for two HY30's **£6.44 + 81p VAT**
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tech tips

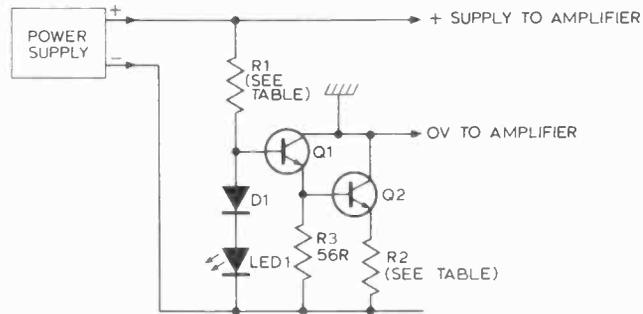
Protection For Power Amplifiers

A. Hiley

In many amplifiers, the only protection against overload is a single fuse. Experience has shown that output transistors can blow faster than fuses. The simple circuit shown below will protect the amplifier in the event of a fault or gross overload.

Normally, the current through R1 biases both the transistors fully on. The P.D. across the LED is less than 2V, and it will not light up. In the event of a fault or overload, the current consumption of the amplifier will increase. The forward bias on the transistors will decrease, and they will tend to turn off. This will cause the potential across R to decrease, which will increase the bias on the transistors, turning them on again. The overall effect is that current limiting takes place. Under these conditions, the LED will light up, indicating a fault condition. If the fault or overload persists, the main fuse in the amplifier will probably blow. The actual protection circuitry needs no resetting.

Under fault conditions, the dissipation in Q2 will be very high, and so it must be bolted onto the chassis or the heatsink.



SUPPLY VOLTAGE	R1
10V to 22V	1k, 1/2 W
22V to 40V	1.8k, 1 W
40V to 70V	2.7k, 2 W

AMPLIFIER POWER (RMS Watts)	R2
15W, 8R or 4W + 4W, 8R or 4W, 4R	0.5R
60W, 8R or 15W + 15W, 8R or 15W, 4R	0.2R
30W + 30W, 8R or 30W, 4R	0.15R

NOTE

Q1 is BD131 (up to 45V supply) or BD139 (up to 90V supply)

Q2 is 2N3055

D1 is 1N914

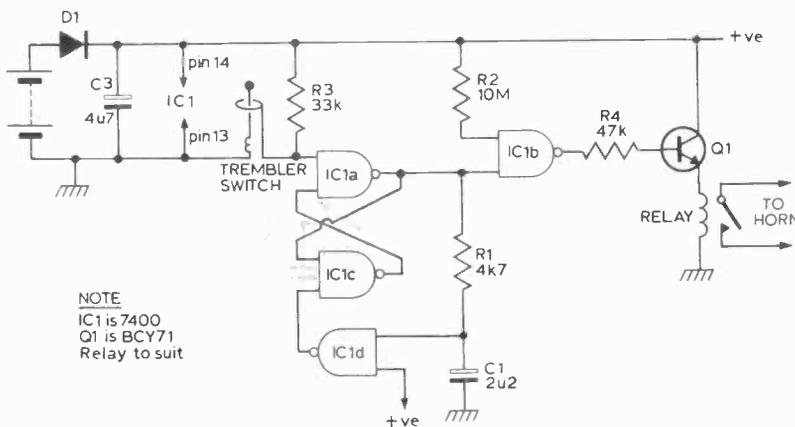
LED1 is a RED LED

Motorcycle Burglar Alarm

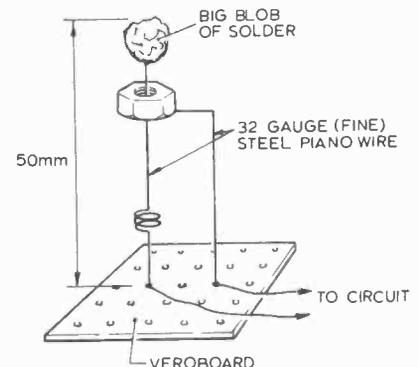
N. Hone

Currently available motorcycle alarms are either very expensive or ineffective. This circuit provides protection against theft, or tampering with the machine.

The alarm, a cross coupled latch is activated by a trembler switch (whose construction is shown), which will sound the alarm for 5 seconds before resetting. As the device is very sensitive, there is a 10 second delay (set by R2, C2) which gives enough time for the trembler switch to stop oscillating, and the keys to be removed. D1 and C3 prevent the supply to the circuit dropping when horn draws a high current and pulls the battery voltage down.



NOTE
IC1 is 7400
Q1 is BCY71
Relay to suit



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.

