

RANSCENDENT 2000

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 affective 7 octave range. There is portamento, pitch bending, a VCO with shape and pitch

ready-built units selling for between £500 and £7001

COMPLETE KIT ONLY £172.00 + VAT!

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

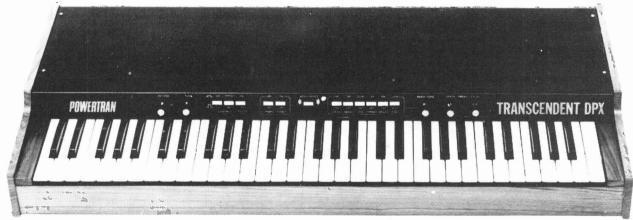


Cabinet size 24.6" x 15.7" x 4.8" (rear) 3.4" (front)

AS FEATURED IN AUGUST-NOVEMBER '79 Another superb design by synthesizer expert Tim Orr!

DIGITALLY CONTROLLED, TOUCH SENSITIVE, POLYPHONIC, MULTI-VOICE SYNTHESIZER

The Transcendent DPX is a really versatile new 5 octave keyboard instrument. There are two audio outputs which can be used simultaneously. On the first there is a beautiful harpsichord or reed sound.— fully polyphonic i.e. you can play chords with as many notes as you like. On the second output there is a wide range of different voices, still fully polyphonic. It can be a straightforward piano or a honky tonk piano or even a mixture of the two! Alternatively you can play strings over the whole range of the keyboard or brass over the whole range of the keyboard and should you prefer.— strings on the top of the keyboard and brass at the lower end (the keyboard is electronically split after the first two octaves) or vice versa or even a combination of strings and brass sounds simultaneously. And on all voices you can switch in circuitry to make the keyboard touch sensitive! The harder you press down a key the louder it sounds.— just like an acoustic piano. The digitally controlled multiplexed system makes practical touch sensitivity with the complex dynamics law necessary for a high degree of realism. There is a master volume and tone control, a separate control for the brass sounds and also a vibrato circuit with variable depth control together with a variable delay control so that the vibrato comes in only after waiting a short time after the note is struck for even more realistic string sounds.



Cabinet size 36.3" x 15.0" x 5.0" (rear) 3.3" (front)

COMPLETE KIT ONLY £365.00 + VAT!

To add interest to the sounds and make them more natural there is a chorus /ensemble unit which is a complex phasing system using CCD (charge coupled device) analogue delay lines overall effect of this is similar to that of several acoustic instruments playing the same piece of music. The ensemble circuitry can be switched in with either strong or mild effects

As the system is based on digital circuitry digital data can be easily taken to and from a computer (for storing and playing back accompaniments with or without pitch or key change, computer composing etc etc.) and an interface socket (25 way D type) is provided for this purpose

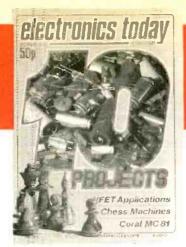
Although the DPX is an advanced design using a very large amount of circuitry, much of it very sophisticated, the kit is mechanically extremely simple with excellent access to all the circuit boards which interconnect with multiway connectors, just four of which are removed to separate the keyboard circuitry and the panel circuitry from the main circuitry in the cabinet

The kit includes fully finished metalwork, solid teak cabinet, professional quality components (all resistors 2% metal oxide), nuts, bolts, etc., even a 13A plug — you need buy absolutely no more parts before plugging in and making great music! When finished you will possess an instrument comparable in performance and quality with ready-built units selling for over £1, 2001.

ORDERING INFORMATION AND MORE KITS ON PAGE 8

kits also available as separate packs (e.g. P.C.B., component sets, hardware sets, etc.)
Prices in FREE CATALOGUE.

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Square sines and triangles p.20



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TRALIA Collyn Riv Publisher Roger Har Acting Ed	rrison	Dee Camilleri Paul Edwards, Tony Strakas Joanne Barseghian Ray Marston	Production Technical Illustrators Project Editor		
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BI-PAK

SEMICONDUCTORS

TRANSISTORS	74 SERIES TTL ICs
Type	Type
AC156	CMOS ICs
AC168 60.29 BC172 60.10 BD206 60.92 BSV41 60.33 2N707 60.55 2N3905 60.12 AC168 60.29 BC172 60.10 BD207 60.92 BSV51 60.29 2N706 60.16 2N3906 60.12 AC169 60.23 BC174 60.10 BD208 60.00 BSV95 60.15 2N711 60.35 2N4058 60.14 AC171 60.29 BC174 60.17 BD22 60.00 BSV955 60.15 2N711 60.35 2N4059 60.14 AC176 60.29 BC174 60.18 BD225 60.54 BSV95A 60.15 2N711 60.35 2N4059 60.16 AC176 60.29 BC177 60.18 BD225 60.54 BSV95A 60.15 2N718 60.29 2N4060 60.16 AC179 60.29 BC178 60.18 BD233 60.55 BU105 61.44 2N7186 60.58 2N4061 60.14 AC179 60.29 BC178 60.18 BD233 60.55 BU105 61.44 2N7186 60.58 2N4061 60.14 AC180 60.33 BC179 60.18 BD233 60.55 BU105 61.41 2N726 60.33 2N4062 60.14 AC180 60.33 BC180 60.29 BD235 60.53 BU205 61.81 2N743 60.23 2N4921 60.53 AC180K 60.32 BC180 60.29 BD235 60.53 BU205 61.81 2N743 60.23 2N4921 60.54 AC181 60.23 BC182 61.05 BD237 60.53 BU208 62.19 2N744 60.23 2N4921 60.54 AC181 60.23 BC182 61.05 BD237 60.53 BU208 62.19 2N744 60.23 2N4915 60.14 AC187 60.21 BC182 61.09 BD239 60.59 BU208 62.19 2N794 60.35 2N5136 60.12 AC187 60.21 BC182 60.09 BD239 60.58 MJE3055 60.69 2N929 60.32 2N5136 60.12 AC187 60.21 BC183 60.19 BD239 60.58 MJE3055 60.60 2N929 60.23 2N5172 60.16 AC188 60.21 BC183 60.19 BD239 60.58 MJE3055 60.60 2N929 60.21 2N5154 60.54	Type
AC18BK €0.32 BC184 €0.10 BDX32 €2.53 MpF102 €0.60 2N946 €0.46 2N5245 €0.46 AC17 €0.40 BC186 €0.25 BDY11 €1.50 MpF102 €0.32 2N1131 €0.21 2N5294 €0.38 ACY18 €0.40 BC186 €0.25 BDY17 €2.07 MpF104 €0.40 2N132 €0.21 2N5296 €0.41 ACY19 €0.40 BC187 €0.25 BDY20 €0.92 MpF105 €0.40 2N1302 €0.17 2N5296 €0.41	LINEAR ICs
ACY20	Type
AF179 C0.69 BC440 £60.35 BF167 £0.28 ĠC74 £0.30 2N2219 £0.23 28327 £0.23 AF180 £0.69 BC441 £6.35 BF176 £0.24 £0.75 £0.35 2N2219 £0.28 £0.23 £0.75 £0.35 2N2220 £0.28 £0.23 £0.31 £0.24 £0.68 £0.44 BF176 £0.44 £0.76 £0.40 £0.82 £0.23 £0.23 £0.23 £0.27 £0.58 £0.222 £0.23 £0.31 £1.09 £0.25 £0.221 £0.31 £0.31 £0.23 £0.23 £0.23 £0.23 £0.21 £0.23 £0.21 £0.23 £0.21 £0.23 £0.21 £0.23 £0.23 £0.23 £0.23 £0.24 £0.23 <t< td=""><td> Type</td></t<>	Type
ASY5B 60.35 BCY34 €0.69 BF197 €0.14 ÖCZ03 €0.98 ZNZ905 €0.21 40430 €1.09 ASY73 €0.35 BCY70 €0.17 BF198 €0.16 OCZ04 €1.04 ZNZ905 €0.23 40476 €1.88 AU104 €1.01 BCY71 €0.17 BF199 €0.16 OCZ05 €1.32 ZNZ906 €0.18 40494 €0.81 AU110 €1.01 BCY72 €0.17 BF290 €0.35 TIC44 €0.33 ZNZ906 €0.22 40495 €0.92	TRIACS
AU113	2 amp T05 Case No. Price 10 amp Price 100 TR12a / 100 60.36 Volts 100 TR10a / 100 60.89 200 TR12a / 200 60.59 100 TR110a / 100 60.89 400 TR1 2a / 400 60.82 200 TR10a / 200 61.06 400 TR1 10a / 400 61.29 100 100 100
BC108A	6 amp Volts 100 mp Volts 100 TR16a / 100 €0.59 400 TR110a / 400p €1.29 200 TR16a / 200 €0.70 Diacs
BC109B	BRIDGE RECTIFIERS
BC116 C0.22 BD139 C0.41 BF337 C0.35 T1P42B C0.53 2N3391 C0.23 BC118 C0.12 BD179 E0.49 BF337 C0.35 T1P42B C0.53 2N3392 C0.23 BC118 C0.16 140mp E0.92 BF457 C0.43 T1P42B C0.55 2N3393 E0.23 BC119 C0.29 BC175 C0.69 BF459 E0.44 T1P42C C0.53 2N3395 E0.23 BC119 C0.29 BC125 C0.20 BD175 E0.69 BF459 E0.43 T1P2955 C0.69 2N3394 E0.23 BC126 C0.25 E0.20 BD177 E0.78 BF596 E0.44 T1S43 E0.25 2N3402 E0.25 E0.25 BC125 E0.20 BD177 E0.78 BF596 E0.32 T1S90 E0.21 2N3404 E0.33 E0.24 E0.26 E0.25 E0.21 E0.78 E0.78 E0.28 E0.28 E0.28 E0.28 E0.29	SILICON 1 amp Type
217107 60.12	SILICON 10 amp Type No. Price 50v RMS BR10 50 €1.73 50v RMS BR25 50 €2.19 200v RMS BR10 200 €1.96 200v RMS BR200 €2.53



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209	BI-PAK TTC Data Book		50p
03	BI-PAK CMOS Data Book		50p

SWITCHES

Description DPDT ministure slide DPDT standard slide Toggle switch SPST 1½ amp 2 Toggle switch DPDT 1 amp 25 Rotary on-off mains switch Push switch — Push to make Push switch — Push to break		No. 1973 1974 1975 1976 1977 1978 1979		Price £0.16 £0.17 £0.38 £0.48 £0.58 £0.16
ROCKER SWITCH A range of rocker switches SPST — moulded in high insulation material available in a choice of colours ideal for small apparatus	Coloui RED BLACK WHITE BLUE YELLOI LUMIN	W	No. 1980 1981 1982 1983 1984 1985	Price £0.35 £0.35 £0.35 £0.35 £0.35
Description Minature SPST toggle 2 amp i Minature SPST toggle 2 amp i Minature DPDT toggle 2 amp Minature DPDT toggle 2 amp Minature DPDT toggle centre 250 v ac. Push-button SPST 2 amp 250' Push-button SPST 2 amp 250' Push-button DPDT 2 amp 250'	250V ac 250V ac off 2 amp V ac V ac	No. 1958 1959 1960 1961 1962 1963 1964		Price £0.81 £0.86 £0.91 £1.07 £1.04 £1.09 £1.34
MIDCET WASED CWITCHS				

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

Descriptio	n	No.	Price
1 pole	12 way	1965	€0.5
2 pole	6 way	1966	€0.5
3 pole	4 way	1967	€0.5
4 pole	3 way	1968	€0.5
MICRO S	WITCHES	No.	Price
	on gives simple 1 pole of		
over action	Ratino 10 amp 250V a	c 1970	€0.2

OPTOELECTRONICS

1502 1503 1504 1505 1506 1509	MIL3232 (TIL211) MIL3331 (OP212A) ARL4850 (FLV117) MIL5251 (TIL222) MIL5351 (MV5353) FLV111	.3mm (.125) .3mm (.125) .3mm (.125) .5mm (.2) .5mm (.2) .5mm (.2)	GREEN YELLOW RED GREEN YELLOW CLEAR (ill. Red)	€0.12 €0.22 €0.22 €0.12 €0.22 €0.22 €0.13
1521 1522 1514	MIL52 ORP12 Light dependent OCP71 Photo transistor	.3mm (.125) .5mm (.2) resistor	RED RED	£0.12 £0.12 £0.63 £0.40
1508/1	25 pack of 5 125 clips pack of 5 2 clips			£0.17 £0.21
RED Sing DL707 7 RED Sing DL527 7 RED Two DL727 7 RED Two DL747 7	segment D.P. left (.30") gle Digit segment D.P. left (.30")	height) height))'' height)	o/no. 1523 Commo o/no. 1512 Commo o/no. 1524 Commo o/no. 1512	n Anode £0.92 n Anode £2.08 n Anode £2.07 n Anode
OPTO-IS	SOLATORS			

OPTO-ISOLATORS
Isolation Breakdown — Voltage 15D0 — continuous fwd current 100mA
CIL74 — Single-Channel 6 pin DIP standard type — optically coupled pair
with infra-red LED Emitter and NPN Silicon Photo Transistor
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o / no. 1498 £1.22
CILQ74 — Multi-Channel 16 pin DIP Four Isolated Channels
o / no. 1499 £2.69

MEL 11 (TIL81) NPN LIGHT DETECTOR
Silicon Photo Darlington Amplifier — VCBO 30v VECO 10v Ic 100mA
Ptot:300mW IL Min 0.5 Typ.2mA 1D 100mA nA o/no. 1496 £0.29

NUTS AND BOLTS

1in OBA 839 £1.38 ½in 4BA 846 ½in OBA 840 £0.75 1in 6BA 847 1in 2BA 842 £0.75 1in 6BA 848 ½in 2BA 844 £0.60 ¼in 6BA 850 1in 4BA 845 £0.50 ¼in 6BA 850 8A NUTS packs of cadmium plated full nuts in multiples of 50 Price Type No. 855 £0.83 4BA 857 2BA 856 £0.55 6BA 858 BA WASHERS flat cadmium plated plain stamped washe in multiples of 50. Type No. Type No. Price Type No.	Гуре	No.	Price	Туре	No.	Price
1in 2BA 842 £0.75 1 in 6BA 848 yin 2BA 843 £0.52 ½in 6BA 849 yin 2BA 844 £0.60 yin 6BA 850 1in 48A 845 £0.51 to see the second of the	1in OBA	839	€1.38		846	£0.37
	√₂in OBA	840	€0.86	¼in 4BA	847	€0.29
Xian 2BA 844 £0.60 Vá in 6BA 850 In 4BA 845 £0.51 Vá in 6BA 850 BA NUTS packs of cadmium plated full nuts in multiples of Type No.	lin 2BA	842	£0.75	1 in 6BA	848	€0,46
### 15	½in 2BA	843	€0.52	½in 6BA	849	€0.24
BA NUTS packs of cadmium plated full nuts in multiples of Type No. Price Type No. Bo. No.	¼in 2BA	844	£0.60	¼in 6BA	850	£0.29
Type No. Price Type No. 0BA 855 £0.83 4BA 857 2BA 856 £0.55 6BA 858 BA WASHERS — flat cadmium plated plain stamped washe in multiples of 50.	1in 48A	845	£0.51			
08A 855 £0.83 48A 857 2BA 856 £0.55 68A 858 BA WASHERS — flat cadmium plated plain stamped washe in multiples of 50.	BA NUTS	packs o	f cadmium p	plated full nuts i	in multiples	of 50.
ZBA B56 £0.55 68A 858 BA WASHERS — flat cadmium plated plain stamped washe in multiples of 50.	Түрө	No.	Price	Туре	No.	Price
BA WASHERS — flat cadmium plated plain stamped washe in multiples of 50.	OBA	855	€0.83	4BA	857	£0.35
in multiples of 50.	2BA	B56	£0.55	6BA	858	£0.28
			at cadmium	plated plain sta	mped wash	ers supplie
			D-:	Torre	M o	Price
						£0.14
OBA 859 £0.16 4BA 861 2BA 860 £0.14 6BA 862						€0.14

AUDIO LEADS

Price Type No. Price 60.46 4BA 853 £0.25 £0.32 6BA 854 £0.25

No.	Туре	Price
107	FM indoor Ribbon Aerial	€0.69
113	3.5mm Jack plug to 3.5mm Jack plug. Length 1.5m	€0.86
114	5 pin DIN plug to 3.5mm Jack connected to pins	
	3 & 5. Length 1 5m	€0.98
115	5 pin DIN plug to 3.5mm Jack connected to pins	
	1 & 4. Length 1.5m	€0.98
116	Car aerial extension Screened insulated lead.	£1.44
	Fitted plug and socket	£1.44
117	AC mains connecting lead for cassette recorders	€0.78
	and radios. 2 metres	€0.78
118	5 pin DIN phono plug to stereo headphone	€1.21
	Jack socket	11.21
119	2+2 pin DIN plugs to stereo Jack socket with	
	attenuation network for stereo headphones.	£1.04
	Length 0.2m	£1.04
120	Car stereo connector Variable geometry plug to	
	fit most car cassettes. 8-track cartridge and	
	combination units. Supplied with infined fuse	€0.69
	power lead and instructions	10.09
123	6.6m Coiled Guitar Lead Mono Jack plug to Mono	€1.72
	Jack plug Black	
124	3 pin DIN plug to 3 pin DIN plug. Length 1 5m	£0.85
125	5 pin DIN plug to 5 pin DIN plug. Length 1 5m	€0.85
126	5 pin DIN plug to Tinned open end. Length 1.5m	20.05
127	5 pin DIN plug to 4 Phono Plugs.	€1.49
	All colour coded. Length 1 5m	£0.92
128	5 pin DIN plug to 5 pin DIN socket Length 1.5m	20.92
129	5 pin DIN plug to 5 pin DIN plug mirror image.	€1.21
	Length 1.5m	£1.21
130	2 pin DIN plug to 2 pin DIN inline socket.	60 -0
	Length 5m	€0.78
131	5 pin DIN plug to 3 pin DIN plug 1 & 4 and 3 & 5.	€0.95
	Length 1 5m	
132	2 pin DIN plug to 2 pin DIN socket. Length 10m	£1.13
133	5 pin DIN plug to 2 Phono plugs.	
	Connected pins 3 & 5, Length 1 5m	88.03

AUDIO LEADS

134	5 pin DIN plug to 2 Phono sockets.	
	Connected pins 3 & 5 Length 23cm	€0.78
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	Connected pins 3 & 5. Length 23cm	€0.78
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	Black, length 6m	€2.01
178	AC mains lead for calculators, etc	€0.52

TRANSFORMERS

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No.	Secondary	Price
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2022	9V-0-9V 100mA	£1.04
2023	12V-0-12V 1D0mA	£1,29
MINIATU	IRE MAINS Primary 240V	
with two in	ndependent secondary windings	
No.	Туре	Price
2024	MT280-0-6V 0-6V RMS	£1.84
2025	MT150-0-12V 0-12V RMS	€1.84

1 AMP M	AINS Primary 240V		
No.	Secondary	Price	
2026	6V-0-6V 1 amp	€2.88	P.&P. 45p
2027	9V-Q-9V 1 amp	€2.30	P.&P. 45p
2028	12V-0-12V 1 amp	£2.99	P.&P. 55p
2029	15V-0-15V 1 amp	€3.16	P.&P. 66p
2030	30V-0-30V 1 amp	€3.97	P.&P. 86p

STANDARD MAINS Primary, 240V
Multi-apped secondary mains transformers available in ½ amp, 1 amp
and 2 amp current rating. Secondary taps are 0-19-25-33-40-50V
Voltages available by use of taps.
7-8-10-14-15-17-19-25-31-33-40-25-0-25V

No. 2031 2032 2033	1, 14, 15, 17, 19, 25, 3 Rating 1/2 amp 1 amp 2 amp	Price £3.91 £5.06 £6.27	P.&P. 86p P.&P. 86p P.&P. £1
2035	240V Primary 0- 2A Secondary	55V @ £7.30	P&P £1

SPECIAL OFFER SPECIAL OFFEN
2042 240V Primary 0-20V @ 2A Secondary. By removing 5 turns for each wolt from the secondary winding any voltage up to 20V @ 2A is easily obtainable. Ideal for the experimenter
£1.50 P. &P. 86p

CASES AND BOXES

INSTRUMENT CASES. In two sections, vinyl covered top and sides.

aluminium t	pottom, tront ar	ig back.		
No.	Length	Width	Height	Price
155	8in	5 ½ in	2in	€1.73
156	11in	6ın	3in	£2.92
157	6in	43/em	1 3/4 in	€1.79
158	9in	51/ain	2 ½1n	£2.43

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

No. 159 160	Length 51/4 in 4(n	Width 2%in 4in	Height 1 1/2 in 1 1/2 c0	Price £0.85
€0.85				
161	4 _{in}	21/4in	1 ½ in	£0.85
162	51/4in	4in	1.5½ in	€0.97
163	4in	21/2 in	2 in	£0.87
164	3in	2in	lin	€0.60
165	7 in	5in	21/2 in	£1.43
166	8in	6in	3in	£1.82
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SLOPE front aluminium boxes with black vinyl base and sides & aluminium back, top & front — strong construction easily accessable

169 2½ın 5%in 2½in 12ın 3½in 8in **£5.45** 168 1½in 7½ın 4in 16ın 4½in 11in **£8.31** VERQ plastic case box. These boxes consist of top and bottom sections which include fixing points for horizontal mounting PC boards/chassis plates, the two sections are held together by four screws which enter through the base and are concealed by plastic feet.

FUSE HOLDERS AND FUSES

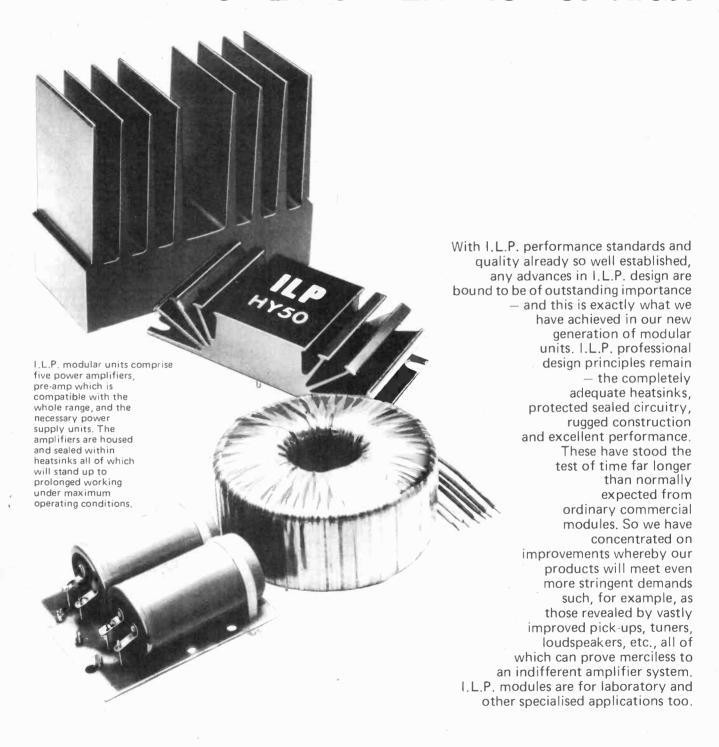
1 1/4 in X 1/4 in 1 1/4 in car i Panel mou Panel mou	on imm chassis no in chassis moi nline type inting 20mm inting 1 ¼ in LOW 20mm		No. 506 507 508 509 510			Price £0.18 £0.14 £0.18 £0.23 £0.37		
	No.	Туре	No.		Type	No.		
150mA (611 7 p	1A	61.5	6р	3A	619	6p	
250mA (612 6p	1.5A	616	7p	4 A	620	10p	
550mA (613 6p	2A	617	6p	5 A	621	6р	
800mA (614 8p	2.5A	618	7p				
ANTI-SU	ANTI-SURGE 20mm							
Туре	No.	Туре	No.		Тур		No.	
100mA	622	1A	625		2.5		628	
250mA	623	2A	626		3 1	5 A	629	
500mA	624	1 6A	627		5A		630	
		Al	1 8p eac	:h				
QUICK-BLOW 1 1/4 in								
Type	No.	Type	No.		Typ	16	No.	
250mA	631	500m/	4 632	2	800)mA	634	
All 8p each								
Туре	No.	Туре	No.		Typ	0.0	No.	
1A	635	2.5A	638		4A		641	
2A	637	3A	639		5A		642	
All 6g each								

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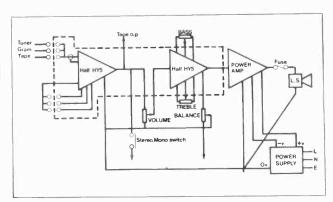
PRODUCTS OF THE WORLD'S FOREMOST SPECIALISTS
IN ELECTRONIC MODULAR DESIGN

and staying there

PERFORMANCE MODULAR UNITS

HY5 PRE-AMPLIFIER

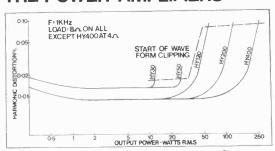


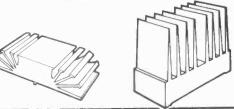


The HY5 pre-amp is compatible with all I.L.P. amplifiers and P.S.U.'s. It is contained within a single pack 50 x 40 x 15 mm, and provides multifunction equalisation for Magnetic/ Ceramic/Tuner/Mic and Aux (Tape) inputs, all with high overload margins. Active tone control circuits; 500 mV out. Distortion at 1KHz-0.01%. Special strips are provided for connecting external pots and switching systems as required. Two HY5's connect easily in stereo. With easy to follow instructions.

£4.64 + 74p VAT

THE POWER AMPLIFIERS

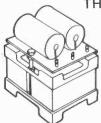




Model	Output Power R.M.S.	Dis- tortion Typical at 1KHz	Minimum Signal/ Noise Ratio	Power Supply Voltage	Size in mm	Weight in gms	Price + V.A.T.
HY30	15 W into 8 Ω	0.02%	80dB	-20 -0- +20	105×50×25	155	£6.34 + 95p
HY50	30 W into 8 Ω	0.02%	90dB	-25 -0- +25	105×50×25	155	£7.24 + £1.09
HY120	60 W into 8 Ω	0.01%	100dB	-35 -0- +35	114x50x85	575	£15.20 + £2.28
HY200	120 W into 8 Ω	0.01%	100dB	-45 -0- +45	114×50×85	575	£18.44 + £2.77
HY400	240 W into 4 Ω	0.01%	100dB	-45 -0- +45	114×100×85	1.15Kg	£27.68 + £4.15

Load impedance — all models 4 - 16 $\,\Omega$ Input sensitivity - all models 500 mV Input impedance—all models 100 KΩ Frequency response - all models 10Hz - 45KHz - 3dB

THE POWER SUPPLY UNITS



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PSU 30 ± 15V at 10ma to drive up to five HY5 pre-amps £4.50 + 68p VAT **PSU 36**

for 1 or 2 HY30's **£8.10** + £1.22 VAT for 1 or 2 HY50's **£8.10** + £1.22 VAT PSU 50 with toroidal transformer for 1 or **PSU 70** £13.61 + £2.04 VAT 2 HY120's

PSU 90 with toroidal transformer for £13.61 + £2.04 VAT 1 HY200 with toroidal transformer for PSU180 1 HY400 or 2 x HY200 Ma

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CHROMATHEQUE 5000



Panel size 19.0" x 3.5". Depth 7.3"

5 CHANNEL LIGHT EFFECTS SYSTEM

COMPLETE KIT

ONLY

£49.50 + VATI

This versatile system featured as a constructional article in ELECTRONICS TODAY INTERNATIONAL has 5 frequency channels with individual level controls on each channel. Control of the lights is comprehensive to say the least. You can run the unit as a straightforward sound-to-light or have it strobe all the lights at a speed dependent upon music level or front panel control or use the internal digital circuitry which produces some superb random and sequencing effects. Each channel handles up to 500W and as the kit is a single board design wiring is minimal and construction very straightforward

Kit includes fully finished metalwork, fibreglass PCB controls wire etc. — Complete right down to the last nut and bolt!

MPA 200 100 WATT (rms into 8Ω) MIXER/AMPLIFIER

COMPLETE KIT ONLY £49.90 + VAT!

MATCHES THE CHROMATHEQUE 5000 PERFECTLY!



Panel size 19.0" x 3.5". Depth 7.3"

Featured as a constructional article in ETI, the MPA 200 is an exceptionally low priced — but professionally finished — general purpose high power amplifier. It features adaptable input mixer which accepts a wider range of sources such as microphone, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 2000 is simplicity itself with minimal wiring needed making construction very straightforward.

The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt.







T20+20 20W STEREO 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.

MATCHING TUNERS — SEE OUR FREE CATALOGUE!

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 (last 4 kits on this page), or professional quality rack mounting cabinet (first 2 kits on this page), cables, nuts, bolts, etc., and full instructions — in fact everything!

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

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DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO 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 H-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.

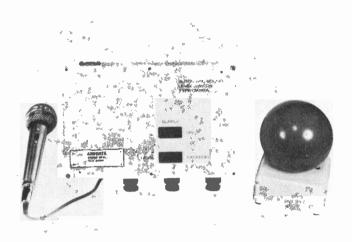
LINSLEY-HOOD CASSETTE DECK £79.60+VAT

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.





DIGEST



Silence Is Golden

It's also ball-shaped. (I'm not going to be rude, honest). The Golden Ball is a new, automatic sound level controller for discos and dance halls. Made by Ardente of Windsor, well-known for their work in noise control, this unit is designed to help club owners avoid complaints, keep neighbours happy and reduce health risks to audiences.

A sensitive directional mike detects harmful noise levels, a golden, ball-shaped light switches on when the sound is too loud and a control box shuts off amplifier power if the warning is ignored.

The mechanically accepted

figure at which sound becomes a danger to health is 90dB, so the system automatically cuts out noise in excess of this figure. Below that, users can set their own particular comfortable maximum noise level.

So what happens when the maximum is exceeded? Well, the ball lights up to warn everyone that the limit has been reached. Five seconds then elapses in which the sound level can be reduced voluntarily. If this isn't done, there's an embarrassing five seconds of silence until the system resets itself.

Full details of the Golden Ball are available from the Anti-Noise Pollution Division, Ardent Ltd, Thames Avenue, Windsor, Berkshire.

Air-Porters

If you've had to lug cases miles around an airport, from terminal to bus station or car park, you're well aware of the need for transport within an airport complex. Gatwick are going in for a luxury system — unmanned vehicles.

However, these won't be the sort of unmanned buses that sit stationary by the kerbside defying all timetables and raising the blood pressure. Built by Westinghouse (couldn't a British firm do it?) the system will comprise two fully automatic buses, each operating on its own track connecting the main terminal to the new satellite building.

Each bus will carry 80 passengers, mainly standing, although some seats will be provided for the elderly, infirm or panic-stricken. Doors will open and shut automatically and pre-recorded message will advise passengers to mind the doors and hold tight. No passenger should have to wait more than 90 seconds for a lift.

Although it's an American system, 45% of the work will be done by UK industry. Work has already begun on the new satellite project, which is due for completion in 1982.

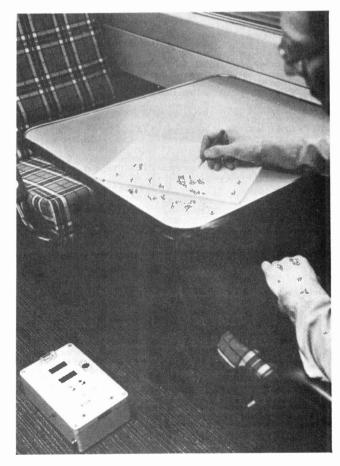
Sitting Comfy?

How do you rate the ride comfort of your daily commuter train? Perhaps the number of coffee spills per mile or the number of times you're woken from pleasant slumbers.

Well, the ride comfort on the new Advanced Passenger Train should be improved, thanks to the Jacobmeter. This interesting little instrument (named after the BR engineer who developed the concept) measures vertical and horizontal accelerations separately and displays calculated root mean square values according to criteria in ride comfort curves derived from the ISO and motion sickness data. The integration period can be set to either 10 or 60 seconds.

The Jacobmeter is currently being used in commissioning trials on the prototype Advanced Passenger Train. It may later be used as a tool for general use throughout British Rail. So, fellow commuters, it looks like chuff-chuff comfort may be a bit better by the time we take out a mortgage on our next season ticket.

The Jacobmeter is made to a BR design by Kemo Ltd, 9-12 Goodwood Parade, Elmers End, Beckenham, Kent BR3 3QZ.



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74LS03	14p	74LS49	130p	74LS151	65p	74LS247	150p
74LS04	15p	74LS73	40p	74LS153	65p	74LS248	150p
74LS05	25p	74LS74	40p	74LS155	96p	74LS249	90p
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74LS21	24p	74L\$107	40p	74LS174	90p	74LS365	95p
74LS22	25p	74LS109	50p	74LS175	92p	74LS366	95p
74LS26	35p	74LS112	50p	74LS190	120p	74LS367	95p
74LS27	25p	74LS113	50p	74LS191	120p	74L\$368	9.5p
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MEMORIES

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SOS (Save Our Servos)

Radio-control remember that sinking feeling in your stomach as you watched your R/C model fall out of the sky, unable to do anything about it. Bet it was a shock, especially if your model was a yacht.

Chromatronics have just announced the introduction of an electronic fail-safe for radio modellers to minimise the danger of a model going out of control in the event of interference or loss of signal. Interference from what? Who said Citizen's Band (or is it Banned)?

The system will cope with co-channel interference from another R/C transmitter or CB (I promise I won't mention it again), total or partial transmitter or receiver failure and the model moving out of range. If your model tips the scales at 5kg or more, a fail-safe device is obligatory under CAA regula-

Unlike earlier simple devices, the PPIM-4CH works by two level threshold detection on all four receiver outputs. So, all primary control functions can be protected from severe

glitches from whatever source. The unit is used to set up to four control servos in preset safe positions during a catastrophe. So, if the world should end, your Sopwith or Starfighter will still be zooming around the blue vonder until it runs out of four star, thanks to Chromatronics.

The unit works with any three wire positive pulse servo and has individual preset controls for each servo and variable fault detection thresholds. Cutin time is only 0.1 seconds. The PP1M-4CH is connected between the receiver and servos and works with either AM or FM systems on the 27MHz UHF band or any other operational frequencies. It is small (62×42×23mm) and lightweight, packed in a robust plastic capsule. It comes with four input leads and four output leads already fitted, but you have to fit the appropriate plugs and sockets for your equipment.

For only £14.95 (including VAT), this electronic fail-safe device sounds like remarkably good value, considering the cost of replacing a crashed model. The PPIM-4CH is available from Chromatronics, Coachworks House, River Way, Harlow, Essex.

New

Neosid, a name well known in professional and consumer electronics, has recently established a new outlet for the amateur constructor and small

The new Small Order Catalo-

gue covers a broad cross section of the company's products ferrite beads, screw cores, rods, E, I and U cores and coil assemblies, plastic formers and trimming tools.

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	POWER SUPPLIES	
	PSU36 — Drives 2 x HY30s	€6.38
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ŀ	PSU90 one HY200	£13.70
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OHIO SUPERBOARD II Only £188.00

Only £188.00

Yes, we are now selling this popular single board microcomputer at the giveaway price of £188.00. Due to the recent devaluation of US Dollar against £ Sterling, we have been able to purchase Superboards at lower price. Naturally, we wish to pass this price advantage on to our customers. Buy now to avoid disappointment should Mrs. Thatcher & Co. decide to devalue the Pound. Superboard II is supplied fully assembled and tested to British TV specification. Also included at no extra cost 4 manuals and a Cassette with programmes. Requires + 5 vs. at 3A and a Video Monitor or TV with RF Conventor to be up and running. (Data sheet supplied. We can also supply the RF Convertor and Power Supply in Kit form or ready-builty). BK Microsoft BASIC in ROM. 4K Static RAM — on BOARD expandable to 8K. Full 53 Key Keyboard with Upper /Lower Case & User programmability and a lot more. See it for yourself. Continuous demonstration on at our retail shop.

Specially designed attractive fibreglass case (VDU Unit can be mounted on it).

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Extra 4K of RAM.

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SLIDE 250V 1A DPDT 1A DPDT c/over 1/2A DPDT 4 pole 2-way PUSH BUTTON

SUB-MIN TOGGLE
SP changeover 59p
SPST on/off 54p
SPST biased 85p
DPDT 6 mgs 70p
DPDT centre off 79p
DPDT Biased 115p

Spring loads SPST on / off SPDT c/over DPDT 6 Tag MINIATURE

PANEL

METERS*

ROTARY: Make your own multiway Sw Adjustable Stop Shafting Assembly. Ac modate up to 6 Waters Mains Switch DPST to fit Break Before Make Waters. 1 pole/12 2p/6 way. 3p/4 way. 4p/3 way. 6p/2 on multiway Switch

ROTARY: (Adjuntable Stop)

1 pole/2 to 12 way, 2p/2 to 6 way, 3 pole/2 to 4 way, 4 pole/2 to 3 way

ROTARY: Mains 250V AC. 4 Amp

Extra 4K of	RAM
CRYSTAL	S
100KHz	385
455KHz	383
1MHz	323
1.008M	395
1.28MHz	392
1.6MHz	323
1.8MHz	323
1.8432MHz	362
2.4576MHz	362
3.2768M	323
3.57954M	195
4.032Mhz	323
4.433619M	135
5.0MHz	355
5.185M	323
6.5536M	200
7.680M	323
8.86723M	323
9.375M	323
10 OMHz	323
10 7MHz	323
12MHz	392
14.3181MHz	
18MHz	323
18.432M	323
20.0MHz	323
27.648M	323
48.0MHz	323
100.00MHz	323
	_

Controller Send SAE plus

CMOS+

40: 40: 40: 40: 40: 40: 40: 40:

Extra 4K of RAM		8.50	RO	TARY
CRYSTALS 100KHz 385 1455KHz 383 1MHz 323 100KHz 385 100	TRANSFORMERS (Main 6-0-6V: 9-0-9V: 12-0-12V 8VA: 6V-5-8 6V-5-8 12V-12V-3A: 15V-12A:	100mA .4A 9V-25A 3A: 6V-1. 4A 15V-22 A: 9V-1. 3A 15V-29 2-2.5A 9V-1. 1.5A: 20 0V-8A 30 356 655 4A: 15V-30 30V-1.5/ 550V-1A 1	4A: 12' 2A 6V- 4A; 20' 0p (20p 3A 9V- 8A; 20' 0p (45p 2:5A, 12' V-1.2A 0V-8A 0p (50p 0p (60p 3A 15' A 30V- 50V-1A	95p V-3A 195p 1.2A; V-3A (p&p) 1.3A; V-6A p&p) 2V-2A 20V- p&p). P&p). V-3A (650p
10 0MHz 323 10 7MHz 323	VOLTAGE REGULAT	npe		
12MHz 392	1A TO3 + ve	Ous	- 1	
14.3181MHz 300	5V 7805 145p	7905	220p	OPT
18MHz 323 18.432M 323	12V 7812 145p	7912	220p	ELE
20.0MHz 323	15V 7815 145p 18V 7818 145p			
27.648M 323	1A TO220 Plastic Casi	nn	- 1	LEDs w
48.0MHz 323	5V 7805 65p	7905	75p	TIL209
100.00MHz 323	12V 7812 65p	7912	75p	TIL211
	15V 7815 65p	7915	75p	TIL220
ETI Projects:	18V 7818 65p	7918	75p	2" Gr
Parts available	24V 7824 65p		- 1	or Amt
for: Click	100mA 1092 Plastic Cas	ing	- 1	Square
Eliminator	5V 78L05 30p	79L05	65p	Gm., Y
Ambush; Gui-	6V 78L62 30p		- 1	TIL32
tar Effect Unit;	8V 78L82 30p	79L12	65p	LS400
	12V 78L12 30p 15V 78L15 30p	79L12	65p	OCP7
Audio Display;			270p	ORP61
DM900, Audio-			270p	2N57
phile Amp,	LM305H 140p LM7 LM309K 135p TAA		50p	
60W Amplifier		525B	95p	IS
System. Train		1412	150p	1L74
Controller.		5 +5/54	595p	TIL11