special

Audio Millivoltmeter

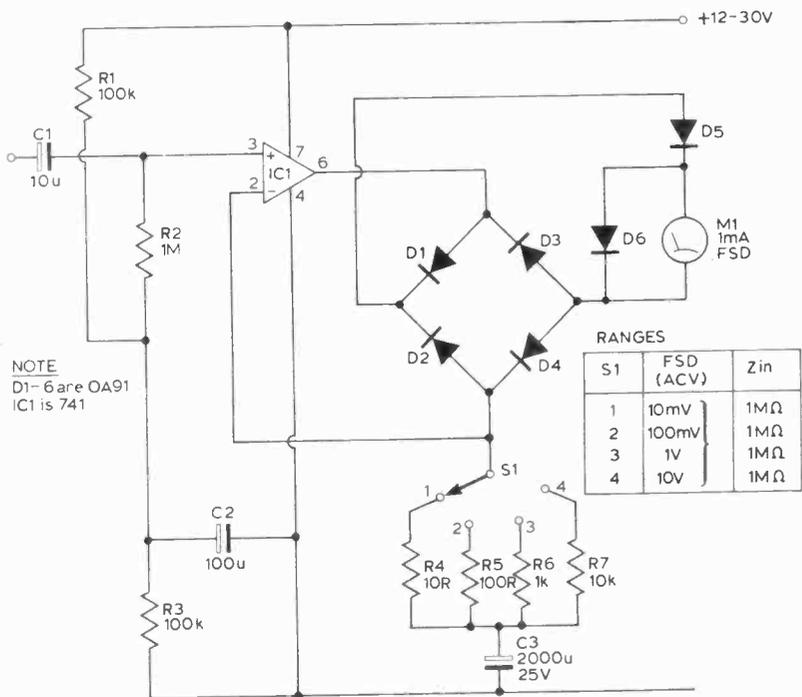
J. P. Macaulay

The circuit shown is of a very simple but effective and accurate millivoltmeter. The non inverting input is biased at half supply by the voltage divider R1/R2, decoupled by C2. The input impedance is defined by R3, whilst C1 isolates unwanted DC.

Due to normal op-amp action the inverting input follows any voltage present at the non inverting input. Because of this the current flowing through the meter, and the resistor selected by S1 is V_{RMS}/R . C3 prevents any DC flowing and hence makes offset nulling unnecessary.

With the component values shown the circuit has a flat response from 8Hz-50kHz (-3db) on the 10mV range. The upper limit remains the same on the less sensitive ranges but the lower frequency limit goes under 1Hz.

D5 and D6 provide protection for the meter under reverse bias and overload conditions respectively. The circuit will work from supply rails between 12 and 30V, and in the quiescent state consumes only 2mA.

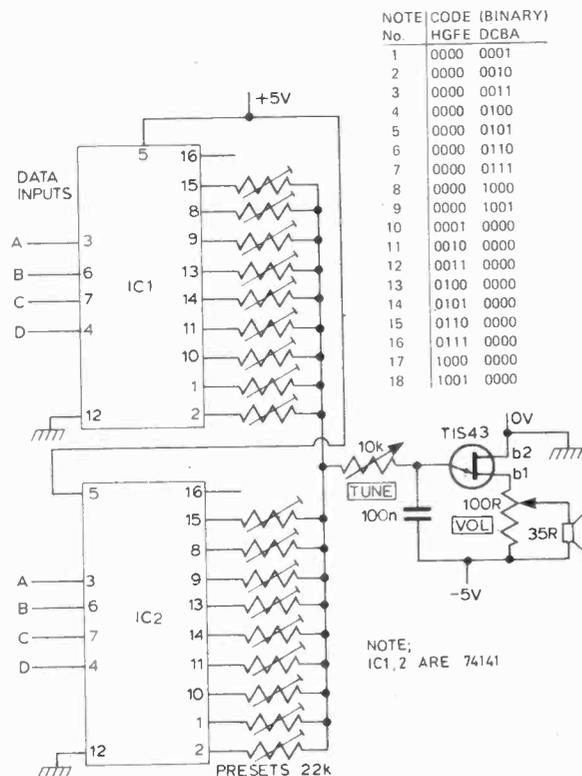


BCD Tone Generator

P. Bailey

When one of the binary codes in the table is set up on the data inputs, a corresponding preset connected to IC1 and 2 will be grounded, and the unijunction will start to oscillate. The frequency of oscillation depending on which output of the ICs is grounded.

If the 18 presets are tuned to form a chromatic scale and the inputs interfaced to your MPU data bus — hey presto you have a simple MPU controlled organ!



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8080A

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TMS4050	4.00
TMS4060	4.50
4096	4.00
MMS270	4.50

PROMS

1702A	5.00
2516(5v)	50.00
27.08	9.00
2716 (TI)	30.00
2716 (INTEL)	50.00
2758	26.60

STATIC RAMS

	1-63	64 up
21L02 (45 (450ns)	1.50	1.18
21L02 (250ns)	1.75	1.50
410D	10.00	8.50
2101-1	2.95	2.50
2102	1.25	.90
2111-1	3.25	2.65
2112-1	2.75	2.35
2114 (300ns)	10.00	8.25
2114 (450ns)	9.00	7.69
2125L	11.00	8.30
TMS4044 (250ns)	8.95	8.00
TMS4044 (450ns)	8.20	7.40
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TMS4045 (450ns)	8.20	7.40

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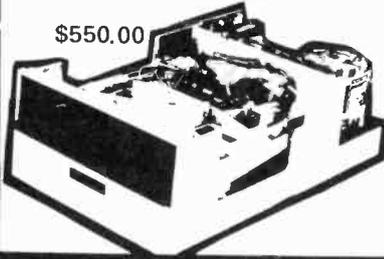
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Temperature Control

S. H. Alsop

This circuit provides full phase proportion control of a heater, infrared lamp etc, uses no expensive transformers for its own power, and is extremely sensitive.

The LM3911 sensor is connected to the sensor via a 3 core cable, and enclosed in a rubber sleeve to enable it to be used as a probe. The output of the LM3911 varies by 10mV/°C and the minute change is amplified by the 741. Any increase in temperature will increase the output of the 741 which will lower the base current through Q1 and so reducing the constant charge current to C2. This variation of charge current with temperature will alter the time taken for the UJT to fire, changing the phase angle of the power to the load.