SMILL VILLE		
ULATORS	1	
	- 1	ОРТО
p 7905	220p	IOPIO
p 7912	220p	ELECTRO
p		LLLOIMO
P	-	LEDs with Clips
astic Casing		TIL209 Red
7905	75 p	TIL211 Grn.
p 7912	75p	TIL212 Yel.
		TIL220 .2" Red
	75p	.2" Green, Yellow
		or Amber
astic Casing		Square LEDs, F
	65p	Gm., Yel.
	-	TIL32 Infra Red
	-	LS400
	65p	OCP71
	65p	ORP12
	270n	ORP61
	38n	2N5777
TA 4550	50p	
	p 7905 7912 p 7912 p 7912 p 7915 p 7915 p 7915 p 7915 p 7918 p 7918 p 7918 p 7918 p 7918 p 7918 p 7918 p 7918 p 7918	7905 220p p 7905 220p p 7912 220p p 7912 75p p 7905 75p p 7912 75p p 7915 75p p 7916 75p p 7916 65p p 79112 65p LM327 270p LM723 38p

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11	18	4050	33	4162	78		55	4557	365	
12	14	4051	45	4163	78		228	4558	105	
13	35	4052	45	4174	82		149	4559	375	
14	55 63	4053	45	4175	78 90		65 152	4560	210	
15 16	25	4054 4055	110	4408	670		55	4561	65 375	
17	60	4056	110	4409	670		145	4566	155	
18	60	4057	1650	4410	670		85	4569	280	
19	32	4059	480	4411	79		135	4572	26	
20	70	4060	90	44126			67	4580	595	
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22	50	4062	995	44151			365	4582	130	
23	14	4063	110	4415			142	4583	75	
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0-500mA 0-7x3" 210 0-1A 0-1A 0-2A 0-25x3" 215 0-25V	2x1" 54 4x5\(\frac{4}{x}\) 1\(\frac{4}{x}\) 72 4x1\(\frac{4}{x}\) 72 (2\(\frac{4}{x}\) 1\(\frac{4}{x}\) 88 (2\(\frac{4}{x}\) 1\(\frac{4}{x}\) 98 (4x2" 98 (4x2" 145 (5x2\(\frac{4}{x}\) 145	0-500µA 0-1mA 0-5mA 0-10mA 0-50mA 0-100mA
'S''	2½x2" 72 (4x2" 98 (4x2" 98 (5x2½" 145 (5x3" 185 0x7x3" 210 0x4¼x3" 175 2x5x3" 215	0-5mA 0-10mA 0-50mA 0-100mA 0-100mA 0-1A 0-2A 0-25V 0-50V AC 0-300V AC

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209 Red 13	0-50µA

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	18	7 Segment Dist		ı
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	48	TIL312 3" CA	105	ı
əd	58	TIL313 .3" CC	105	ı
	255		115	i
	120	TIL322 .5" CC	115	ı
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	85	DL707 3" CA	99	ı
	45	DL747.6" CA	180	ı
		FND357 Red	120	ı
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Bandwidth Wide **Modulator for Com-**£4.70 puters

SPECIAL OFFER

310 240 16 57 42 46 35 1.95 55 80 70 206 741 **17p** 2114 **439p** 555 **20p** 2708 675p

Core **Blimey**

Walmore Electronics have introduced a new range of transformer cores for switched mode power supplies. The range includes toroidal cores and three sizes of E core.

The cores are made from iron powder, the advantage over ferrite being that high saturation flux density is maintained to unit operating temperatures. Because of this, inductors can also often be reduced in size. The use of a distributed gap enables a reduction to be made in the external flux leakage Other core materials need large lumped air gaps to maintain incremental inductance at high DC bias levels.

Also from Walmore are three new ranges of power Darlington transistors in TO-92 miniature plastic packages. The devices are Unitrode types U2TA506/508/510 and feature a current gain of 500 at a collector current of 3A and a saturation voltage of only 1V5 at 3V. They are planar NPN devices, each consisting of a two transistor circuit on a single monolithic clip which also includes an integral bias resistor and protective diode. Each type is specified according to its maximum collector-emitter voltage - 60V for the 506, 80V for the 508 and 120V for the 510. These new Darlingtons are ideally suited to pulse power applications in power supplies, printers, solid state relays, etc.

The new ranges of cores and power Darlingtons are available from Walmore Electronics, 11-15 Betterton Street, Drury Lane, London WC2H 9BS

Oops OOPS Microwave Oven Leakage **Detector**

This has proved to be a very popular project. We've had a lot of inquiries about the diode used. If you're having trouble finding one, you can get it from Brian J. Reed, 161 St. John's Hill, Battersea, London SW11 1TQ. Mr Reed's catalogue is 75p + a large stamped (27p) addressed envelope. If you just want one diode, send 30p + a

Motor Speed Controller

Let's see if we can get it right this time. The unmarked resistor above Q2 on the overlay on page 49 should be marked R11. Now, if we take the overlay labelling on page 49 as correct, let's alter the circuit diagram to agree with it. The first column shows the published resistor labelling and the second column shows the corrected ver-

> R10 R11 R13 R11 R13 R14 R14 R15

Also, a resistor has been omitted from the circuit diagram. R10, a 2M2 resistor, should be shown between pin 2 of IC4 and the OV line ie in parallel with C5. These changes in resistor labelling also apply to the parts



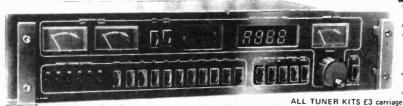
Typical Reader Competition

We're interested to know what our readers think of us. We don't usually hear what readers think of themselves, though. This is what Mr. O'Donohoe figures a typical ETI reader looks like. Wot — no suspenders and stockings? You've shattered my illusions, Mr. O'Donohoe. But you've started something. Let's see what the rest of you think (or hope) the typical ETI reader looks like. If we get any photos that are printable, there could be a few free T shirts in the post.

4490

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DIY Hi-Fi will never seem the same again. Ambit's Mark III tuner system is electrically and visually superior to all others Some options available, but the illustrated version with reference series modules £149.00 + £22.35 VAT With Hyperfi Series modules £185.00 + £27.75 VAT



- Precision construction & design of all parts
- Time/frequency display State of the art performance with facilities for undates using modular plug in systems.
- Deviation level calibrator for recording
- All usual tuner features

Digital Dorchester All Band Broadcast Tuner: LW/MW/SW/SW/SW/FM stereo

A multiband superhet tuner, constructed using a single IC for RF/IF processing - but with all features you would expect of designs of far greater complexity. The FM section uses a three section (air gang) tuned FET tunerhead, with ceramic IF filters and interstation mute; AM employs a double balanced mixer input stage, with mechanical IF filters - plus a BFO and MOSFET product detector for CW/SSB reception. Styled in a matching unit to the Mark III FM only tuner, employing the same degree of care in mechanical design to enable easy construction. MW/LW reception via a ferrite rod antenna.

Electronics only (PCB and all components thereon)

Complete with digital frequency readout/clock-timer hardware

£99.00 + £14.85 VAT

Complete with MA1023 clock/timer module with dial scale £66.00 + £9.90 VAT 'dardware packages are available separately if you wish to house your own designs in a professional case structure. Please deduct the cost of electronics from complete prices.

LW/MW/FM LCD Digital Frequency Display - July PW feature

Update your old radio, or build this into a new design Or use it as a servicing aid - this low power unit with CD display reads direct frequency in kHz/MHz, or with usual AM/FM IF offsets for received frequency. Low power LCD means no RFI - 15-20mA at 9v even with the divide by 100 prescalar. FM resolution is 100kHz, AM IkHz, Sensitivities better than 10mV ***********

Complete kit £19.50 + £2.93 VAT, built and tested module £27.00 + £4.05 VAT

Ambit stocks and distributes a wide range of frequency counter LSI for all types of DFM-part two of the catalogue contains details of the MSM5523/4/5/6 range, and the versatile MSL2318 divide by ten or hundred prescalar IC. The DFM1 combined counter for AM,FM SW and direct/clock/stopwatch/timers - details available, but SAE please !

PW SANDBANKS PI METAL LOCATOR Maintaining our professional approach to home constructor kits, we offer the pulse induction 'Sandbanks'. Now with injection molded casing for greatly improved environmental sealing. £37.00+£5.55vat

VHF MONITOR RX WITH PLESSEY IC 4/9 channel version of the PW design but using standard (fundx9) crystals, and TOYO 8 pole crystal filter with matching transformers. Coil sets from our standard range to cover bands from 40 to 200MHz. Complete module kit £31.25 +£4,68 vat

MICRO	MAR	ET	OSTS of	verflow	:
6800P		8212	230p	12102	170p
6820P		8216	195p	2112	340p
6850P	275p		350p	2513	754p
6810		8228	478p		578p
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8080	630p	8255	540p	+15%	VAT

ADIO and AUDIO MODULES: Consistently the most advanced	
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EF5801-3-4 series: 6 stage varicap tuning, all with oscillator output	

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7030 single 6 pole linear phase filter IF with HA1137£10.95 + 1.64VAT

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DECÓDERS for MPX (STEREO)

Various types, guaranteed the world's biggest and best ranges

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MOSFET front end combined with CA3089 IF £26.50 +3.97VAT
7252

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FM/AM tuning synthesiser, see details elsewhere in th is advertisement

90p 35p 175p 175p

COMPONENTS FOR RADIO/COMMUNICATIONS/AUDIO/TV etc.
As usual, Ambit brings you the latest and best, a small selection of which is shown in this advertisement. The Ambit catalogues contain information on most of the devices mentioned here - and an order for the new part three will ensure you stay up with latest developments. Data photocopying service described in pricelist info.

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RADIO ICs	for FM	vat	SL1600	eries		Audio prean	nps	vat	1
CA3089E	1.94	29	SL1610	1.60	24	LM381N	1.81	27	1 X
CA3189E	2.45	37	SL1611	1.60	24	LM382N	1.65	25	.50 pr etc. achi types
HA1137W	2.20	33	SL1612	1.60	24	KB4436	2.53	38	
HA11225	2.20	33	SL1613	1.89	28	KB4438	2.22	33	25.3
SN76660N	0.75	11	SL1620	2.17	33	TDA1028	3.50	53	+≥52
RADIO ICs	for AM	/FM	SL1621	2.17	33	TDA1029	3.50	53	AH G
TDA1090	3.35	50	SL1623	2.44	37	TDA1074	3.75	56	9 5 5 A
TDA1083	1.95	29	SL 624	3.28	49	Audio powe	r		# E E F
TDA1220	1.40	21	SL1625	2.17	33	TBA820M	0.75	11	\$ <u>~ ~</u> \$
IF AMPLIFI	ERS		SL1626	2.44	37	TBA810AS	1.09	16	3 c # 8
KB4406	0.50	07	SL1630	1.62	24	LM380N	1.00	15	2S 2S 2S 3rs
MC1350	1.20	18.	SL1640	1.89	28	ULN2283	1.00	15	133/ 113 tr
see comms in	es also		SL1641	1.89	28	TDA2002	1.95	29	
COMMUNIC	ATION	IS	SL6640	2.75	41	HA1370	2.99	45	2SJ1; variou from series
KB4412	2.55	38	SL6690	3.20	48	TDA2020	2.99	45	U 2 = 2
KB4413	2.75	41	MC3357	3.12	47	FETs, MOSE	ETs, b	ipola	irs.
SD6000	3.75	56	MC1496	1.25	19	and various	others:	see F	PL

OSTS: Remember all OSTS stocks are obtained from BS9000 approved sources - you assurance that all devices are very best first quality commercial types. Some LPSN TTL is presently in great demand, so please check by phone before ordering.

TL: Standard AND LP Schottky All prices listed in pence * VOLTAGE REGS: 7800 series 1 Amp pos 95p 7900 series 1 Amp pos 95p 7900 series 1 Amp pos 1000 mp neg

	1	1	1	-	1				1		7900 series TAmp ne	
7400		20	7472	28		74142	265	1	74257	108	78M series ½Amp po	5
7401		20	7473	32 38		74143	312	1	74260	153	78LCP 100mA	
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7403		20	7475	38 40		74145	65	97	74283	120	79MGT2C variable	
7404	14	24	7476	37 38	1	74147	175	-	74293	95	723CN variable IC	
7405	18	26	7478	38	1	74148	109	191	74365	49	NE550	
7406	38		7480	48	1	74150	99	1	74366	49	L200 variable V and	
7409	17	24	7481	86		74151	64	B4	74367	43		
7410	15	24	7482	69		74153	64	54	74368	49	MAINS EMI FILTER	
7411	20	24	7485	104 99		74154	96		74373	77	(BS etc approved typ	
7412	17		7486	40		74155	54	110	74374	77	1 Amp in IEC chassis	
7413	30		7489	205		74156	80	110	74377	124	connector	
7414	51		7490	33 90	1	74 157	67	55	74379	130	6 Amp in IEC	
7415		24	7491	761110		74158		60	74393	140	5 Amp wirein	
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7421	29		7495a		1	74162		130	NE555 30		E556 78p NE558	
7423	27		74961		1	74163	92	78	LM3909 72			
7425	27		7497			74164		130	95H90DC d	ivide b	y 10/11 to 320MHz	
7426	11	27				74165	105		11C90 DC di	vide by	10/11 to 650MHz	-1
7427		29	741XX		. /	74167	20		8629 divide	by 100	to 175MHz min	
7428	35		74107		38	74169	1	200	MSL2318 di	vide by	10/100 to 175MHz m	in:
7430	17		74109		38	74170	230	200	ICM7216BH	인 : 8 :	decade 10MHz DFM co	un
7432	25		74110		54	74172	625	200	and full fund	tion ti	mer, with direct drive f	or
7437	40		74111	68		74174	87	120	LED display	(mpx)	. Uses 10MHz xtal	1
7438	33		74112	1	38	74175	87	110	ICM7217AII	BI - 4 i	decade programmable	
7440	17		74113		38	74176	75	110	counter with	direct	LED drive	
7441	74		74114		38	74177	78		ICM7207 cld			
7442	70	aa	74116	198		74181		350	ICM7208 - 7	decad	e counter display	1
	115	33	74118	83		74183	103	210	ICM7106CP	· I CD	DVM (3½ digit)	- "
	112		74120	115		74184	135	210	ICM7106CP	K - ava	luation kit for 7106	2
7448	94		74121	25		74185	134		ICM7107CP	· LED	DVM (3½ digit)	
7446	94		74122	46		74188	275		ICM7107CP	KILL	D OVM kit for 7107	20
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7448	56		74124		137	74190			d-i 10 (23/4	LED/Fluorescent displ	ay
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			74126	57	44		105		received freq	nency	display and direct cour	
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7460	17		74139		60	74199	160	. 1			17106 or MSM5526	11
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IMPORTANT: ALL PRICES SHOWN EXCLUDE VAT WHICH MUST BE ADDED AT 15% OVERALL. PLEASE NOTE THE REDUCED CMOS/LPSN TTL RANGES DUE TO CURRENT SUPPLY SHORTAGE.	4000 4001 4002 4006 4007 4008 4008 4008 4010 4011 4011 4011 4011	117 117 117 117 117 117 117 118 119 117 117 155 117 155 157 159 159 177 180 177 180 180 183 183 183 183 183 183 183 183 183 183	4522 4522 4522 4532 4533 4533 4533 4543 4554 4556 4566 4566	3 102 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	84 90 72 67 30 66 186 60 64 36 65 59 65 66 27 70 36 105	0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
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£3 + 0. lock/tim			1VIOS 3 + 0.	PA n 57 V	nodule AT. 12	25

MORE FROM THE GENERAL AI Varicap tuning diodes for AM/FM/TV: 1-9 v AM tuning (Cr 15:1) from TOKO— KV1211 double matched 175p 26p vat KV1210 triple matched 245p 37p vat KV1215 triple snapapapar 245p 37p vat	MBIT CATALOGUE RANGES: MPU controllable digital freq. synthesiser PCB. Preliminary: Serial data controlled, with the standard swallow count system for maximum speed of operation.
MVAM115 single 15v MVAM125 single 25v MVAM2 double 25v BB204/104 double FM BA102 single AFC etc BA121/1Tr210 single afc BB105B single UHF 40p 6p vat B0 vat	Multiple time constant filters, suitable for AM/FM and other communications/generator applications, Not for beginners. Full preliminary data package £1 + SAE. No phone enquiries answered on this system for the
PIN DIODES, BANDSWITCH types BA479 PIN attenuator 35p 5p vat TDA1061Pi-form atten. 95p 14p vat BA182 Bandswitch 21p 3p vat All RF semiconductors stocked in depth. Please ask for quantity pricing details.	time being. Watch this space Projected cost of the controller PCB less than £30: comprises the two modulus counter, prog.div., phase detector, multiple TC loop filter/integrators.

MPU controllable digital freq. synthesiser PCB. Preliminary: Serial data controlled, with the standard swallow count system two modulus counter, prog.div., phase detector, multiple TC loop filter/integrators. TOP GRADE LEDS by AEG: PRICES ARE EXC. VAT (add 15%) SIZE Red Green Yello Orang Quantity discount for LEDs:

	op 15p 20	Op 10	per type - less 10%
			0 per type · less 30%
2½x5 17p 20	Op 20p 2		10 mix in 10s - less 25%
FUTABA FLU	DRESCENT	VACUUM	DISPLAYS for CLOCKs etc
			th AM/PM flags £9 + 1.35
			SI counter £9.45 + 1.42 vat
6LT06 5 digi	t DFM displa	y IGI AYS	3100) mpxed £9.75 +1.46 vat
			for AM/FM/TV comms-
TYPE Size:	5mm 7mm		(please add VAT @15%)
AM IF	55p 33p	30p	Various for ICs, transistor etc
FM IF	55p 33p	33p	Various for ICs, transistor etc
SW coils		33p	Two impedance series
OSC coils	55p 33p	33p	For LW/MW/SW
TV vif/sif		35p	
Various coils in	the range 20k	Hz to 300	MHz - see TOKO catalogue
CERAMIC and	MECHANICA	L FILTER	S (inc MURATA TYPES)
CFT455B/ CFT	455C 60p:	CFX014 -	180p: CFU455C - 85p
CFT470C - 60p;			
			min blank filmer 1 of

MURATA CFU455H and CFU455F cermic block filters 1,95ea MURATA CFM45S series ladder filters, 0,E,F,G,H bandwidths available now (20,16,12,8,6 kHz) £8.35 ea [metal encapsulated] SFD455B, SFD470B, SFD472B S5p ea CFM2 series mechanical elements types A,B,C,D (4-10kHz bandwidth)

CFINIZ series mechanical elements types A.B.(C) (4-10kHz bandwidth)
-65p va. (As used in RCME feature)

MULTIPLEX/PILOT TONE FILTERS, FM IF FILTERS (see cat and:)
CFSE10.7/SFE10.7 - stereo FM IF ceramic filters (sim FM4 etc.) 50
CFSB10.7/SFE10.7MJ - mono bandwidth ceramic FM IF filters 50
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COA10.7 - 10.7 MHz ceramic discriminator (for CA3089 etc) 70
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COA10.7 - 10.7 MHz ceramic discriminator (for CA3089 etc.) 70
COA10.7 - 10.7 MHz ceramic disc

Current news: A PCB for the Mullard DC tone and volume control system is now available £3 + 0.45 VAT. HMOS PA modules for 60-100W - kit £14 +£2.10VAT, heatsink £4.10+0.61. FM radio control system crystals £3.75 pair inc VAT (Sept. on). MK50366N: static drive clock/timer IC £3.78 + 0.57 VAT. 12/kHz channel spacing 8 pole 10.7MHz XTAL filter by TOYO type H4402 £15.50 + £2.32VAT. A further updated pricelist is now available, and we would like to remind you that enquiries can only be answered if accompanied either by an official business letterhead, or an SAE. STOP PRESS: TOKO's new split-apart triple AM tuning diodes are in stock £2.45 + 37p VAT. (KV1215). S BL1 diode DBM 1-500MHz - £4.25+0.64p.