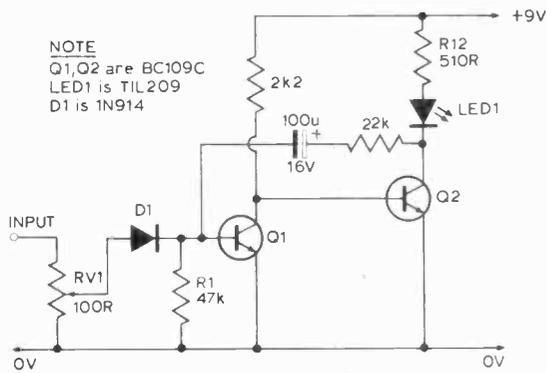
Peak Level Indicator

T. Norris

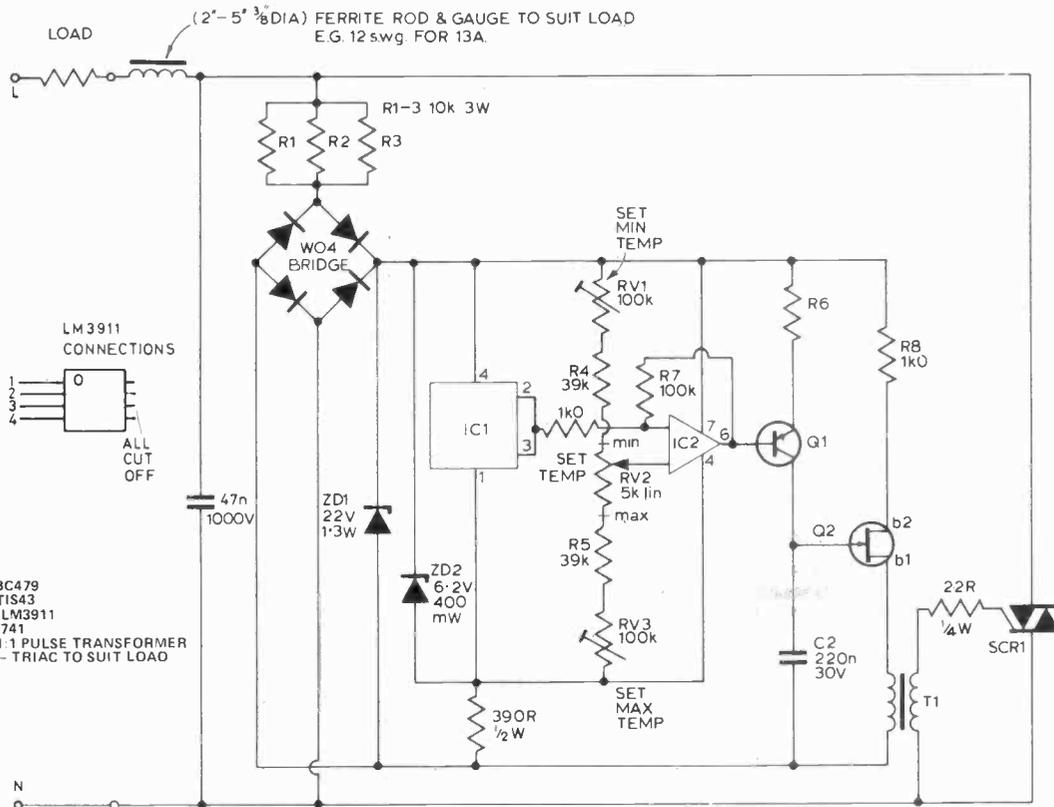
The diagram shows a simple monostable multivibrator with a LED which is normally lit, but will be briefly extinguished if the input exceeds a pre-

set (by RV1) level. A possible application is to monitor the output voltage across a loudspeaker, when the LED will flicker with large signals.

The 5k lin pot is set to the temperature required and is linear over its entire range. The upper and lower limits of this control can be changed by adjusting the 100k presets.



NOTE
Q1, Q2 are BC109C
LED1 is TIL209
D1 is 1N914



NOTE:
Q1 IS BC479
Q2 IS TIS43
IC1 IS LM3911
IC2 IS 741
T1 IS 1:1 PULSE TRANSFORMER
SCR1 - TRIAC TO SUIT LOAD

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5 FUNCTION LCD

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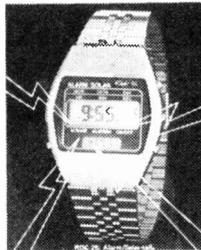


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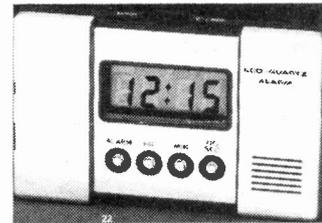
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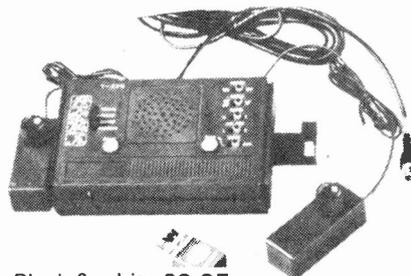
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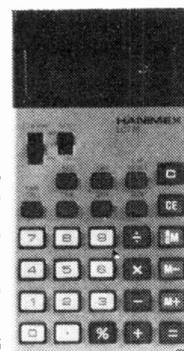
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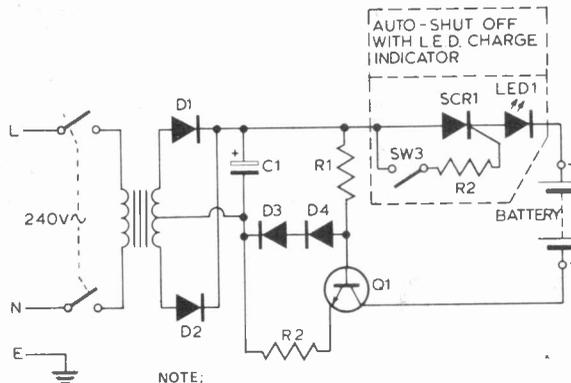


Ni-Cad Charger Mod.

B. V. Barton

This modification was made to the ETI 519 Ni-cad charger to protect the cells in case a power cut occurred while the cells were charging. Normally the cells on charge would rapidly discharge through the charging circuitry, causing possible damage.

The modification involved the addition of a low voltage thyristor in series with the battery. If power fails, the battery cannot discharge. When power is reapplied, the battery will not continue to charge until SW3 is closed momentarily.



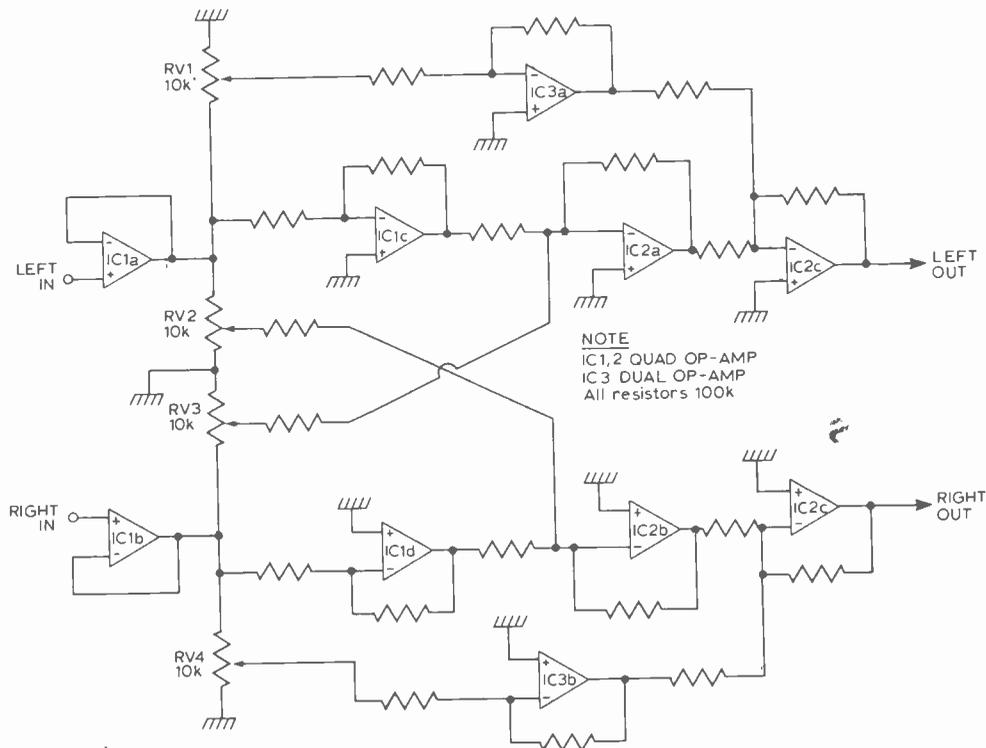
NOTE:
LED1 IS TIL209
SCR1 ANY LOW VOLTAGE THYRISTOR
R2 SELECTED TO GIVE ONLY ONE
CHARGE RATE OF 45mA INSTEAD OF
SIX POSITION RANGE SWITCH GIVEN
IN ORIGINAL DESIGN

4 Channel Synthesizer

T. Huffinley

This circuit will synthesize two rear channels for 'quadraphonic' sound when fed with a stereo signal. The rear output for the Left channel, is a combination of the left channel input

180° out of phase, added to a proportion of the right hand channel (also out of phase). The right hand rear output is obtained in a similar way.



NOTE
IC1, 2 QUAD OP-AMP
IC3 DUAL OP-AMP
All resistors 100k

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APPLE II SERIAL I/O INTERFACE *

Part no. 2

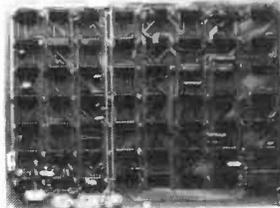
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — \$15.00; with parts — \$42.00; assembled and tested — \$62.00.



T.V. TYPEWRITER

Part no. 106

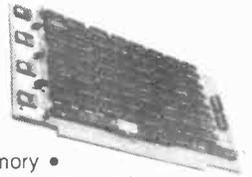
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled cursor • Auto scroll • Non-destructive cursor • Cursor inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only \$39.00; with parts \$145.00



8K STATIC RAM

Part no. 300

• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only \$22.50; with parts \$160.00



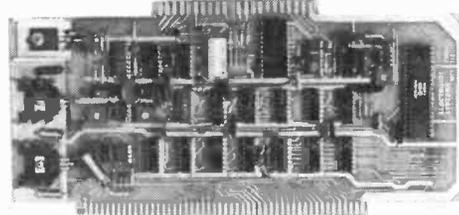
MODEM *

Part no. 109

• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board \$7.60; with parts \$27.50



TIDMA *



Part no. 112

• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only \$35.00; with parts \$110.00

DC POWER SUPPLY *

Part no. 6085

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only \$12.50; with parts excluding transformers \$42.50



Part no. 107

• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board \$7.60; with parts \$13.50



RS 232/TTY * INTERFACE

Part no. 600

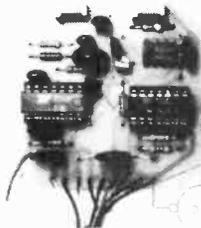
• Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232 • Two separate circuits • Requires +12 and -12 volts • Board only \$4.50, with parts \$7.00



TAPE INTERFACE *

Part no. 111

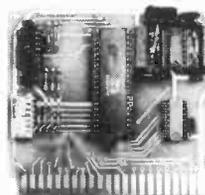
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board \$7.60; with parts \$27.50



UART & BAUD RATE GENERATOR *

Part no. 101

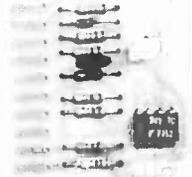
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity • All connections go to a 44 pin gold plated edge connector • Board only \$12.00; with parts \$35.00 with connector add \$3.00



RS 232/TTL * INTERFACE

Part no. 232

• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only \$4.50; with parts \$7.00 with connector add \$2.00