Terms: CWO please. Account facilities for commercial customers OA. Postage 25p per order. Minimum credit invoice for account customers £10.00. Please follow instructions on VAT, which is usually shown as a separate amount. Overseas customers welcome - please allow for postage etc according to desired shipping method. Account facilities for credit purchases.

Catalogues: Ambit. Part 1 45p. Part 2 50p 90p pair. TOKO Euro shortform 20p. Micrometals toroid cores 40p, All inc PP etc. Full data service described in pricelist supplements. Hours/phone: We are open from 9am 7pm for phone calls. Callers from 10am to 7pm. Administrative enquiries 9am to 4.30pm please (not Saturdays), Saturday service 10am to 6pm.

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AMBIT catalogues are guaranteed to contain the most up-to-date and best informed comment or modern developments and advances in the field of radio and audio. There is no competetive publication that even approaches the broad range of parts/information on modern techniques.

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Compare our make, quality and p items subject to prior sale CD4015BE 57p CD4027BE CD402BBE RC4 CD4053BE CD4098BE RCA

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DL 704 / DL 707 FND 500 / FND 510 NOW THE CHIPS ARE DOWN

Due to bulk purchase, we are able to offer unbeatable prices on INTERSIL chips. Compare our prices and see how much 4.04 05.4

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ICL7106CPL	6.50	6.25	5.95
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LM324N Quad OP Amp NE555N-8 Timer I M556N-14 Dual Timer LM723CN Voltage Regulator LM747CN-14 Dual Op Amp 33p 40p

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Only £9.95 complete with British type

LED BAR GRAPH AND ANALOG METER DRIVER.

New from National LM3914. Drives 10 LED directly for making bar graphs, audio power meters, analog meters, LED power meters, analog meters, LED oscilloscopes, etc. Units can be stacked for more LEDs. A super versatile and truly remarkable IC. Just out! Special price: Only £1.99 inc. 12 page spec. sheet.

FAIRCHILD RED LED LAMPS

*FLV5057 Medium Size Clear Case RED EMITTING. These are not retested offspec. units as sold by some of our competitors. These are factory prime, first quality, new units.



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18 PIN 20 PIN 20 **22 PIN** 22 **24 PIN** 24 **28 PIN** 28 40 PIN 40

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FAIRCHILD SUPER JUMBO LED
READOUT
A full .80 inch character. The biggest
readout we have ever sold / Super efficient

> YOUR CHOICE FND 847 Common Anode £2 each

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THE MOST VERSATILE **LIQUID CRYSTAL DISPLAY**

1.24 25+100+ LCD106 6.45 5.50 5.25

5" Field effect LCD display featuring 31/2 digits, colon, plus/minus sign, 3 decimal points and "LO BAT" indicator. Ideal for DMMs, DPMs, digital thermometers, AM/FM radio readouts. Just look at the features. Ultra low power consumption, high contrast viewing ratio-wide angle-rapid responseproven sealing techniques-superior MTBF-reflective aluminium foil. Over 300,000 already sold! Compare our price at below distributors!

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We apologise to our customers for the delay in completing orders during July/ August as a result of our move. We are now back to normal.

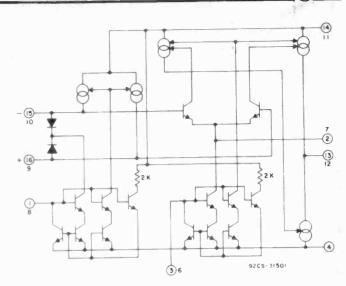
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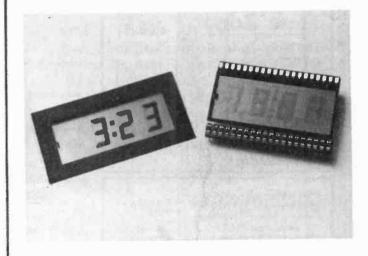
Happy Families

The latest offspring of RCA Solid State is a new family of dual variable operation amplifiers. The CA3280G Series combines two operational transconductance amplifiers in a single package.

The two amps are independent, differential input types and the output is a current proportional to the differential input voltage and the transconductance, which is programmable via a separate input terminal.

All characteristics of the two amplifiers are matched to within 5%. Peak output current can be as high as 650 uA at a bias current of 500 uA and operating bandwidth is 9MHz at a bias current of 1mA.

Applications include voltagecontrolled amplifiers, voltage controlled filters, voltage controlled oscillators, function generators, etc. The devices are supplied in 16 lead DIL plastic packages and are available with operating temperature ranges of -55 to +125°C (CA3280 AG) and 0 to +70°C (CA3280) from RCA Solid State - Europe, Sunbury on Thames, Middlesex TW16 7HW



Display Giants

New from Fairchild are a range of large area liquid crystal displays, suitable for clock and

digital panel meter purposes.

There are two versions — 3½ digit (FLB 3513) and 4 digit (FLB 4013), both featuring 0.5 inch digits. The inclusion of a colon allows the displays to be

used in timekeeping applications. Decimal point and polarity signs are included for digital panel meter use.

Power requirements? - 5V typical with a maximum drive current requirement, at 3V with all segments on, of 5uA.

You can find out more about these LCDs from Fairchild Camera & Instrument (UK) Ltd, 230 High Street, Potters Bar, Herts EN6 5BU

Quartz Melody Multi-Alarm Chrono For 1980 Try this 34 Function

Count-down



Can be used for a host of applications from boiling an egg to warning you your parking meter is expired. The timer is presettable to 23 hours

59 mins. 00 secs. in 1 min. steps and counts down in 1 sec. steps. It operates quite independently of the other counters and the watch can be in any other mode whilst it is being

At the preset time the musical tone will sound for 1 minute.

Alarm



The alarm can be set at 1 minute intervals to any time within the 24 hour period.

A clear firm musical tone sounds for 1 minute at the appointed time. An automatic roll-over to the normal time is a feature after the alarm has been read. A clear indicator displays whether the alarm is set or not.

Time Zone



The time zone enables you to tell the time in two places at once. It can be useful on holiday or business trips. Just programme the second time zone and it will be permanently recorded for your easy reference.

Chronograph



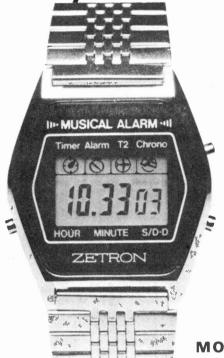
This watch incorporates a sophisticated and very accurate stop/start counter which has many applications in sporting events and timing for recordings

Mode 1: Is the normal stop-watch mode. Stop-

Mode 2: The lap timer enables first and second past the post times to be recorded. The display is frozen but the counter continues to count.

Mode 3: Longer timing intervals, such as journey times, can be recorded whilst the watch is reading its normal time, or the count-down is being used. The counter counts to 1 hour in 1/100 sec. steps in all

for only £26.95



MODEL M30

Display Format (NORMAL TIME DISPLAY)

2nd time-zone indicator Count down Alarm indicator Chronograph alarm indicator indicator Press S1-bs1 light Press S3mode selection Hold S3-S2 Press S2test SEC/DATE alarm sound Alternative hold S2-MIN SEC Sec to zero

5 independent working modes

- Normal watch
- Count down alarm ii)
- iii) Alarm
- iv Dual time zone
- 1/100 sec. chronov) graph

Display indicators (not all shown)

A very impressive new watch at a superbly low price from Metac. This super slim watch is only 7mm thick (that's thinner than most mechanical tick-tocks), but its microprocessor heart packs 34 different features.

In addition to those listed on the left the watch can display the day of the week in French or German or English (just select the one that suits you).~

It has fast and slow setting rates for the counter and the alarm as well as the normal time setting.

There are 7 display indicators, 6 digits and a back light for night viewing. The 5 working modes are independent of each other, and the watch can be operated in all 5 modes at once.

FOR ORDERING INFORMATION PLEASE SEE OVER



North & Midlands 67 High Street, D'AVENTRY Northamptonshire Telephone: 03272 76545

QUARTZ LCD 5 Function

Hours, mins, secs. month, date, auto calendar, back light, fully adjustable bracelet to fit all wrists.

£6.65

Guaranteed same day despatch.

Very slim, only



M1

M5

M9

SOLAR QUARTZ LCD 5 Function

Genuine solar panel with battery back-up Hours, mins, secs Day / date. Fully adjustable bracelet Back-light Only 7mm thick



Guaranteed same day dispatch.

£8 65



M2

QUARTZ LCD 11 Function SLIM CHRONO

6 digit, 11 functions Hours, mins., secs., day, date, day of week. 1/100th, 1/10th, secs.; 10X secs., mins. Split and Jap modes. Back-light, auto calendar. Only 8mm thick. Stainless steel bracelet

and back.
Adjustable bracelet. Metac Price

£10.65 Thousands sold!

Guaranteed same day dispatch

QUARTZ LCD ALARM 7 Function

Hours, mins., secs. Month, date, day. 6 digits. 3 flags plus continuous display of day and date or seconds. Back-light. Only 9mm thick £12.65

Guaranteed same day dispatch



MULTI ALARM 6 Digits

- 10 Functions
- Hours mins, secs Month, date, day Basic alarm Memory date
- alarm * Timer alarm with dual time and 5 country
- zone ★ Back light
 ★ 8mm thick

£18.65



9 024

FRONT-BUTTON ALARM Chrono Dual Time

6 digits, 5 flags, 22 functions Constant display of hours and mins, plus optional seconds or date display AM / PM indication Month, date Continuous display of day.

Stop-watch to 12 hours 59.9 secs. in 1/10 second steps Split and lap timing modes. Dual time zones Only 8mm thick Back-light.

.... 10. 10 cd Fully adjustat

£22.65 Guaranteed same M6

10. 10

SOLAR QUARTZ LCD Chronograph with Alarm

Dual Time Zone Facility 6 digits, 5 flags, 22 functions. Solar panel with battery back-up.
6 basic functions
stop-watch to
12 hours 59.9 secs. in 1/10 sec. steps. Split and lap timing modes.
Dual time zones Alarm, 9mm thick

Back-light. Fully adjustable bracelet.

£27.95

ALARM CHRONO with 9 World Time Zones

- 6 digits, 5 flags. 6 basic functions
- 8 further time
- Count-down alarm. Stop-watch to 12 hours 59.9 secs. in 1/10 sec. steps.
- Split and lap
- timing modes Alarm. 9mm thick
- Back-light. Fully adjustable

£29.65



M8

SOLAR QUARTZ LCD Chronograph

Powered from solar panel with battery back-up 6 digit. 11 functions Hours, mins., secs, day date, day of week 1/100th, 1/10th secs. 10X secs, mins. Split and lap modes Back light Auto calendar Only 8mm solar panel with

thick Stainless steel bracelet and back Adjustable bracelet

Metac Price £13.65

day dispatch

LADIES DAY WATCH QUARTZ LCD

Ladies Day Watch only 25 × 20 mm and 6mm thick. Hours, minutes, seconds, day, date, backlight and auto calendar.

Elegant bracelet in silver or gold fully adjustable to suit very slim wrists. State colour preference.

£9.95 Guaranteed same day despatch M15



Lady's Fashion Watch. Elegant bracelet in bronze/ gold finish or silver colour. Hours, minutes, seconds, day, date, backlight and auto calendar. Adjustable for the slimmest of wrists.

State colour preference.

£14.95

Guaranteed same day despatch

ANALOGUE

MACY QUARTZ



M7

10.10 a

10.10 90

M3

M17

LADIES COCKTAIL WATCH QUARTZ LCD

Lady's Cocktail Watch Highly functional watch which also suits those special occasions. Beautifully designed with a very thin bracelet which retains strength as well as elegance. Hours, mins., secs., day, date, backlight and autocalendar

Bracelet fully adjust-able to suit slim wrists. State gold or silver fin-£19.95

Guaranteed same day

Metac price break-

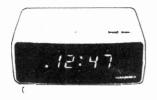
through for an

Alarm Chrono-



M18

HANIMEX Electronic LED Alarm Clock



Features and Specification Features and Specification. How minute dieptor, Large LED display with pilm and alarmion indicator, 24 Hours alarmic th no leff control. Display flashing for power fors indication. Reheatance 9 minute shooze. Display to just disminutes control. Size (5.15.1 x 3.93.1 x 2.36. +131min x 11mm x 60mm). Vie gnt 1 43 lbs (0 65 kg

£10.20 Thousands sold! Mains operated

Guaranteed same day despatch

M13

EXECUTIVE **ALARM WATCH**

6 functions plus alarm: Conference signal, 5 minute snooze alarm. Conference signal sounds 4 secs. before main alarm to give ad-vance warning and option to cancel. Snooze sounds 5 mins after main alarm and is always preceded by the conference signal.

£14.95 19 (*



M60

Automatic calendar day and date, infinite bracelet. This man's watch has elegance as well as the robust appearance provided by a watch with traditional features. Accuracy is provided



£24.95





M21

HOW TO ORDER Payment can be made by sending cheque, postal order, Barclay, Access or American Express card numbers. Write your name, address and order details clearly, enclose 40 pence per single item for post and packing or the amount stated in the advert. All products carry 1 year written guarantee and full money-back 10 day reassurance. Battery fitting and electronic calibration service is available to customers at any Metac shop. All prices include VAT currently at 15%.

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Trade enquiries — send for a complete list of prices for all the goods advertised plus many more not shown, also minimum order details.
Telephone orders. Credit card customers can telephone orders direct to Daventry (03272) 76545 or Edgware Road 01-723 4753 24 hours a day.

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graph with

Dual Time Only £16.95

OUTSTANDING FEATURES * DUAL TIME. Local time always visible

- and you can set and recall any other time zone (such as GMT).

 Also has a light for night viewing CALENDAR FUNCTIONS include
- the date and day in each time zone.
 CHRONOGRAPH/STOPWATCH
- displays up to 12 hours, 59 minutes and 59.9 seconds.
 On command, stopwatch display freezes to show intermediate (split/lap) time while stopwatch continues to run. Can also switch to and from
- timekeeping and stopwatch modes without affecting either's operation.

 ALARM can be set to any time within a 24-hour period. At the designated time, a pleasant, but effective buzzer sounds to remind or awaken you!

M16 Guaranteed same day despatch



ELECTRONICS & TIME CENTRES

North & Midlands 67 High Street, DAVENTRY Northamptonshire Telephone: 03272 76545

SEIKO MEMORY BANK

Calendar watch M354 Hours, mins., secs. Month, day, date in 12 or 24 hour format all indicated continuously.

Monthly calendar display month, year and all dates or any selected month over 80 year period.

Memory bank function.
Any desired dates up to 11 can be stored in advance.
2 year battery life.

Metac Price **£79.50**

Water resistant.

M11

SEIKO ALARM CHRONOGRAPH

With WEEKLY Alarm. Hours, mins, Secs, month, date, day, am/pm.
Weekly alarm — can
be set for every day at

designated time, e.g. 6.30am on Mon., Wed. and Friday. Alarm set time displayed above time Full stopwatch functions, laptime, split, etc.

Price £89.95

M₁₀

SEIKO MELODY ALARM CHRONOGRAPH

Chiming Alarm, plus chrono. Hours, mins secs, date, day, 24-hour alarm, 12 hour chronograph, 1 / 10th secs, laptime. back light, stainless steel, mineral glass

Metac Price £92.95 M19

SEIKO CALCULATOR WATCH

Full specification calculator with memory, plus multi function watch. Hours, mins, secs, day, date, backlight. Automatic calendar. Long-life battery.

Price £96.20

M27

CASIO CHRONO 95QS-3LB

Stainless steel case water resistant to 66 feet. Hours, mins, sec am/pm, year, month, date, day, Auto-calendar pre-programmed until year 2029, 12/24 hou stopwatch function.
Range 7 hours, 1/100
sec. (Mode), Net
time/lap-time/1st-2nd place times. Dual time function. Accuracy 15secs, per month, Battery life approx. 4

Price £22.95

M22

1:4059



Elegant slim line stainless steel bracelet, fully adjustable. Hours, mins, 10 sec. symbol second by flash, am/pm. Month, date, day. Auto-calendar pre-programmed for 28th day in Feb. Accuracy per month 15 secs., battery life approx. 15 months.

Hill io:58

Price £29.95 **M23**

CASIO F-200 SPORTS CHRONO

Attractive man's watch in black resin with mineral glass, Hours, mins, secs, am/pm. Month, date, alpha-numeric day Auto-calendar set 28th Feb. Stopwatch working range 1 hour units 1/100 sec. Mode. Net time / lan time / 1st-2nd place times. Accuracy approx. 15 secs. per month. Battery 12 months

Price £14.95



M24

CASIO ALARM CHRONO 81CS-36B

day, and also day, month and year perpetual automatic calendar. 100th sec. chronograph to 7 hours. Net time / lap time / 1st and 2nd place times. User optional 12/24 hr display. 24 Alarm. User optional, hourly chime. Backlight, mineral glass, stainless steel. Water resistant to 100ft. Battery life approx. 4 years.



£34.95 **M25**

BELTIME **CHRONOGRAPH**

9 Functions Hours, mins, secs, day, date, month, interchange feature, automatic calendar backlight, net time/lap time. Stainless steel bracelet. Battery life 1



Price £14.95 **M34**

BELTIME **MULTI ALARM**

29 Functions Hours, mins, secs, date, day. Alarm chronograph, light Watch 8 functions, Alarm 4 functions, chronograph 17 functions. Stainless steel bracelet.



Price £29.95

M35

CASIO F-8C

Hours, mins, secs, am/pm, date, day. Auto calendar set. 28th Feb. Stopwatch function. Accuracy 15 secs. per month.
Battery life approx. 3



Price £9.95

M36

CASIO CALENDAR 200

47CS-23B-1Black Stainless steel. Hours, mins, 10 second symbol, second (by flash), am/pm. Month, day, date. Auto calendar set from 1901 to 2009. Full month calendar display. dual time function. Accuracy 10 secs. per month, Battery life approx. 15 months

Price £59.95

M37

Mile.

MELODY MULTI-ALARM **CHRONOGRAPH**



Hours, mins, secs, day date, countdown alarm, dual time zone, 1/100th sec stopwatch Lap/split time, 1st and 2nd place times. Melody test function

Price £26.95

M30

DUAL TIME-ALARM **CHRONOGRAPH**



Incorporating module of world-famous Japanese watch manufacture. Hours, mins, secs. day of week, month, day and date, 24 hour alarm, 12 hour chronograph, 1/10th secs, lap time, backlight, stainless steel case and bracelet, mineral glass, battery hatch, long life battery

Price £35.00

M12

PICOQUARTZ NO. **MICROPROCESSOR ALARM** CHRONOGRAPH



Multi-language — day of the week can be set to English, French, German, Italian or Spanish. Chime — every full hour com-Spanish. Chime — every full nour combined with a response signal, beebing at every pressing of the functions. Can be switched off 12-24 hour format, backlight, Chrono — 1 full-scale chrono with lap, counting hours, up to 24 hours Minutes, secs, 1/100th secs. Two Alarm systems. Two time zones.

Price £37.95

M32

SEIKO CHRONOGRAPH



Hours mins, secs and day of the week. Month, date and day of the week. Stop-watch display Hours, mins, secs up to 12 hours (minutes, secs, 1/100 secs up to 20 minutes). Lap timing, continuous time measurement of two competitors, Stainless steel, mineral glass

Price £56.00

M33



North & Midlands 67 High Street, DAVENTRY Northamptonshire Telephone: 03272 76545

DIGITAL **CLOCK RADIO**



Mains. AM/FM/LW radio. Green digital display. Snooze alarm. Auto switch off. Clock dimmer. External FM Aerial.

£19.95

plus £1.30 Post & Packing

M40

Portable LCD Clock Radio



- Back-light.
 Batteries supplied free.
 Quartz crystal controlled.
- £17.95

M41

DIGITAL CLOCK LCD Travel



Hours, mins. 24 hour time and Alarm. Snooze timer. Large 12.5mm display. Night light. Size: 120mm x 74mm x

Weight: 120 grams.

£17.65

M42

QUARTZ ANALOGUE **CLOCK TRAVEL**



Mini Quartz Alarm clock. Complete with travel pouch. Features loud alarm and travel pouch. Features loud operates from 11/2 volt battery.

M43

LCD Calculator



Credit Card size Memory % ect plus auto power off. £7.95

M44

Digital Clock/Alarm/

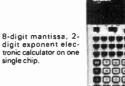


Calculator with % and memory. Continuous clock with hours, mins., secs., day, month, day of week, Alarm, Stopwatch, split-time. 1 year battery. Leatherette wallet.

£17.95

M45

LCD CALCULATOR SCIENTIFIC



Functions-SIN, COS, TAN, SIN-1, COS-1. Tan-1, SINH, COSH, TANH, e^X, 10^X, Ln, Log, V^X, 1/x. Statistical f

Statistical functions £16.95

M46

LCD CALCULATOR CASIO MELODY 80



Full calculator spec 3 independent musical alarms time, stop-watch, count-

£23.95

M47

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Black & White or Colour. 4 game, 2 bell speed, 2 ball angles, 2 battery sizes. Tennis, Hockey, Football, Handbell, Practice.

£11.95 Colour £8.95 B/W plus 54p Post & Packing

M48

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M49

AIR FRESHENER Electronic



Timer can be set to emit nice smells when required or running permanently to remove really bad smells. Battery

Price £4.95

M50

DIGITAL **CLOCK**

LED Display. Features Hours/mins. Display Alarm with snooze. Mains operated excellent value for money. Compact size only 6 in x 21/2 in x 3 in.

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M51

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M52

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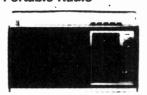


Condensor microphone. Battery or AC. Pushbutton key operation. Auto level control. Retractable handle. Eject equip-

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M53

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M54

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Battery operation. Retractable aerial. £9.95

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M59

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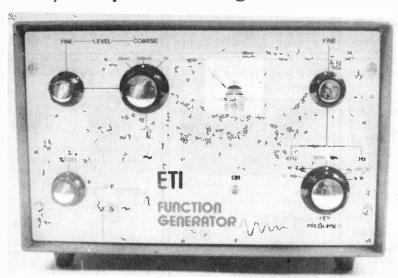
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FUNCTION GENERATOR

A wide range (1 Hz - 100 kHz) sine/triangle and square wave generator with built-in analogue frequency meter.

A really nice piece of test gear from ETI.



he main characteristic of a function generator is that it produces a basic fixed-amplitude waveform other than a sine wave, from which a fixed-amplitude sine wave is then synthesised. The main advantage of this technique is that the resulting output waveforms of the generator are immune to amplitude bounce' when they are swept through their frequency ranges, thus enabling amplifier or filter gain / frequency tests, etc. to be carried out very rapidly. The only disadvantage of the technique is that the resulting sine wave has an inherently higher degree of distortion than is obtainable from good 'Wien bridge' and similar tuned' oscillator circuits.

The ETI function generator produces three output waveforms (sine, triangle and square) and covers the frequency range 1 Hz to 100 kHz in five decade ranges. The sine wave output typically produces a THD (total

harmonic distortion) value of only 0.5%, has a maximum amplitude of 2 volts rms, and is ideal for general purpose testing. The triangle output has a typical linearity of 1%, a maximum peak-to-peak amplitude of 5V6 and is ideal for cross-over distortion testing of class-AB amplifiers, etc. The square wave output is positive-going, has a maximum peak amplitude of 8 volts, has typical rise and fall times of less than 200 nS and is ideal for testing digital circuits. All ouput waveforms of the generator are DC coupled, with the sine and triangle waveforms swinging symmetrically about the zero volts line.

Our function generator incorporates a number of additional, very attractive features. It has a built-in analogue frequency meter, for ease of calibration. It has two output terminals, each with its own attenuator network. A sine or triangle waveform is available from one output and a

PARTS LIST

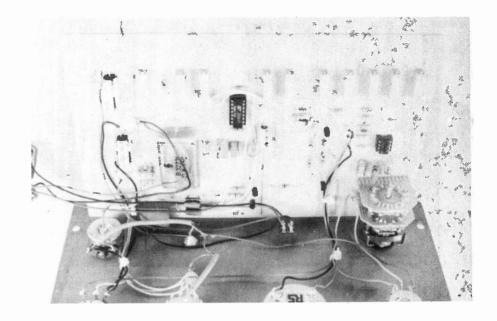
MACINES.	
	The Artist Decouples
	AII ¼W, 5%
R1,2,14	10k
R3,17	1k0
R4,5,10	2k2
R6,7,9	22k
R8	470R
R11,18	100R
R12,13,15,	47R
16	
R19	11R
POTENTION	METERS
RV1,2	47k cermet multiturn
	(3/4")
RV3	22k cermet multiturn
	(3/4")
RV4	470R cermet multi-
	turn (3/4")
RV5	4k7 cermet multiturn
	(3/4")
RV6	100k lin dual gang
RV7-10	10k
RV11	100k cermet multi-
	turn (3/4")
RV12,13	1k0 lin
11	
CAPACITO	RS
01,2	100u 25V electrolytic
C3,9	150p polystyrene
C4,13	10n polyester
C5.10.14.11	100n polyester
C6,15	1u0 polycarbonate
C7,8	10u 25V electrolytic
C12	in0 polystyrene
	ino porysej reno
SEMICOND	UCTORS
IC1	XR2206CP
C2	NE555
Q1,3	BC182L
02,4	BC212L
D1-3	1N4148
ZD1	BZY885V6
101	BZ 1003 VO
MISCELLA	NEOUS
SW1	DPDT (PCB type)
	toggle.
SW2	4 pole 5 way wafer
3072	switch assembly and 2
	PCB wafers (2 pole 6
	way)
SW3	DPDT toggle
SW4	1 pole 3 way rotary
344	switch
2 BNC sens	ectors, 2 PP7 batteries,
case to suit,	
case to suit,	100.

square wave is available from the other. The square wave output is available at all times, is synchronous with the sine/triangle waveform and can thus be used to provide synchronisation signals to an oscilloscope timebase during sine wave testing, etc. The unit is battery powered, for maximum user convenience.

A fine unusual feature is that the frequency ranges are alternately contra-connected, so that to increase frequency you turn the 'fine' control clockwise on one range, anticlockwise on the next range and clockwise on the next range, etc. This facility enables the frequency to be swept through several decades very rapidly when testing the frequency response of amplifiers and filters, etc. As we said in the introduction, this is a really nice piece of test gear.

Construction

Most of the circuit is built up on a single large PCB. Various points should be noted before starting construction. First, note that 4-pole 5-way range switch SW1 is mounted directly on the PCB and in fact is a 6-way PCB type (see Buylines) with one of the 'ways' unused. The next point to note is that the C6 (1uO) and C7 (10u) main timing capacitors are non-electrolytic types. We obtained ours from Electrovalue.



SPECIFICATION

Frequency range
Output waveforms:
Sine: distortion (typical)
Triangle: linearity (typical)
Square: rise/fall times (typical)
Waveform stability (typical)

Maximum output levels (with 9-0-9 V supply).

Supply Total current consumption

1 Hz to 100 kHz in 5 decade ranges.

0.5% at 1 kHz.

1% at 1 kHz.

less than 200 nS.

.002% per °C.

.01%/V supply sensitivity.

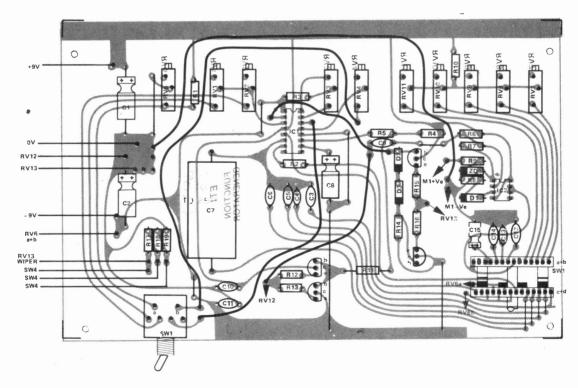
Sine = 2 V rms.

Triangle = 5V6 pk-pk.

Square = 8 V peak.

Two 9 V batteries.

30 mA typical.



At this stage access to a distortion meter is desirable, so that RV3 and RV4 can be trimmed for minimum distortion. With care, a thd figure of 0.5% can be obtained. In the absence of a distortion meter, the simple twin-T 1 kHz filter of Fig. 2 can be used in conjunction with the oscilloscope or with a milivoltmeter to set the generator for minimum distortion at 1 kHz. The procedure is to apply the sine wave output of the generator to the input of the filter at about 1 volt rms at approximately 1 kHz and take the output of the filter to the input of the 'scope or millivoltmeter. Next, adjust the generator frequency and R4 of the filter to give minimum output indication and, finally, adjust RV3 and RV4 of the generator to reduce the output indication of the filter to the minimum possible value. At final balance, the output of the filter corresponds to approximately 0.1% thd per mV rms of indicated reading, ie if the indicator shows a reading of 5 mV rms, the thd of the generator approximates 0.5%. Now retrim OFFSET control RV5.. The sine wave calibration procedure is then complete.

(3). Set the unit to TRIANGLE mode. Monitor the waveform on the 'scope and adjust RV2 for a pk-pk amplitude of 5V6.

(4). Check that the unit is functional on all ranges, in all waveform modes.

(5). Switch the unit to its top frequency range, set the output frequency to 100 kHz and adjust RV7 for full scale deflection. If necessary, slightly reduce the value of C3 so that 100 kHz can be obtained.

(6). Repeat the frequency calibration procedure on all ranges, using the

appropriate pre-set (RV8 to RV11), noting that a very 'Jerky' reading will be obtained on the lowest (1 Hz to 10 Hz) range. The calibration procedure is then complete, and the unit is ready for use.

A final point to note is that we used 10-turn cermets for all pre-sets on our prototype unit. A slight touch of luxury, this. You can get away with ordinary presets, if you prefer, but in this case you'll have to make slight modifications to the PCB.

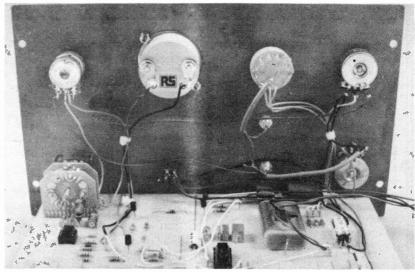
Actual construction on the PCB is fairly straightforward, but take extra care to observe the polarities of all electrolytics and all semiconductor devices. When construction is complete, fit the board into a suitable case and complete the interwiring to the remaining switches, pots and to the moving coil meter. The unit is then ready for testing and calibration.

CALIBRATION

Calibration of the unit is fairly tricky and requires access to an oscilloscope and some kind of frequency reference (you can use the 'scope timebase as a reference if it is known to be reasonably accurate). The calibration procedure is as follows:

(1). Set the unit to the SINE mode. Set the attenuator controls for maximum output. Set the frequency controls for approximately 1 kHz on the 1-10 kHz range. Set all pre-set pots at mid value. Switch the unit on, and use a 'scope to check that some kind of waveform is available (the waveform may be pretty awful at this stage). Check that the frequency is variable via RV6.

(2). Reset RV6 for a 1 kHz output and adjust RV1 for a pk-pk amplitude of about 5V6. Adjust RV4 for a 'passable' sine wave, and then readjust RV1 for 5V6. Now alternately adjust RV4 for MINIMUM DISTOR-



Rear view of the front panel controls.

HOW IT WORKS

There is not an enormous amount we can say here, since most of the work of the circuit is carried out inside IC1, which is a special function generator chip that produces a square wave output from pin 11 and a sine or triangle wave from pin 2. The purity of the sine wave can be trimmed via RV3 and RV4 and the maximum amplitude can be pre-set via RV1. The maximum triangle amplitude can be preset via RV2 and both waveforms can be offset via RV5. The sine/triangle waveforms are made available to the outside world via buffer amplifier Q3-Q4 and the associated attenuator network. The square wave is made available, in positive-going form only, via the Q1-Q2 buffer and RV12.

The operating frequency of the generator is variable via timing capacitors C3 to C7 and via resistor network R2-RV6. The frequency is monitored on a simple analogue frequency meter that is designed around 555 timer IC2, which is triggered via the square wave output of the Q1-Q2 buffer amplifier.

The entire circuit is powered from two 9 volt batteries, and the circuit consumes a typical total current of about 30 mA.

TION and RV3 for best SYMMETRY, occasionally readjusting RV1 for 5V6 pk-pk until a good sine wave is produced. Adjust RV5 for zero offset (so that the output waveform swings symmetrically about the zero volts level) and retrim RV3 and RV4 for a good sine wave.

COMMON C COMMON C COMMON C COMMON A COMMON A COMMON A COMMON A COMMON B COMMON B

Fig 3 Range switch wafer pin-out.

BUYLINES

The 10u (C7) capacitor can be purchased from Electrovalue Ltd. All other components used in the function generator should be readily available from major mail order companies that advertise in this issue.

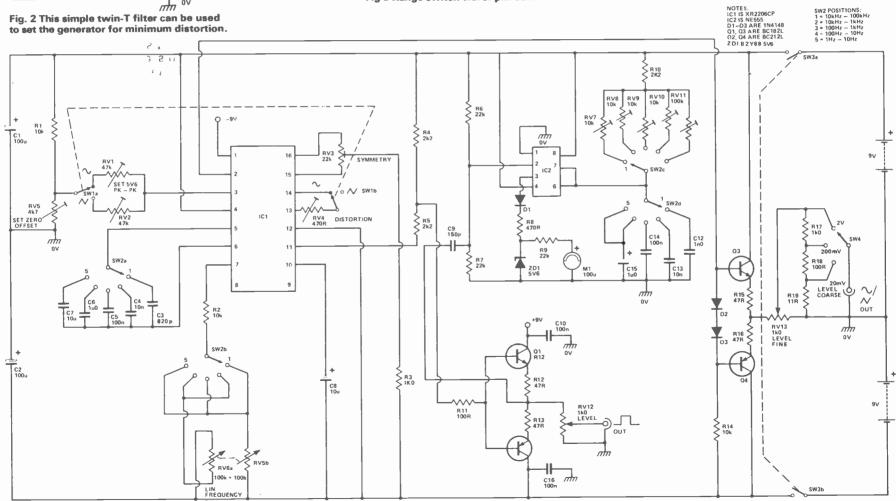


Fig. 4 Circuit diagram.

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PROGRAMMABLE £29.50 + VAT. COLOUR CARTRIDGE T.V. GAME.

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digital scoring and colour coding on scores and balls.
Italieks sounds are transmitted through the TV's speaker,
simulating the actual game being played.

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Manufactured by quaranteed for one year



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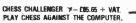
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naster dimming control.
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VFET APPLICATIONS

Is the VMOS power FET a really important device, or a mere flash-in-the-pan? In the next few pages
Project Editor Ray Marston appraises the device.

MAGINE a power transistor that has virtually infinite input impedance, 'beta', and power gain which has a bandwidth extending from DC to 600 MHz and which can switch 1 A on or off in a mere four nanoseconds. Imagine also that this device is immune to secondary breakdown and has a negative temperature coefficient that minimises thermal runaway problems and enables devices to be directly parallelled for increased power handling capability.

The above 'miracle' device already exists, and is readly avaibale at fairly low cost. It is known as a VMOS Power FET. VMOS Power FETs were first introduced by Siliconix in 1976. At that time they were hailed as 'the most revolutionary semiconductor in decades — likely to eliminate bipolars within five years'. Now, three years on, VMOS still hasn't made a great impact on the industrial or consumer market.

What Is It?

The term 'VMOS power FET' stands for 'Vertical structured Metal-Oxide Silicon power Field-Effect Transistor'. Conventioal MOSFETs use the form of construction shown in Figure 1, in which current flows *Horizontally* from source to drain through the channel, which is induced on the top surface of the silicon substrate. This form of structure results in low current densities, poor heat dissipation capabilities, very limited power handling capacity and relatively large chip capacitance.

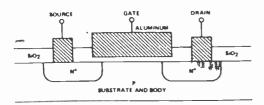


Fig 1. Cross Section of a conventional FET.

VMOS power FETs, on the other hand, use the form of structure shown in Figure 2, in which current flows *vertically* from source to drain. This structure results in high current densities, low saturation resistance, excellent heat dissipation and power handling capabilities, low chip capacitance and excellent wide band performance.

VMOS power FET technology has been pioneered by Siliconix, who currently produce a variety of such devices

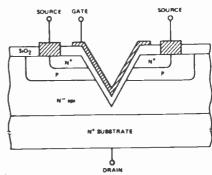


Fig 2. Cross Section of a VMOS power FET.

with maximum continuous drain current ratings ranging from a modest 500 mA up to a hefty 12A5, and with maximum drain-to-source voltage ratings ranging from 35 to 90V. All the products in their present VMOS range are n-channel enhancement-mode devices, in which the source-to-drain path is normally closed but can be opened by applying a positive gate voltage. The gate has a near-infinite input impedance.

A major defect of the existing VMOS technology is that it is not readily compatible with the production of p-channel devices. This factor greatly reduces the devices' attractions in audio power amplifier applications, where calss-AB output stages are currently in vogue.

A more detailed account of VMOS construction and operation theory is given in the July '78 edition of ETI.

Characteristics

Figure 3 shows typical output and saturation characteristics of the type VN67AF VMOS power FET. Note the following points:

1 The device passes negligible drain current until the gate voltage reaches a threshold value of approximately 1 volt The drain current then increases non-linearly as the gate is varied up to approximately 4 volts, at which point the drain current has a value of about 400 mA. The device, in fact, has square law transfer characteritics below 400mA.

2 The device has a highly linear transfer characteristic above 400mA (4V on the gate) and thus offers great potential as a low-distortion class-A power amplifier.

3 The drain current is controlled almost entirely by the gate voltage and is almost independent of the drain voltage so long as the device is not saturated. A point not shown in the diagram is that, for a given value of gate voltage, the

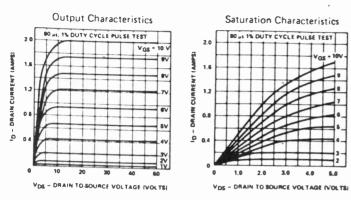


Fig 3. Output and saturation characteristics of the VN67AF VMOS power FET.

drain current has a negative temperature coefficient of about 0.7% per °C so that the drain current decreases as temperature rises. This characteristic gives a fair degree of protection against thermal runaway.

4 When the device is saturated (switched fully on) the drain-to-source path acts as an almost pure resistance with a value controlled by the gate voltage. The resistance value is typically 2RO when 10 volts are on the gate, and 10R when 2 volts are on the gate. The off resistance of the device is in the order of megohms. These characteristics make the device highly suitable for use as a low-distortion high-speed analogue power switch.

Figure 4 shows the circuit symbol and the case outline of the VN67AF, which incorporates a 15V input-protection

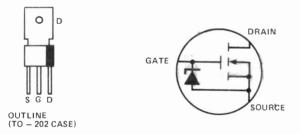


Fig 4. Symbol and outline of the VN67AF.

Zener and Fig. 5 summarises the static and dynamic characteristics of the device. Points to note here are that the input (gate-to-source) signal must not be allowed to exceed the 15V Zenerating of the device and that the device has a typical dynamic input capacitance of only 50 p: this capacitance dictates the dynamic input impedance of the device. The static input impedace is of the order of a million megohms.