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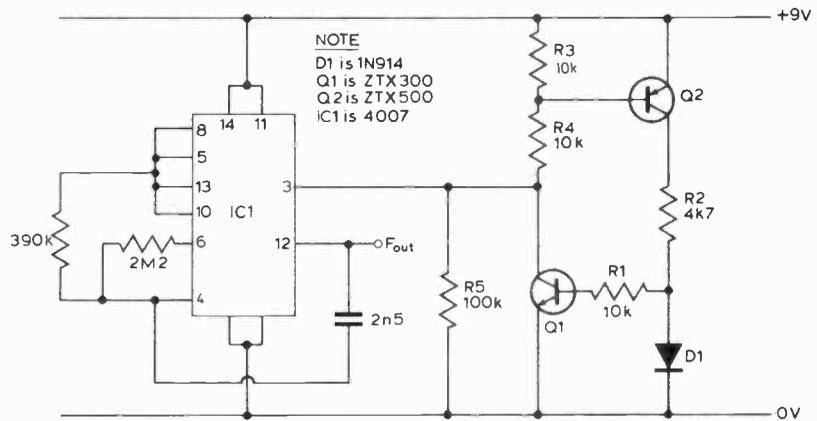
* Circuits designed by John Bell

Temperature to Frequency Converter

P. Reynolds

This circuit uses the fact that when fed from a constant current source, the forward voltage of a silicon diode varies with temperature, in a reasonably linear way.

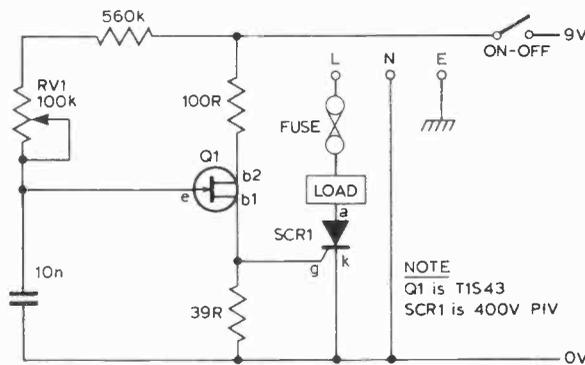
Diode D1, and resistor R2 form a potential divider, fed from the constant current source. As the temperature rises the forward voltage of D1 falls tending to turn Q1 off. The output voltage from Q1 will thus rise, and this is used as the control voltage for the CMOS VCO. With the values shown, the device gave an increase of just under $3\text{Hz}/^\circ\text{C}$ (between 0°C and 60°C) giving a frequency of 470Hz at 0°C .



Lighting Effects

D. Stewart

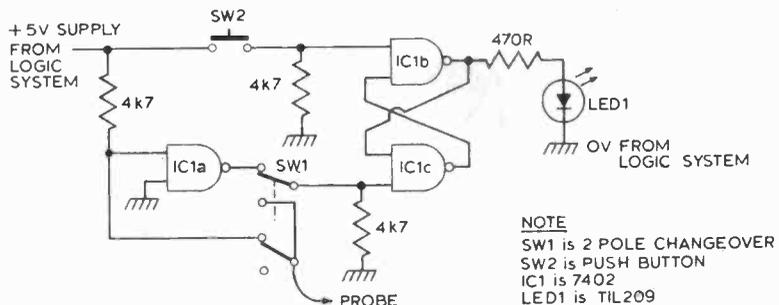
This circuit can be used to produce some interesting lighting effects. A unijunction relaxation oscillator is used to trigger the thyristor. The frequency of the oscillator is controlled by RV1. The load (a light bulb) will not be triggered at the same frequency as the unijunction oscillator, and some interesting effects can result. Care should be taken with this circuit as it is not isolated from the mains.



Logic Noise Detector

G. Robinson

Ever since the advent of binary logic, spurious noise spikes and pulses have been the curse of the designers of even elementary systems. This circuit will help detect 'noisy' logic levels. With SW1 in position 1, any logic zero spikes occurring on a steady logic '1' will set the R-S latch and the LED will be illuminated. With SW1 in position 2, an extra inverter is brought in, and the circuit will be triggered by any logic '1' spikes.



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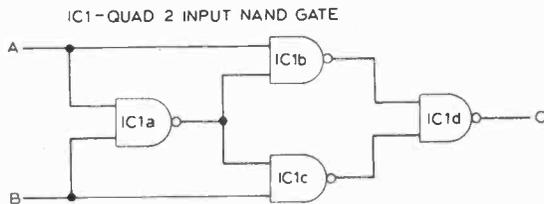


Exclusive OR and NOR gates

D. S. Smith

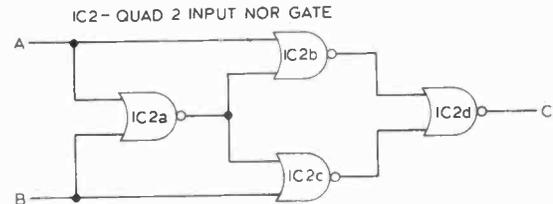
When constructing logic circuits which need either an exclusive OR or exclusive NOR gate, and one is not available, the following arrangement

of NAND or NOR gates can produce the required results. The circuits can be constructed using standard TTL or CMOS gates.