Digital Circuits

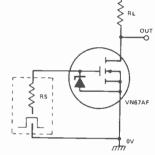
VMOS is delightfully easy to use in digital switching and amplifier applications. Figure 6 shows the basic connections. The load is wired between the drain and the positive supply rail and the digital input signal is fed directly to the gate. Switch-off occurs when the input goes below the gate threshold value (typically 1V2). The drain on current is determined by the peak amplitute of the gate signal, as shown in Figure 3, unless saturation occurs. In most digital applications the on current should be chosen to ensure saturation.

1	Maximum Drain-Source Voltage	
1 1	Maximum Drain-Gate Voltage	
	Maximum Continuous Drain Current	<i></i>
1 1	Maximum Pulsed Drain Current	
l i	Maximum Continuous Forward Gate Currer	nt
ن	Maximum Pulsed Forward Gate Current	
=	Maximum Continuous Reverse Gate Current	1
⋖	Maximum Forward Gate-Source (Zener) Vo	Itage
1 70	Maximum Reverse Gate-Source Voltage	-0.3V
1 1	Maximum Dissipation at 25°C Case Temper	ature
11	Temperature Operating and Storage Range.	
	Gate Threshold Voltage	
	Zero Gate Voltage Drain Current	
	ON-state Drain Current at V _{CC} =10V	1.0A min, 2.0A typical
1 7	Torward Transconductance	Zou millimnos typical
Ö	Input Capacitance	
AM	Reverse Transfer Capacitance	
	Common-Source Output Capacitance	
		Turn-ON Delay 2 nS
		Rise Time 2 nS
		Turn-OFF Delay 2 nS
	from a 50R source	Fall Time 2 nS

Fig 5. Summary of the static and dynamic characteristics of the ${\bf VN67AF}.$

The static input impedance of VMOS is virtually infinite, so zero drive power is required to maintain the VN67AF in the on or off state. Drive power is, however, required to switch the device from one state to the other. This power is absorbed in charging or discharging the 50p input capacitance of the VN67AF.

Fig 6. Basic VMOS digital switch or amplifier.



The rise and fall times of the output of the circuit are determined by the source impedance of the input signal, the input capacitance and forward transconductance of the VMOS device and the value of $R_{\rm L}$. If $R_{\rm L}$ is large compared to $R_{\rm S}$ the VN67AF gives rise and fall times of roughly 0.11 nS per ohm of $R_{\rm S}$ resistance. Thus, a 100R source impedance gives an 11 nS rise or fall time.

If R_L is not large compared to R_S these times may be considerably changed. A point to note when driving the VN67Af is that it's input Zener forward and reverse ratings must never be exceeded. Also, because of the very high frequency response of VMOS, the device is prone to unwanted oscillations if circuitry is improerly designed. Gate leads should be kept short, or be protected with a ferrite bead or small resistor in series with the gate.

VMOS can be interfaced directly with the output of CMOS, as shown in Figure 7. Rise and fall times of about 60 nS can be expected, due to the limited output currents available from a single CMOS gate. Rise and fall times can be reduced by driving the VMOS from a number of CMOS gates in parallel, as shown in Figure 8, or by using a special high-current driver.

VMOS can be interfaced with TTL (either standard or LS type) by using a pull-up resistor on the TTL output, as shown in Figure 9. The 5 volt TTL output of this circuit is

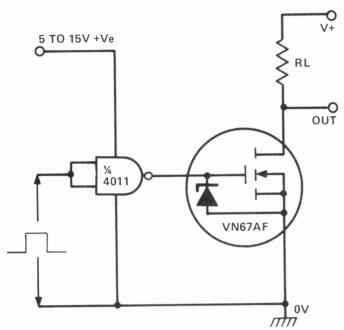


Fig 7. Method of interfacing VMOS with CMOS!

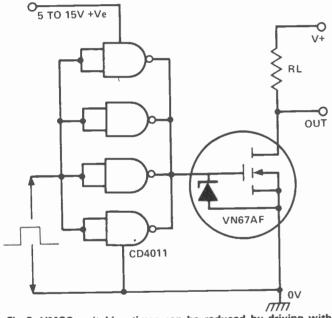


Fig 8. VMOS switching times can be reduced by driving with a number of gates in parallel. Typical $\rm R_{T}=25~nS.$

sufficient to drive 600 mA through a single VN67AF. Higher currents can be obtained either by wiring a level shifter between the TTL output and the VN67AF input, or by wiring a number of VN67AFs in parallel as shown in Figure 10.

Analogue Circuits

VMOS power FETs can be used with relative ease in either the common source or common drain (voltage follower) modes. The voltage gain in the common source mode is equal to the product of RL and the devices gm or forward transductance. In the case of the VN67AF, the device gives a voltage gain of 0.25 per ohm of $R_{\rm L}$ value, i.e., a gain of 4.0 with 16R load, or a gain of 25 with a 100R load. The voltage gain in the common drain mode is slightly less than unity.

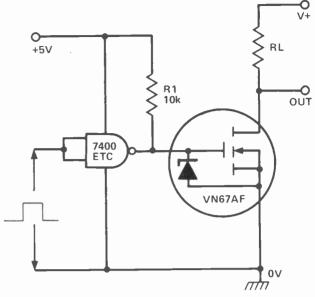


Fig 9. VMOS can be driven from the output of TTL if a pull-up resistor (R1) is used.

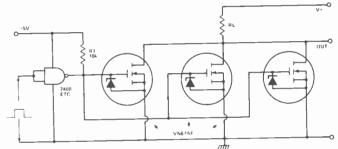


Fig 10. Boosting the output of Fig 9 by driving three VN67AF in parallel.

Fig. 11 shows three alternative basic ways of biasing the VMOS power FET for common source operation. In most practical applications, the device will be biased into the linear mode, with the drain at a quiescent value of approximately V_{supply}/2, so that maximal signal swings can be accommodated between the cut-off and saturation clipping levels.

In Fig 11a the gate is biased at a supposedly fixed level by potential divider R1-R2. The input impedance of the circuit is (at low frequencies) equal to the parallel values of R1 and R2. Defects of this simple biasing arrangement are that the voltage biasing level varies with the supply voltage, and the drain current biasing level depends on the characteristics of the individual VN67AF that is used in the circuit. An advantage of the circuit is that the quiescent drain voltage can be biased below that of the gate.

The alternative circuits of Figs. 11b and 11c can be used in cases where the quiescent drain voltage is greater than that of the gate. In Fig 11b, potential divider R1-R2 is fed from the drain of the VN67AF, and DC negative feedback makes the quiescent drain current substantially independent of variations in supply voltage and device characteristics. AC negative feedback also occurs, and reduces the effective input impedance to a value approximating the parallel values of R1 and R2 divided by the voltage gain (gm x R_I) of the circuit.

Figure 11c is a simple modification of the Fig 11b circuit, and results in increased input impedance. R3 is wired

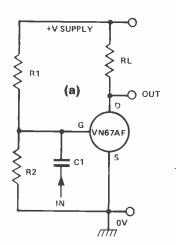
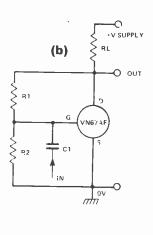


Fig 11. Methods of bias for

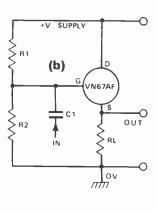
common source VMOS

operation.



(C) RL O OUT

R1 (a) D OUT R2 IN OV



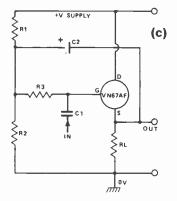


Fig 12. Bias for common drain VMOS operation methods.

between the gate of the VN67AF and the junction of R1-R2. R3 does not effect the biasing of the circuit, but if its value is large relative to that of R1 and R2 it raises the input relative to that of R1 and R2 it raises the input impedance to a value approximating that of R3. If the source impedance of the input signal is low relative to R3, the AC negative feedback effects of the circuit are virtually eliminated and the input impedance is further increased. If, in the Fig 11c circuit, the drain is likely to swing below the desired gate bias level under active conditions, a capacitor can be wired across R2 to preserve stable biasing conditions.

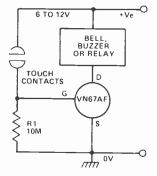
Fig. 2 shows methods of biasing VMOS power FETs for common drain operation. In Fig. 12a the circuit is biased by a simple potential divider (R1-R2), and the source takes up a value a few volts below that of the gate. Because of the inherently high level of negative feedback of this configuration, the resulting bias (quiescent) source/drain current of the circuit is substantially independent of the characteristics of the individual VN67AF that is used. The input impedance of this circuit is equal to the parallel values of R1 and R2.

Figures 12b and 12c show how the input impedance of the basic Fig 12a circuit can be increased. In Fig 12b, R3 is given a value that is large relative to R1 and R2, thereby raising the input impedance to a value approximating that of R3 without effecting the biasing of the circuit. In Fig 12c the value of R3, and thus the input impedance, is effectively increased by a factor of 1/(1-Av) via bootstrap capacitor C2. Thus, if R3 is 10M and Av is 0.95, the input impedance is raised to 20M. If R3 is 1MO and Av is 0.99, the input impedance is raised to 100M. C2 must have the

impedance that is low relative to R1 and R2 over the required bandwidth of the amplifier.

Practical Circuits

The best way to get to know VMOS power FETs is to experiment with them in a few practical circuits. With this in mind, Figs. 13 and 22 show a few simple designs that you can play with. All of these circuits are based on the VN67AF, which typically costs less than a pound in one-off quantities.



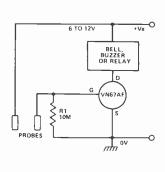
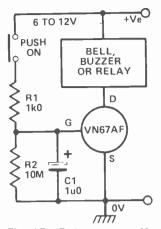


Fig 13. Touch switch.

Fig 14. Water switch.

Figs, 13 and 14 couldn't be simpler. When the contacts/probes are open, zero volts are on the gate of the VN67AF and the device passes zero current. When a resistance (zero to tens of megohms) is placed across the contact/probes (by contrast with skin resistance, water, etc), a substantial gate voltage is developed by potential dividier action and the VN67AF passes a high drain current.



ON RV1 12V 500mA

RV1 100k G VN67AF

R2 18k 0V

Fig 16. DC lamp dimmer.

Fig 15. Delay turn off switch.

In the Fig. 15 circuit, C1 charges rapidly via R1 when S1 is closed and discharges slowly via R2 when S1 is open Thus, the load activates as soon as S1 is closed, but does not deactivate until some tens of seconds after S1 is released.

Figs. 16 to 18 are lamp control circuits. In Fig. 16 the drain current and lamp brightness is controlled via RV1. In

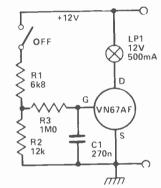


Fig 17. Soft-start analogue lamp switch.

Fig. 17 the lamp turns on slowly when the switch is closed as C1 charges up via R3, and turns off slowly when the switch is opened as C1 discharges via R3.

The Fig. 18 circuit is a highly efficient 'digital' lamp dimmer. The two 4011 gates are connected as an astable

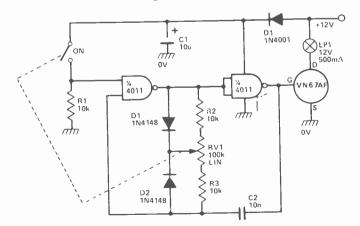


Fig 18. Digital DC lamp dimmer.

multivibrator that has a mark/space ratio that is variable from 10:1 to 1:10 via RV1, and has it's output fed to the gate of the VN67AF, thereby enabling the 'mean' lamp

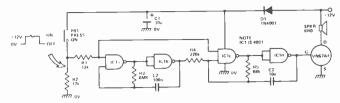


Fig 19. Warble-tone alarm (2 tone output).

brightness to be varied from virtually full-off to full-on.

Fig. 19 is an inexpensive but very impressive alarm-cell generator circuit that produces a police-like 'dee-dah' sound. The alarm can be turned on by closing PB1 or by feeding a 'high' voltage to the R1-R2 junction. The circuit is used with an 8RO speaker, and generates roughly 6 watts of output power.

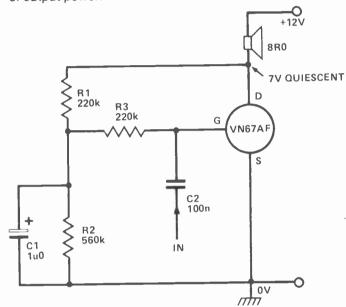


Fig 20. Super simple class-A amplifier.

The Fig. 20 class-A power amplifier gives an incredibly impressive performance, but is very inefficient. The VN67AF must be mounted on a decent heat sink. Since the amplifier is used in the class-A mode, it produces a valve sound output. Because of the excellent linearity of the VN67AF, the apparent distortion of the amplifier is remarkably low. When used with 8RO resistive load, the amplifier has a bandwidth that extends up to 10 MHz.

The Appraisal

VMOS is undoubtedly a remarkable technology with many great advantages over conventional bipolar technology. Latest reports indicate that at least five major semiconductor companies other than Siliconix are now actively researching into or actually manufacturing VMOS power FETs, so that technology is clearly not just a 'flash in the pan'. Each of these companies is apparently developing it's own particular version of the technology and preliminary reports indicate that the Siliconix technology is still way ahead of the competition in most areas (switching speeds, device linearity, high voltage rating, etc.).

Siliconix are expected to announce a 400 volt 8 amp device, which can switch 8 amps in less than 100 nanoseconds, within the next few months. They already have a 65 volt 8 amp 100 watt device on the stocks that can give a 10 dB gain at 175 MHz.

FEATURE: VFET Applications,

The simple circuit of Fig. 21 makes an excellent radio control or CW transmitter output stage. The L1-C2 and L2-C3 values must be chosen to suit the required operating frequency.

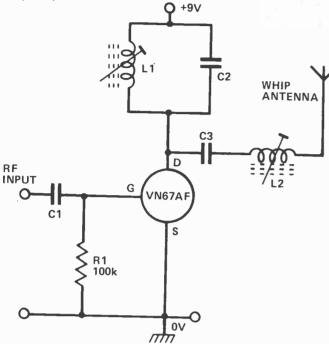


Fig 21. 60mWR/C or CW transmitter L1-C2 is tank circuit, C3-L2 is the antenna circuit.

Finally, Fig. 22 shows the basic circuit of a .20-watt class-D audio power amplifer using a pair of VN67AF's. We hope to publish a practical version of this circuit in ETI in the near future, so keep your eyes open.

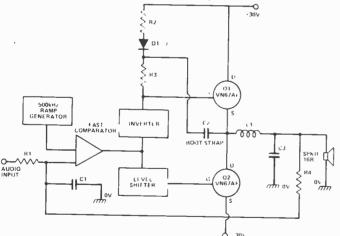


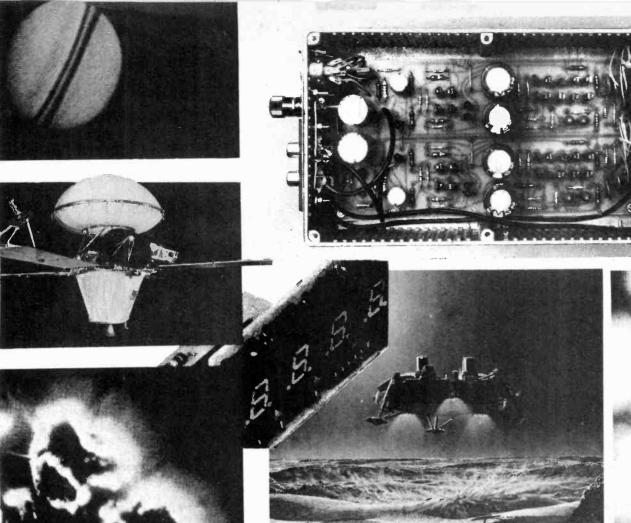
Fig 22. Basic circuit of a 20W clas-D switched-mode audio power amplifier. An ideal application for VMOS.

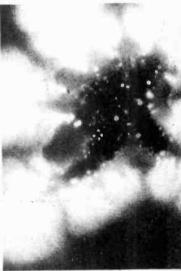
The only criticism that we've been able to make against the Siliconix VMOS power FET technology concerns the present total lack of p-channel devices. Our spies tell us, however, that Siliconix are already working on that problem, and will have it beaten within a year. If that is so, we reckon that the 1976 prediction that "VMOS may eliminate bipolars within five years" could still come true.

In the meantime, we at ETI are already 'sold' on VMOS, and plan to use a good deal of it in the coming year. We reckon that once you've started using it, you'll like it as much as we do.









electronics today

January issue on sale December 7th

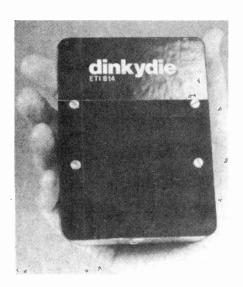
Containing constructional details of five projects including a superb DIGITAL FREQUENCY METER and a very hi-fi MOVING COIL PREAMP. Amongst the usual array of brilliant features you will find KIRLIAN PHOTOGRAPHY full explained and DEEP SPACE PROBES beautifully detailed. Miss a single page and you will weep long into the cold winter nights.





DIE

Liven up your Ludo with the ETI Dinkydie. Throw away that Block of wood with dots on and bring your board games into the twentieth century.



ed up with shaking rattling and rolling that boring set of wooden dice? Need something to brighten up that game of which the kids have grown tired?

We've spent some time designing this little project — an example of just how difficult it can sometimes be to get something 'just right': As few components as possible, all the desirable features, no obscure parts and nice low price for the constructor.

Operation couldn't be simpler: To 'throw' the dice, touch two fingers across one set of screw heads seen either side of the front panel in the picture here. Your 'throw' then appears in a dice pattern on the LEDs behind the perspex.

To throw again, touch the pair of screw heads once more.

If you leave the dice 'un-thrown' for a few seconds, the display fades and the circuit switches itself off, drawing only a miniscule current in its quiescent state.

Mount all the components on the board, placing the LEDs last. These should be spaced off the board by about 3 mm so to ensure that they are the highest components. If the bolts are level no spacers are needed as they can be tightened just enough to hold the LEDs hard against the perspex. If you wish, a piece of block cardboard may be cut to cover the other components to obscure the board.

Once the board is assembled the battery clip and battery may be connected and the device tested. Once bolted in the nuts on the underside of the board should be quickly soldered to the pads to ensure good contact. To complete the assembly the bottom of the case can be screwed in, and the battery jammed in place with a small piece of foam rubber or styrofoam. (Use the bit the CMOS IC's came in perhaps). Finally, if you fear for the coffee table top, four adhesive rubber feet on the bottom would be a good idea?

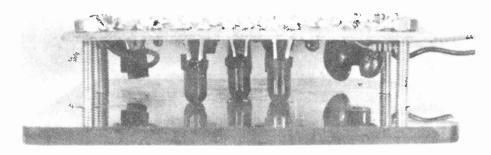
BUYLINES

All the components used in the Dinkydie should be readily available from your favourite mail order supplier.

PARTS LIST

	** //			7) *	
R	esistors all	14W 5%		*	
١,	R1				Ä,
		10k		*	ic A
	R3	100k			
1/2	R4	56k			
	R5	4k7			
	R6	270k			
	R9-R11				
	R12	330R			
	KIZ	33010			
C	apacitors				
A		33u 10V ta	ntalun	1	
ge:	C3	10n polyes			
. Se	emiconduc	etors			
	D1				
		ED7 Red LEI	os TII	2206	, v
ર્શ્વ ક	Q1,Q2		, III.	2201	`
`	Q3-Q6				Ψ.
	IC1	4011B			
	IC2	4029B			1
80-	102	10271			
-M	iscellaneo	us			ŝ
		battery cli	p. glu	e, fo	ur
<	6BA nuts	s and 20 mm	bolts.	PCB.	
8 %					
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An LED sandwich — make sure the LED's are the highest components on the PCB.