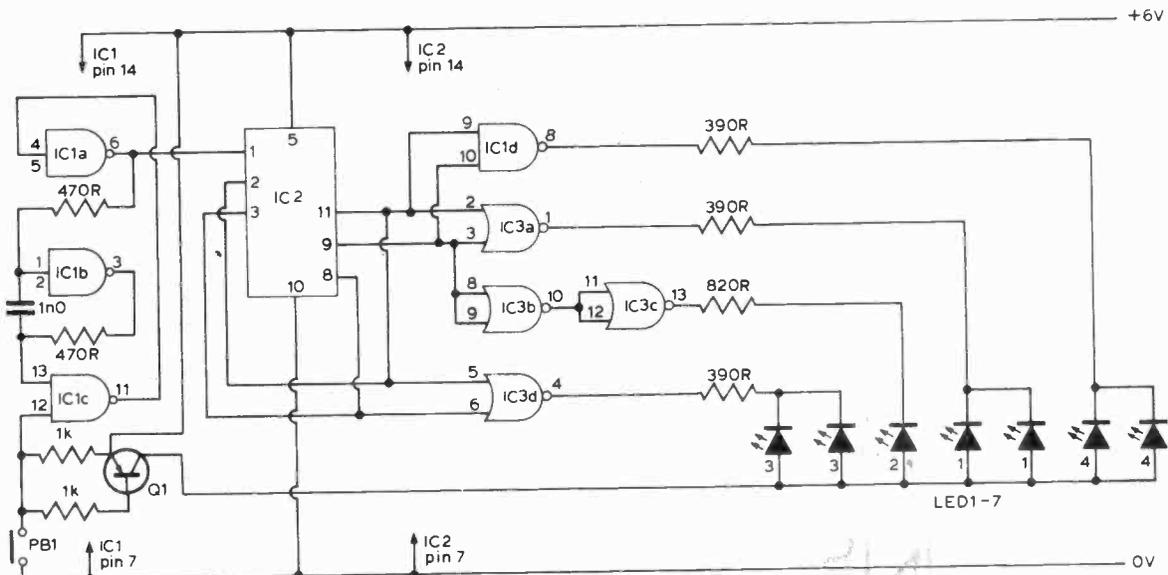
TRUTH TABLE

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0



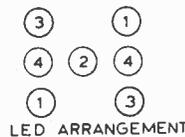
TRUTH TABLE

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1



NOTE

LED1-7 are TIL209 or equivalent
 IC1 is 7400
 IC2 is 7493
 IC3 is 7402
 Q1 gen purp. PNP $I_{cmax} > 50mA$
 PB1 is normally closed



Electronic Dice

G. Vance

This dice circuit is interesting, as the

six LEDs are arranged to produce a display the same as the dots on a dice. When PB1 is depressed, the display is blanked and the oscillator (IC7a, b, c) clocks IC2 at about 1MHz. IC2 counts

from zero and resets on seven. When PB1 is released, the display is enabled and a novel decoding system produce the correct output on the LEDs.

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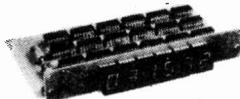
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CD4018	0.83	CD4042	0.89	CD4072	0.20	CD40106	0.82	CD4556	0.78
CD4019	0.50	CD4043	0.88	CD4073	0.20	CD40107	0.69	CD4555	0.78
CD4020	1.11	CD4044	0.84	CD4075	0.20	CD40108	5.36	MC14528	0.93
CD4021	0.90	CD4045	1.26	CD4076	1.17	CD40109	1.03	MC14553	4.43
CD4022	0.82	CD4046	1.20	CD4077	0.39	CD40160	1.19	IM6508	8.05
CD4023	0.18	CD4047	0.89	CD4078	0.20	CD40161	1.19		
CD4024	0.70	CD4048	0.50	CD4079	0.20	CD40162	1.19		
CD4025	0.20	CD4049	0.50	CD4082	0.20	CD40163	1.19		
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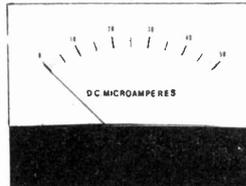
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T25	0-5mA	T36	Vu Meter
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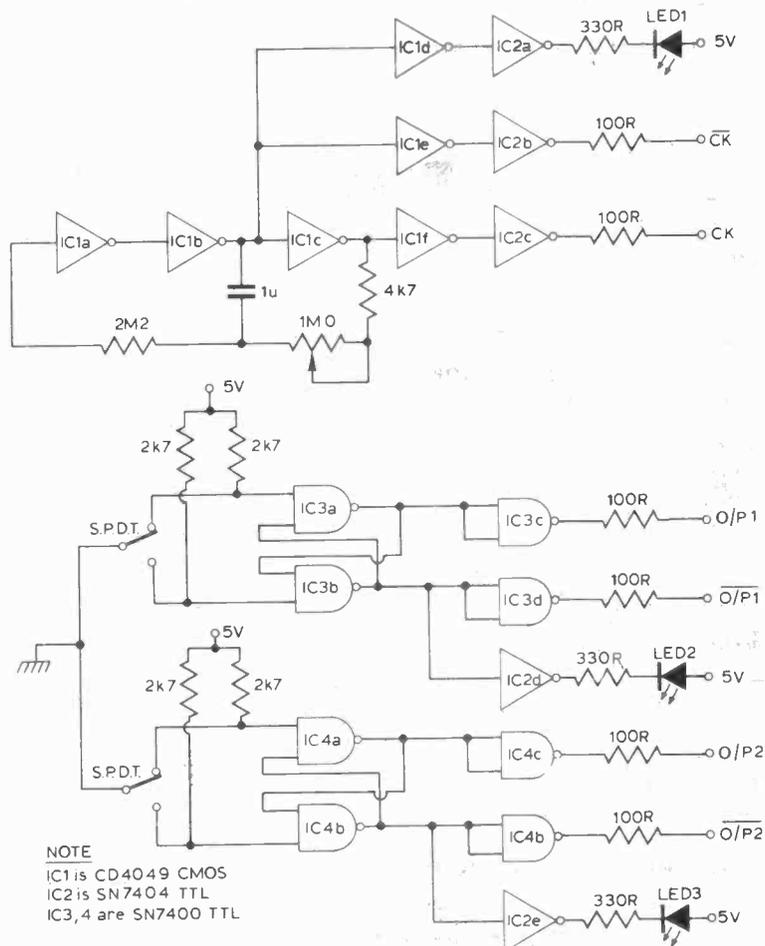
Test Unit for Sequential Logic

D. Rayner

Any one testing a sequential logic circuit requires input pulses free of contact bounce. This unit does this, providing two switched, jitter-free outputs and a 'slow' variable speed clock. The complements of these signals are also provided.