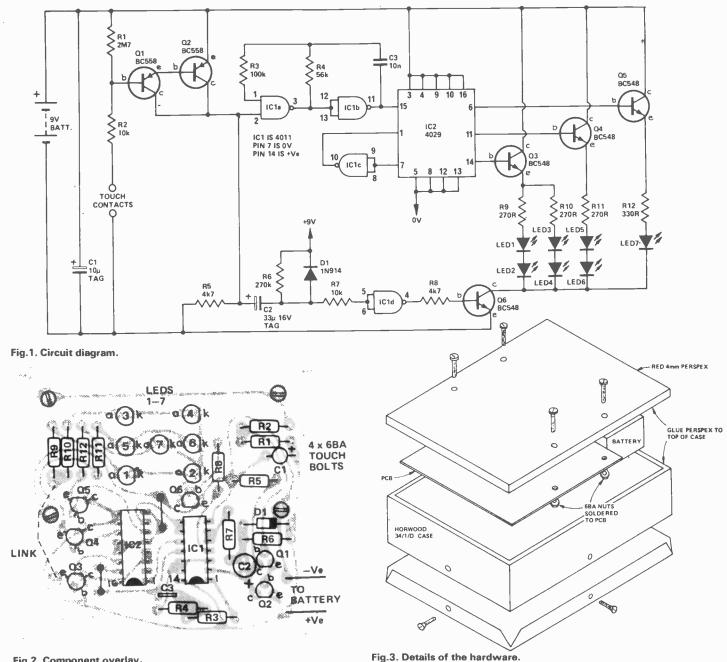


Fig.2. Component overlay.

WORKS

This device simulates a single dice 'die' electronically by illuminating LEDs in a die face pattern after you have heldyour fingers on two sensor contacts for a period to 'throw' the dice. The device operates by counting pulses from a free running astable multivibrator, hence the number finallydisplayed is defined by the duration of the touch.

As the quiescent current is well below luA, no power switch is used.

Initially, Q1 and Q2 are biased off. The astable multivibration, formed by ICla and b, is disabled and the display driver Q6 is also off. When the sensor

contacts are touched, a small leakage current flows into the base of Q1/Q2 which form a Darlington pair, and the collectors go high.

This has two effects. Firstly, the astable multivibrator made up of two nand gates (IC1a and b) is enabled and clocks the counter, IC2, at about 1 kHz. Secondly, C2 is discharged via D1, in preparation for initiating the display delay period. The duration of the touch defines the number which results, but the clock is sufficiently fast to prevent any form of cheating.

When the touch contacts are released the clock stops and the inputs of IC1d are pulled low. The gate is connected as an inverter, and the output thus sources current to Q7 which enables the display by pulling the LED cathodes low. The contents of counter IC2 are thus displayed in die-face format by the LEDs. When C2 recharges to above the threshold of IC1d via Q5 the display fades. Quiescent current is well below luA, so no power switch is required. The "all ones" state (i.e. 1111) is detected by the carry output and causes 1001 to be loaded by the parallel load input, IC1c does the required logic inversion for the parallel load function.

QTY.		ODES/Z		11	MICRO's, R	AMS,
_	1N914	100v	10mA	.05	CPU's, E-PR	OMS
	1N4005	600v	1A	.08	QTY.	
	1N4007	1000v	1A	.15	8T13	2.50
_	1N4148	75v	10mA	.05	8T23	2.50
	1N4733	5.1v	1 W Zenne		8T24	3.00
	1N4749	24v	1W	.25	8T97	1.75
_	1N753A	6.2v	500 mW Zen		74S188	3.00
-	1N758A	1:0v		.25	1488	1.25
-	1N759A	12v	- 11	.25	1489	1.25
-	1N5243	13v		.25	1702A	4.50
	1N5244B	14v		.25	AM 9050	4.00
	1N5245B	15v		.25	ICM 7207	6.95
_	1N5349	12v	3W	.25	ICM 7208	13.95
QTY.	SO	CKETS/	BRIDGES		MPS 6520	10.00
	8-pin	pcb	.16 ww	.35	MM 5314	4.00
_	14-pin	pcb	.20 ww	.40	MM_5316	4.50
	16-pin	pcb	.25 ww	.45	MM 5387	3.50
-	18-pin		.30 ww	.95	MM 5369	2.95
		pcb			TR 16028	3.95
_	20-pin	pcb	.35 ww	1.05	UPD 414	4.95
	22-pin	pcb	.40 ww	1.15	Z 80 A	22.50
	24-pin	pcb	.45 ww	1.25	Z 80	17.50
	28-pin	pcb	.50 ww	1.35	Z 80 P10	10.50
	40-pin	pcb	.55 ww	1.45	2102	1.45
	Molex pi	ns .01	To-3 Sockets	.35	2102L	1.75
	2 Amp B		100-prv	.95	2107B-4	4.95
	25 Amp		200-prv	1.50	2114	9.50
					2513	6.25
QTY.	TRAN	ISISTOR	S, LEDS, e	tc.	2708	11.50
	2N2222M	(2N222	2 Plastic .10)	.15	2716 D.S.	34.00
	2N2222A			.19	2716 (5v)	69.00
-	2N2907A			.19	2758 (5v)	26.95
	2N3906	PNP (P		.19	3242	10.50
_	2N3904	NPN (F	Plastic)	.19	4116	11,50
	2N3054 2N3055		5A 60v	.55	6800	13,95
	T1P125		arlington	1.95	6850	7.95
	LED Green			llow .19	8080	7.50
	D:L.747		8" High com-a		8085	22.50
	MAN72		m-anode (Red)		8212	2.75
	MAN3610	7 seg co	m-anode (Oran	ge) 1.25	8214	4.95
	MAN82A		m-anode (Yello		8216	3.50
	MAN74		m-cathode (Re		8224	4.25
	FND359	7 seg co	m-cathode (Re	d) 1.25	8228	6.00
		9000 SE	RIES		8251	7.50
QTY.			QTY.	11	8253	18.50
	9301	.85	9322	.65	8255	8,50
	9309	.50	9601	.30	TMS 4044	9.95
			9602	.45		

			C N	AOS		à .	
QTY.	Ġ.	TY.	Q	TY.		QTY.	
4000	.15	4017	.75	4034	2.45	4069/74C0	4 .45
4001	.20	4018	.75	4035	.75	4071	,25
4002	.25	4019	.35	4037	1.80	4081	.30
4004	3.95	4020	.85	4040	.75	4082	.30
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4010	.35	4025	.25	4046	1.25	4519	.85
4011	.30	4026	1.95	4047	2.50	4522	1,10
401:2	.25	4027	.35	4048	1.25	4526	.95
4013	.40	4028	.75	4049	.65	4528	1,10
4014	.75	4029	1.15	4050	.45	4529	,95
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4016	.35	4033	1,50	4053	.95	MC14419	4.85
				4066	.75	74C151	2,50

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7401	.20	7493	.35		74H21	.25	74LS8	
7402	.20	7494	.75		74H22	.40	74LS9	
7403	.20	7495	.60		74H30	.30	74LS9	
7404	.20	7496	.80		74H40	.35	74LS9	
7405	.35		1.15		74H50	.30	74LS1	
7406	.25	74107	.35		74H51	.30	74LS1	
7407	.55	74121	.35		74H52	.20	74LS1	
7408	.20	74122	.55		74H53	.25	74LS1	
7409	.25	74123	.55		74H55	.25	74LS1	
7410	.20	74125	.45		74H72	.35	74LS1	
7411	.25	74126	.45		74H74	.35	74LS1	57 1.15
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7413	.45	74141	.90		74H103	.55	74 LS1	
7414	.75	74150	.85	7	74H106	1.15	74LS1	93 2.00
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RAIN ALARM

Don't get wet feet, don your wellies and come and see the Rain in Spain fall Mainly on the ETI Rain Alarm. - By George, we've got it!

ave you ever been tied up with other jobs, such as polishing the furniture, doing the washing up, etc while your washing is out drying on the line? Then, just as you are finishing your present chore you look out of the window and see that the heavens have opened on your nearly dry washing. Well, this happens virtually every Monday (being washing day) to the ETI Project Team and we were just about getting fed up with it

. . . .so we had a conference!

It became apparent, after we had looked in the piggybank and found we didn't have enough for a second-hand tumble dryer, that we should do something constructive (for a change). We decided that even we couldn't design a machine to stop it raining on Mondays (though officially we won't admit it) so the alternative was the ETI Rain Alarm, which, at the vaguest hint of rain, will ring out loud and clear so that the pots and pans can be dropped while we run outside and fetch in the washing from the line.



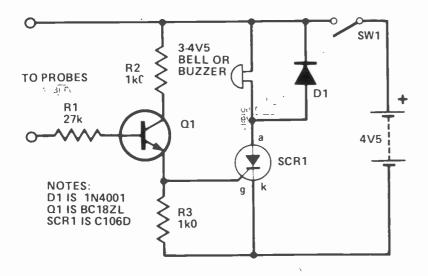


Fig. 1. Circuit diagram.

HOW IT WORKS

The heart of the rain alarm lies around the thyristor SCR 1 which switches the bell or buzzer on. Normally, in D.C. mode a thyristor is switched on by a small gate current. It will not switch off however, until the voltage applied across the whole device reduces to near zero, at which point it will remain off until the voltage at the gate increases enough to switch it on again.

When used with a make and break device such as a bell or buzzer the applied voltage momentarily decreases to zero at whatever frequency the bell or buzzer is operating at. This will in turn, switch off the SCR. This gives us a non-latching D.C. switch, operated by applying a small D.C. voltage to its gate.

QI provides switching action in that as the resistance across the probes decreases from infinity to a comparitively low value (ie. as rain falls on them) then the voltage across R3 increases from near zero to above the threshold voltage necessary to switch SCR1 on.

TO BATTERY

Fig. 2. Component overlay.

Of course detecting rain to keep your washing dry needn't be its only function. Anywhere a device to detect the presence of water is required, then the Rain Alarm will do it. It takes only minimal current when in standby mode so can quite happily be left on for long periods without significantly battery wastage.

Construction

As the whole rain alarm only contains

PARTS LIST

RESISTORS All %W. 5%

R1 R2,3

27k 1k0

SEMICONDUCTORS

01

BC182L 1N4001

D1SCR1

C106D

MISCELLANEOUS

SW1 SPST switch

3-4%V

Bell or buzzer 4½ volt

battery.

Small piece of stripboard.

seven components, including the on/off switch, it fits very neatly onto a small PCB only about 1 inch by 11/2 inches (or 25 mm by 40 mm if you have already been metricated by the vet). In fact, the 41/2 volt bell battery is by far the biggest item in the project.

The construction of the circuit on our PC layout will present no difficulties - just take care that the semiconductors are inserted cor-

BUYLINES

All parts should be easily obtainable from your local stockists. However any of the mail order firms advertising in ETI should be able to help, if you are stuck.

rectly. Use a printed circuit mounting switch for SW1 if you can obtain one it makes a neater job, but if not, any SPST switch will do.

The probes in our prototype were constructed from a small piece of commercially available stripboard, the two leads soldered to alternate copperstrips, providing an interleaving of the copper. Any small drop of water landing on the copper side of the stripboard will automatically bridge at least two of the strips, therefore operating the alarm.

And, now that you have finished the ETI Rain Alarm, you can go - in the words of the immortal and legendary Gene Kelly (Ray's hero) -Ringing in the Rain. EΠ



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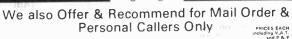
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AUDIOPHILE

Having spent a month coiled up with a lump of Coral (well each to his own) Ron Harris presents a review of the new MC81 pick up.

T has been a month of musical evenings. The television has remained off, the soldering iron cold, the wargames unplayed and the books unopened. Meanwhile the power amp glows red in the night and my neighbours have taken to wearing ear defenders and shaking their fists at my approach.

Ah, the fools, they know not the delights they scorn. . . . You see. I have been playing a lot of records this month, all due to this MC81 device I mentioned when last you read Audiophile. They should put a warning on the side of the box — "This cartridge can seriously damage your social life."

At first glance it is a most unimpressive blob of black plastic, but that in itself brought to mind something someone once told me about not covering judges with books — or something like that anyway.

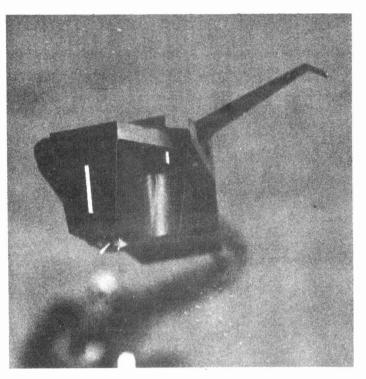
Book Covers

Being of the moving coil strain, the Coral MC81 needs a head amp, or pre-pre-amp as some people with stutters persist in calling them, to increase the voltage level to around 3mV in order that a normal RIAA input can process the signal.

The unit designed to work with the MC81 in this manner is the H300, which possesses a few unusual points itself. There are head amps on the market which will work with the majority of cartridges, but none are totally satisfactory with all. The best of these is possibly the Sony HA55, (which is mains powered). The H300 has a variable input impedance facility which suggests that it too is aimed this way and it will be interesting to see if it gains acceptance on the end of cantilevers other than the MC81. I confess I did not audition it any other way myself, but I will get around to that. . . .

Back to the cartridge. It weighs a puny 5g, but is surprisingly large for this weight as you can see from the photos. Set up in the SME III the Coral tracked most material happily at 1.8g, and took everything (just!) at 2.0g. The damping option on the SME should be exercised, although the fluid may need thinning for best results.

One good point about the cartirdge body itself is that the top is sensibly large and flat — allowing for a large contact area with the headshell and thus good mechanical coupling between the two. At least it *would* do if the SME headshell was long enough!



Coiled Up

Initially I had the MC81 operating through a HA55, while the H300 was getting over its birth pains and into this cruel world. In this configuration the cartridge worked well, but I was less than happy with the lowest bass registers. The mid-range, however, came as a revelation. It was crystal clear and sharp and 'opened out' relative to the other cartridges I was comparing with it (Coral's own 777EX and the Entré 1). Treble quality was all I'd hoped for, being both accurate and extended without either emphasising surface noise or wielding that steel edge with which some moving coils cut through the music. I was impressed!

I was further beguiled once I had the MC81 and H300 operating together, a combination which went a long way to taking the ground from under my objections to the bass. It was never that the unit lacked bass at all, but that I had a feeling that the level was down upon what I would have expected.

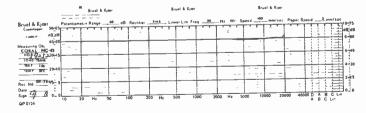


Fig. 1. Frequency response of the MC81. If you can't see it that's because it's so straight it's hidden behind the graph paper. What happened to all those nice dips and peaks reviewers could have such fun commenting on?

39

Bass quality was immaculate. Each instrument, bass guitar, drum, double bass or whatever was clearly and precisely identified and distinguishable. If you think that's easy, try it with your own cartridge — now — can you absolutely distinguish the different notes from a bass guitar for instance? Is the bass drum in full possession of it's transients?

As regards this aspect the Coral has the *best* bass I've heard and I'm not prepared to trade that quality back in for a bit more quantity of a less than equal pedigree.

Timely Decision

Running through an evening of the best recorded LPs I had soon convinced me that any initial unease I had experienced was groundless. Direct comparison between the V15 IV, the Entré an FR1 and the MC 91 led to others being employed in ever shorter bursts and, before the day was through, left alone.

In each comparison there were differences. The FR1 had a 'sweeter' mid-range but *not* the incredible detail. The Shure had for more bass signal present but *not* the attack and the Entré just didn't measure up at all — with either or any head amp.

In fact it was probably the V15 IV's slight bass emphasis that had led me up the garden path in the first place.

Talking Of Heads

Consider the H300 for a moment. The input of this device has variable gain and variable capacitance facility. Loading can be switched from 5000p to 20000p in steps of 5n. Gain can be switched up from 23-30dB.

Both these are controlled by DIL switch banks on the front of the PCB, but can only be accessed by removing the front panel entirely. That same panel contains the power switch and 'charge' light.

The H300 takes its electrons from a Ni-Cad source, and when switched off the batteries go on trickle charge. It takes (say Videotone) twelve hours to deplete the storage — I didn't fancy staying awake long enough to get an accurate figure — and forty eight hours to replace the power once used up. The charge light (LED) comes on when the box is switched off, a changeover relay diverts the input from a separate mains adaptor to the charger. This same relay operates as a switch-on delay system to prevent a 'thump' which is potentially dangerous to amp, ears and cones.

Unfortunately this relay doesn't seem to work on switch off and I got a loud 'whoop' if I did things in the wrong order! It could all lead to a flat cell and no music tonight, Josephine.

All in all, even weighing the advantages of reduced hum and lower source resistance (hence less RF interference etc), I think I prefer a plain mains supply with the extra costs that infers.

Still the H300 system works, and works well. The head amp sounds very fine indeed, and on audition proved indistinguishable from the Sony HA55 at a fraction of that unit's cost.

Full marks for circuit design and final performance Videotone but the grumble on supply you'll have to live with — it's an odd solution albeit one that works.

System Round-Up

Taken together the MC81/H300 system is an impressive and exciting new pickup system. The cartridge is well-nigh excellent and does not entail a second mortage on the



Above: the H300 sat sitting between the MC81 in SME dressing and an ACI it fed. Small is it not?

mortage to afford it, like some Oriental Offerings I could name (It costs about £90 in the shops).

The H300 sounds very healthy indeed, but has that quirky PSU arrangement. This should give no trouble but does not make life as "thought-free" as it could. (Cost circa £60).

I would heartily recommend anyone interested in a new cartridge to head for an MC81 with open ear, and try and get a good listen.

If Felicity Kendal was interested, I'm sure I could find SOMEONE willing to extend the hospitality of his hi-fi for an evening or two (thousand!).

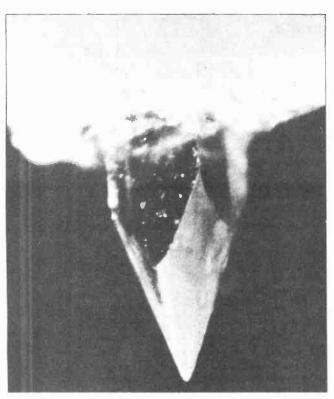
A Gold Ring To It?

The point on the right has a point to it. A very strange shaped point—but a point nonetheless, a Van den Hul point in fact. After many months of trial and tribulation Goldring have fitted said sharp bit to a cantilever for their new G900IGC pick-up cartridge.

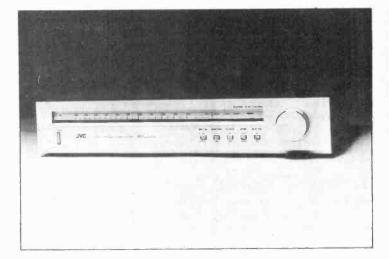
To all things under heaven there is a season, eh? Welcome to the pickup season. After the Coral cometh the IGC and Io, music was bountiful upon the ears of Man and he heard that it was good.

The new G900 is claimed to exhibit greatly reduced distortion when compared to either a conventional ellipital point or the Shibata variation upon the theme. This is claimed to be due to the straight line of contact between stylus and groove and the smaller minor radius of the Van den Hul design.

The finish and presentation of the cartridge is superb, but up to now I haven't had a chance to listen to my sample at all. So once again its next month folks...



Above: the point of Goldring's new G900IGC is easily seen.



Tuning In JVC

Interesting looking new tuner from JVC, the TX5, features their award winning Phase Tracking Loop detector stage. Naturally PTL is claimed to improve everything from AM objection to sliced bread — and judging by the details I've seen could be Wonderloaf are in for a hard time.

The TX5 also has two patented ideas incorporated — a 'quieting slope' control which acts as a sort of signal sensitive noise reducer, and a new tuning system. The price is around £250.