The components shown give the clock a frequency range of 1-200Hz. The clock's buffered output will drive up to two TTL inputs.

The 100R resistors on all outputs provide some measure of accidental short circuit protection.



NOTE
 IC1 is CD4049 CMOS
 IC2 is SN7404 TTL
 IC3,4 are SN7400 TTL

Speaker Power Indicator

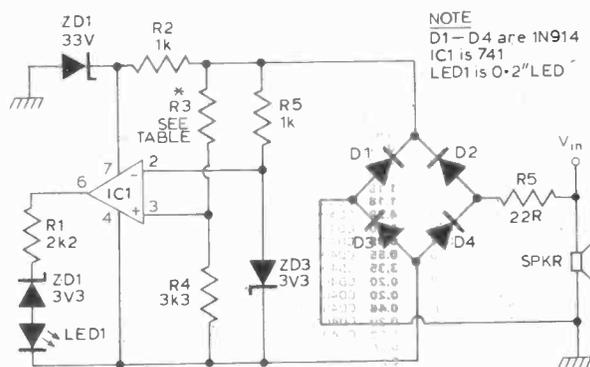
J. Macauley

This circuit will indicate the peak level of an input signal applied to a speaker. It is primarily intended as a fail safe device when connected to an amplifier of higher power rating than the speaker.

The circuit is unique in that no separate DC power supply is required since the circuitry operates from the input voltage to the speaker.

R5 isolates the amplifier's output stage from possible fault conditions in the circuit. D1 to D4 full wave rectify the input signal and the resulting DC is used to supply the op amp.

The 741 is used as a comparator a reference voltage being obtained from across ZD3 and fed into the inverting input of the op-amp. The non inverting input samples the rectified input signal. When a peak is fed into the circuit the IC's output goes high and the led flashes. ZD1 prevents the LED turning on when the output of IC1 is low due to the output being unable to go less than 1.5V above earth under these circumstances. ZD2 defines the upper limit of the op amp's supply voltage in the presence of large transients whilst R2 is the current limit resistor. It should be obvious that the level at which the led lights is dependent upon the value of R3. The accompanying table shows the value required for this component for dif-



NOTE
 D1-D4 are 1N914
 IC1 is 741
 LED1 is 0.2" LED

WATT/8Ω	5	10	15	20	25	30	35
R3kΩ	5.6k	9.1k	12k	15k	18k	18k	22k

ferent input powers across an 8 ohm load. If different load values are to be used for the speaker the value of R3 can be determined from the equation,

$$R3 = \frac{1.4}{P} \sqrt{PR} - 3.3 \text{ k}\Omega$$

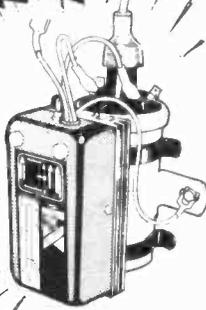
$P = P_{out}$
 $R = \text{load in } \Omega$

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Note: in this section all data, books are subject to 0% VAT, for postage see 'Terms' at foot of page.

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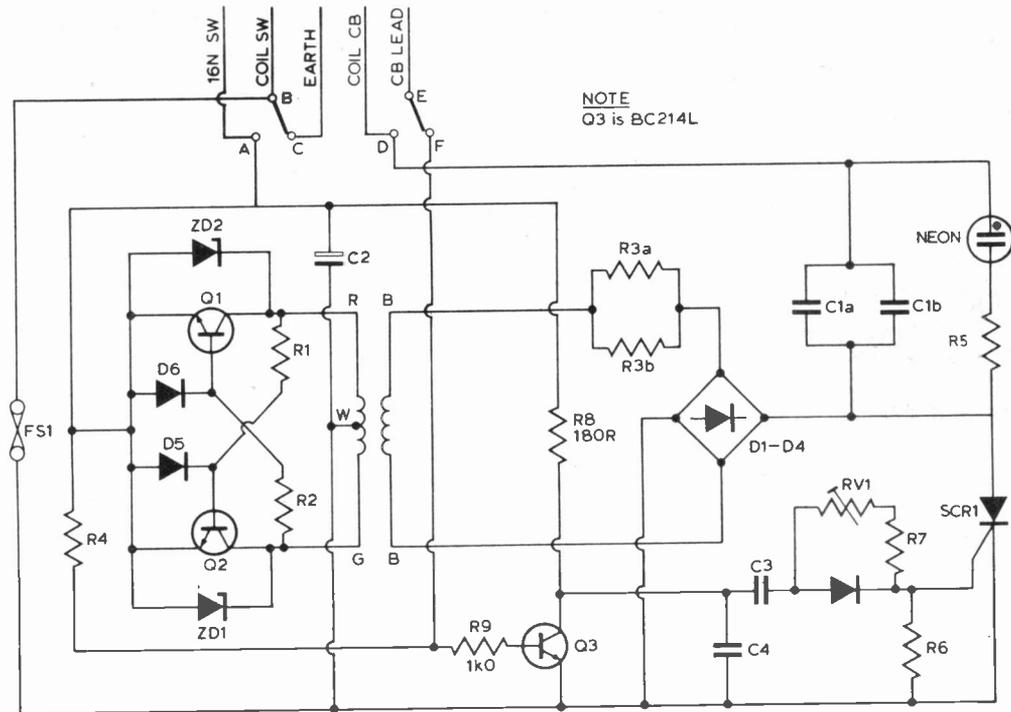
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CDI for Positive Earth

R. Vivian

The CDI Mk II ignition published in the May issue has been designed for

negative earth cars. Attempting to install it in positive earth vehicles by reversing the supply connections will lead to problems caused by SCR1 triggering as C3 is discharged (ie as the contact points close, and not as they open).

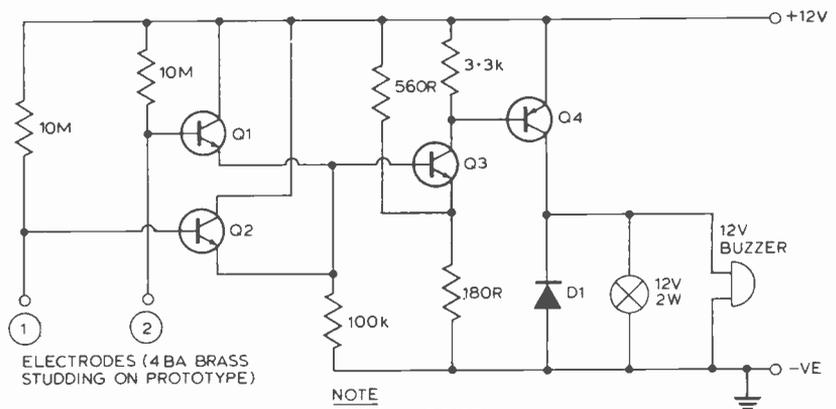
This modification provides a solution by discharging (C3) through a transistor (Q3) which conducts when the points open. Any general purpose PNP transistor capable of sinking 200mA (eg BC212, BC214L) will do.

Brake Fluid Indicator

D. Shorthouse

This circuit indicates by means of a warning light and a buzzer when the fluid in the tank of a braking system is getting low.

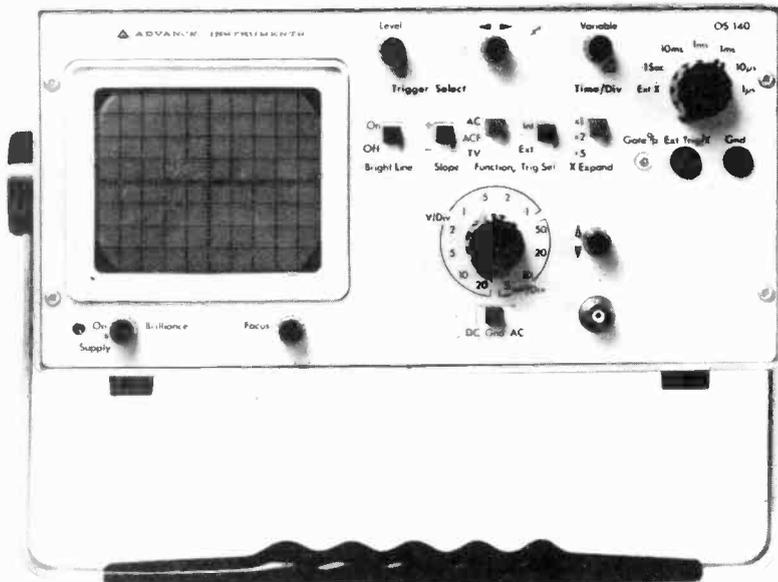
Normally both electrodes are immersed in the brake fluid, and the bases of Q1 and Q2 are at ground potential (the fluid makes a connection between the electrodes and the brake cylinder which is connected to the car chassis). If the fluid level should fall, and either of the electrodes becomes dry, Q1 or Q2 will turn on which will turn on Q3 and Q4 and the alarm energised.



NOTE
Q1,2,3 are BC107
Q4 is BC461
D1 is 1N4001

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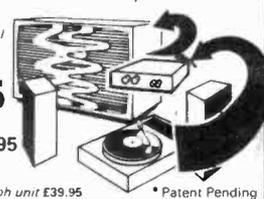
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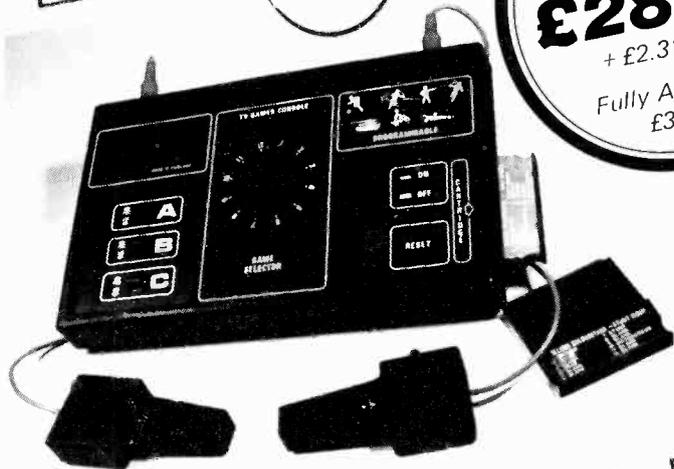
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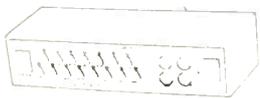
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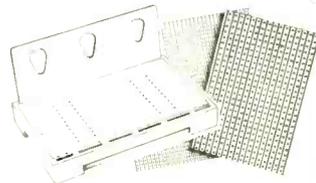
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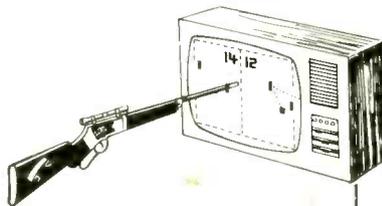


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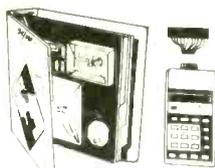
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