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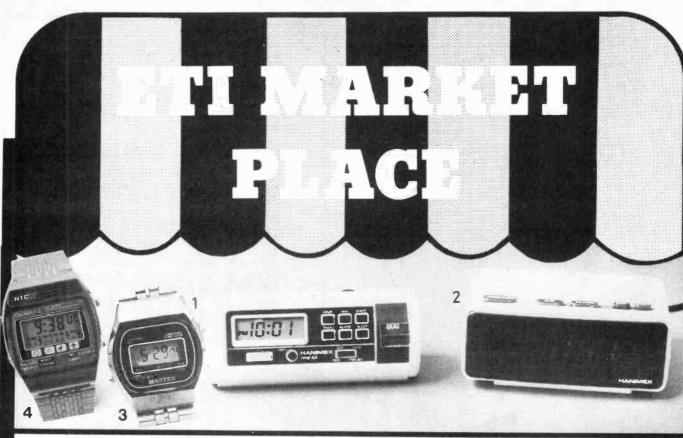
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1	7400	12p	7476 35 p	74160 90 p	4013 50p	
1		12p	7470 50p	74160 30p	4015 80p	CA3
1	7401	12p		74161 100p	4016 45p	CA3
1	7402	12p	7481 85 p		4010 43p	CA3
1	7403	12p	7482 75 p	74163 100p		CA3
4	7404	12p	7483 80p	74164 115 p	4018 80 p	CA3
1	7405	18p	7484 100p	74165 120p	4019 50p	CA3
-1	7406	30p	7485 75 p	74166 140p	4020 100p	CA3
1	7407	35p	7486 35p	74167 200 p	4022 95p	CA3
	7408	18p	7489 200 p	74170 200 p	4023 25p	CA3
	7409	18p	7490 35p	74173 120p	4024 55p	CA3
1	7410	12p	7491 80 p	74174 90p	4025 20 p	
п	7411	20p	7492 40 p	74175 90 p	4026 150p	CA3
1	7412	18p	7493 35 p	74176 85p	4027 50p	CA3
-1	7413	30p	7494 85 p	74177 80p	4028 85p	CA3
ч	7414	50p	7495 70p	74178 160p	4029 100p	CA3
1	7416	30p	7496 60p	74179 140 p	4030 60p	CA3
1	7417	30p	7497 190 p	74180 95 p	4032 100 p	CA3
	7420		74100 130p	74181 180p	4033 150p	.CA3
	7420	16p 30p	74100 130p	74182 90p	4040 100p	CA3
1				74184 140 p	4043 95 p	FX2
4	7422	18p			4046 120 p	LD1
П	7423	30p	74107 35p		4047 100p	LF3
П	7425	30p	74109 55 p	74188 320p	4047 100p	LF3
	7426	40p	74120 115p	74190 100p	4048 60p	LM2
- 1	7427	30p	74121 25 p	74191 100 p	4049 45 p	LM3
	7428	35p	74122 50p	74192 100p	4050 50p	LM3
1	7430	18p	74123 50p	74193 100 p	4054 130p	LM3
	7432	25p	74125 45p	74194 100p	4055 130p	LM3
J	7433	40p	74126 60p	74195 100p	4056 135 p	LM3
	7437	30p	74128 75p	74196 100 p	4060 115p	LM3
	7438	35p	74130 130p	74197 80p	4066 60p	LM:
	7440	15p	74131 100p	74198 150p	4068 22p	LM:
	7441	70p	74132 75 p	74199 150p	4069 20p	
	7442	70p	74135 100p	74293 125 p	4070 30 p	LM:
	7443	115p	74136 80p	74LS00 15p	4071 20p	LMC
	7444	115p	74137 100 p	74LS112 85p	4072 20p	LM:
	7445	100p	74141 70 p		4075 25p	LM:
	7446	95p	74142 200p		4077 40 p	· LM:
	7447	60p	74143 300p		4081 20p	1
	7448	60p	74144 300p		4082 20p	1
	7450	18p	74145 75p		4093 80p	9
	7450	18p	74147 180p	CMOS	4501 20p	'
	7453	18p.	74148 130p	4000 14p	4507 55p	
	7453	18p.	74150 100p	4001 14p	4510 100p	Mui
	7460	18p	74150 100p	4002 15p	4511 150p	iviui
1.8	7460		74151 70p	4006 90p	4516 120p	
		30p	74153 70p 74154 100p	4007 18p	4518 100p	
	7472 7473	30p		4009 40p	4520 100p	
		35p		4011 18p	4528 100p	
	7474	30p	74156 85p	4011 18p	4583 80p	3
	7475	35p	74157 70p	-012 10p	.500 000	

LINE	AR I	LM348N	90p	SAS660	270p	TBA810	100p
CA3039	70p	LM380	80p	SAS670	250p	TBA820	80p
CA3046	70p	LM381N	150p	SL917B	650p	TBA920Q	290p
CA3060	225p	LM382	120p	SN766 6 6N	100p	TCA270S	250p
CA3065	200p	LM391	170p	SN76003N	170p	TCA270Q	250p
CA3076	250p	LM5 55	25p	SN76013N	150p	TCA760	300p
CA3080	75p	LM565	125p	SN76013ND	130p	TCA4500A	300p
CA3084	250p	LM709C	40p	SN76023N	150p	TDA1004	300p
CA3085	80p	LM710T05	65p	SN76023ND	130p	TDA1008	320p
CA3086	50p	LM710DIL	65p	SN76033N	180p	TDA1022	600p
CA3088	185p	LM723T05	40p	SN 7 6131N	115p	TDA1024	125p
CA3089	225p	LM723DIL	40p	SN76227N	150p	TDA1034	250p
CA3090A0	400p	LM 733	120p	SN76228N	160p	TDA2002	320p
CA3123E	200p	LM739	150p	SN76660N	85p	TDA2020	320p
CA3130	100p	LM741	20p	TAA300	250p	TL08 ₁	50p
CA3140	70p	LM747	70p	TAA350	250p	TL082	100p
CA3161E	150p	LM748	40p	TAA550	35p	TL083	110p
CA3162E	450p	LM1303N	95p	TAA570	250p	TL084	130p
CA3189E	250p	LM1458	60p	TAA661B	150p	UAA170	200p
FX209	760p	LM3900	60p	TAA 700	340p	XR320	250p
LD130	460p	LM3909N	70p	TAA790	340p	XR2003	150p
LF356	90p	MC1310P	150p	TAD100	150p	XR2206	400p
LF357	90p	MC1312P	160p	TAD110	130p	XR2207	400p
LM211H	240p	MC1314P	190p	TBA120A	60p	XR2208	590p
LM300T0!		MC1315P	230p	TBA120S	70p	XR2216	675p
LM301AN	30p	MK 50398	650p	TBA120T	90p	XR2264	440p
LM301T0	5 45p	MM5314	380p	TBA480Q	190p	XR2265	440p
LM304	190p	MM5316	470p	TBA520Q	190p	XR2567	250p
LM307N	60p	NE529K	150p	TBA530Q	190p	XR4136	150p
LM308T0	5 100p	NE555	25p	TBA 540	220p	XR4151	350p
LM308DIL		NE556	70p	TBA550Q	250p	XR4202	150p
LM309K	140p	NE562B	420p	TBA560C	240p	XR4212	150p
LM310T0		NE566	160p	TBA641A12	250p	XR4739	150p
LM311T0		NE567	170p	TBA 700	200p	ZN414	95p
LM317K	350p	SAD1024	1400p	TBA720Q	240p	ZN1034E	200p
LM324	70p	SAS560	155p	TBA750Q	200p	95H90	800p
 LM339 	70p	SAS570	150p	TBA800	90p	11090	1400p
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HUM FILTER

Got a hum problem that's making your hi-fi distinctly lo-fi?

Our natty notch filter cuts the moronic mains monotone down to size.

he magnetic field around the transformer in the power amplifier can couple to the preamp or tape deck. Also, the location of nearby 240V mains wiring can cause problems that can be very difficult to overcome. In theory, if the equipment and leads have been properly shielded and earthed this problem shouldn't exist. In practice it's a very different story.

This project aims at overcoming some of the problems of mains induced hum by using a notch filter at the hum frequency of 50 Hz. At this frequency any signal present will be attenuated. At frequencies either side of the notch the response should return to the unattenuated input level.

The 'Q', or Quality Factor, of a tuned circuit — which the RC network in this circuit forms, determines the bandwidth, or narrowness, of the amplitude response of the circuit (see the diagram). As this circuit forms a notch filter, the Q of the circuit determines the narrowness of the notch.

With a high-Q notch the frequency response of the circuit will dip suddenly around the notch frequency. Frequencies a little either side of the notch centre frequency will be little affected. If the Q is low, frequencies some way either side of the notch frequency will be attenuated. The actual attenuation at the notch frequency is greater with a high-Q circuit than with a low-Q circuit.

High-Q circuits have the disadvantage that slight changes in component values, due to temperature changes etc, will affect the centre frequency. Tuning of the circuit to frequency is also quite critical. Lower-Q circuits do not suffer



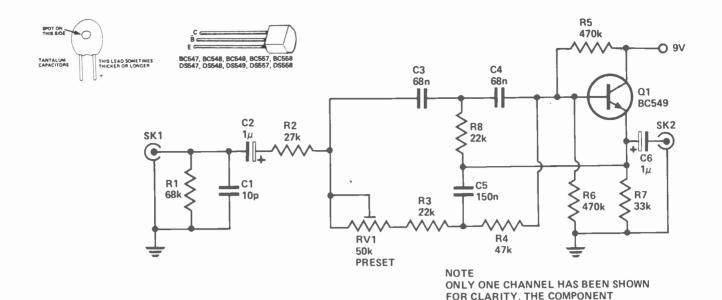


Fig.1. Circuit diagram of one channel of the hum filter.

so much from this disadvantage.

The design Q chosen for this project was a compromise between the constraints of critical tuning and drift effect and good attenuation at the notch with little affect on nearby frequencies. Peak attenuation at the notch centre frequency of 50 Hz is around 80 dB while attenuation of only 3 dB is obtained at 40 Hz and 58 Hz. There is some audible effect on the bass response of a system, but this is minimal.

Construction

Mount the resistors and capacitors on the board first. Be sure the orientation of the tantalum capacitors is correct. These are polarized and can only be installed one way round. Next, install the preset pot. Finally, solder the transistor in place.

The circuit is run from a single nine volt battery. The current consumption of the prototype was 200 uA so the battery life should be good for several months. If it is found that battery life is not long enough a power switch could be fitted.

The filter can be used almost anywhere in the amplification chain since its overload margin is very high (typically 8 V p-p). It should obviously be placed after the point where the hum is being picked up. If the hum is in the turntable and the magnetic phono input of the amplifier since the input impedance is 47 k shunted by 10 pF, which should suit most magnetic cartridges.

Once the filter is in place, the presets are adjusted so that the hum is brought to a minimum by adjusting each channel independently.

HOW IT WORKS

The circuit consists of a "Twin-T" notch filter formed by capacitors C3, C4 and C5 and resistors R3, R4, R8 and preset PR1.

The operation of the Twin-T requires that $C_3 = C_4 = C_5$

and
$$R_3 + PR1 = R_4 = 2R_8$$

These conditions must be met with reasonable accuracy if a good, deep notch is to be obtained. The preset corrects to a certain extent for errors due to component

mis-match and assumes that the notch can be adjusted to the exact frequency of the hum to be rejected.

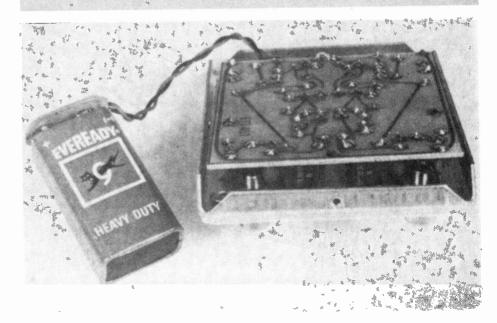
The frequency of the notch is then given by

f = 1

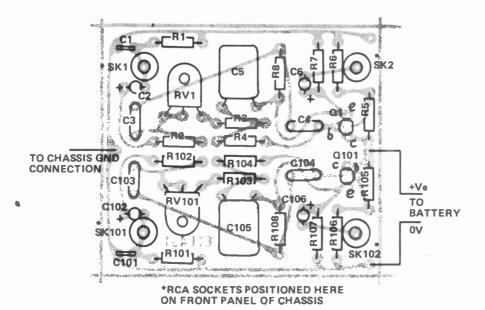
 $2\pi R_4 C_4$

NUMBERING OF THE OTHER CHANNEL BEGINS at 101 i.e. R101 R102 etc.

The transistor is operating as an emitter follower, giving zero voltage gain, but providing feedback into the notch to increase the Q to acceptable limits.



The finished PCB fitted to the front panel, with the battery on flying leads.



FLAT TO > 100kHz 0 10 dB ATTENUATION 20 The worst-case response of the Hum Filter. With most combinations of resistor and capacitor values, the 3 dB 30 points of the notch were around 46 Hz and 54 Hz, making the notch considerably narrower. 40 50 60 70 40Hz 50Hz 58Hz **FREQUENCY**



"IT'S A GREAT HUM FILTER-WON'T LET ANY
PUNK ROCK THROUGH AT ALL!"

Fig.2. Component overlay.

PARTS LIST

Resistors all ¼V	V, 5%
R1,R101	68k
R2,R102	27k
R3,R103,8,	
108	22k
R4,R104	47k
R5,R6,R105	
R106	470k
R7,R107	33k
Capacitors	
C1,C101	10pf ceramic
C2,C102,6,	
106	1u tantalum
C3,C4,C103,	
C104	68n polyester
C5,C105	150n polyester
Potentiometers	
	50k min preset
Semiconductors	
Q1,Q101	BC549, BC109
Miscellaneous	
	B, box to suit, 4 panel
- mounting.	
	100 Hz operation
R4,R104	22k
R8,R108	10k
Replace R3 v	with wire link.
w/ * * *	

BUYLINES

You shouldn't have any difficulty in getting hold of any of the components for this project. We haven't bothered to box our prototype. You can use anything from a plain aluminium box to a classy wooden case whatever takes your fancy.

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RAVEN ON...

This month Dave Raven, of Metac Electronics, has a bash at crystal gazing into the future of computers and delves into chip reliability.

Predicting the future in electronics is a regular feature of TV and the press with "Tomorrows World" and newspaper features on technology. People not involved in science probably have difficulty believing the forecasts since they are quite often so far outside what we already understand.

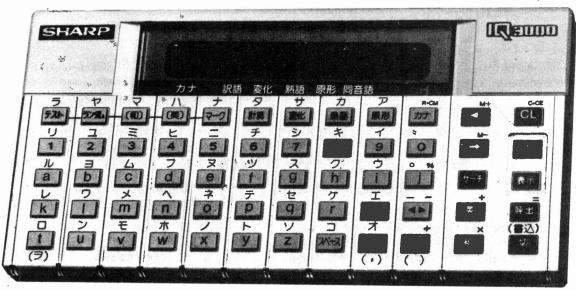
Home computers and Robotics are two areas which receive quite a lot of attention since they are predicted to be areas which will have major effects on the ways in which we work and live. At a recent symposium held in France by a computer manufacturer, experts assembled to discuss the future. It was predicted that there will be at least four major computer revolutions during the 1980s. The component processors revolution forecast for 1979/80 begins with the basic building blocks for computers and communication systems, large scale integration and very large scale integration of devices, hardware, intelligent machine products, people appliances, digital automation products, communications ICs and intelligent data communication satellite systems. All this resulting in components becoming the end product.

Phase two will begin 1981/83 with the Component Computer revolution. This will provide intelligent data management systems and communications subsystem components with the machine/computers becoming just components. Carrying on in 1983/85 we should have the component memory age. This kicks off with the basic building block for information systems, distributed memory, a system component revolutionising com-

munications, information appliances, a data base computer and knowledge based systems. This results in memory becoming components and offices becoming portable machines. Phase four brings the component systems revolution forecast for 1985/88. The component systems will further revolutionise our institutions leading to the end of the main frame computer and allow factories to become machines. The era will be the "system on a wafer technology", communications will substitute for travel and buildings and an information society will emerge. Computers become components and factories become machines. Computer evolution is increasing tenfold every decade and chip technology at 100x/decade while innovation is going at 1000x/decade.

Robots for Robots

People amplifier appliances, the knowledge based system and robots. In the 1990s we can expect intelligent robots, androids and world linked robots. Also, would you believe worker/slave robots for robots. If you find a credibility gap emerging between yourself and the prophets of the future it may be of interest to read this extract from The Times of January 28th 1926 — "Members of the Royal Institution and other visitors to a laboratory in an upper room in Frith Street, Soho, on Tuesday, saw a demonstration of apparatus invented by Mr J. L. Baird. For the purpose of the demonstration the head of a ventriloquist's doll was



manipulated as the image to be transmitted through the human face was also reproduced, first on a receiver in the same room as the transmitter and then on a portable receiver in another room. The visitors were shown recognisable reception of the movement of the dummy head and a person speaking. The image transmitted was faint and often blurred, but substantiated a claim that through the 'televisor' as Mr Baird has named his apparatus, it is possible to transmit and reproduce instantly the details of movement and such things as the play of expression on the face.'

The Cathode Ray tube was of course still only a suggestion made back in 1907 by Cambell Swinton in England and Boris Rosing in Russia. So far, though, this suggestion had produced no satisfactory system of television.

Global Games

Electronic home entertainment equipment is largely imported into the UK from Japan and Hong Kong. Some items are made in Taiwan and South Korea. However, these two countries have stronger links with America. Several European firms have set up manufacturing in special export zones in India which have very attractive tax benefits. Both Philips and Rank Radio are in India, also many other companies have goods manufactured in the Far East with their own brand name on. Hong Kong is particularly strong in exporting to England due mainly to our colonial ties. Goods from Hong Kong have been much maligned over the years for low quality probably due to the cheap plastic toy image they are best known for. Early electronic products were of varying quality but since this new technology was not completely debugged it was not only Hong Kong that had problems (reference UK made TV games, calculators and electronic watches).

The high failure rate of electronic goods at the onset of production is nearly always caused by the chip. The low yields of TV game, calculator and watch chips is well documented but as usual the problems are eventually solved and the yield dramatically improves. Now with calculators, TV games and many watch chips the producer just cranks the handle and out they come by the bucketful.

Nipon Word Box

Having referred to the possibility of an electronic dictionary last month it is not surprising that one has now appeared, such is the speed of development in electronics. Made in Japan this time by Sharp it will be going on sale next month.

It features 48 kilobytes of read-only meory together with logic and display control circuits. The liquid crystal display is in dot-matrix and this enables it to run for about 1,000 hours on three silver-oxide batteries.

The dictionary is for Japanese-English, English-Japanese and is intended primarily for Japanese people learning English. It has a central processing unit, two display-control chips and four 12-kilobyte ROMs encoded with a total of 2,500 English words, 300 English compounds and 5,000 Japanese words. Conjugations of English verbs are provided and the dictionary form can be called up from another tense at the push of a button. One further novel feature is a test key for checking the spelling of an English word with a reply of "good" or "wrong". It can also process incorrect or incomplete information. If a user tries to translate "speake" the display will respond with "speak?"

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VMOS Design Catalog (96 page) .	20p
CA3080 (Programmable OTA)	70p
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LM 733 (120MHz diff. amp)	50p
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4017B (f _{tog} 16MHz typ. @ 10v) 55p 4020B (f _{tog} 25MHz typ. @ 10v) 70p
4069UB (tp20nS typ. @ 10v) 14p DACO8 (10MHz, 0.19%, 8 bit DAC) .
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BC107 BC109 BC148 BC182 BCY71 BC117	7p 7p 7p 7p 7p 9p 18p	BC108 8C147 BC158 BCY70 BCY72 BC143	7p 7p 7p 9p 9p 20p	POLYESTER CAPACITORS 0 01 μf = 0 1 μf 2p. 0.15, 0 22 3p. 0 33, 0.47 5p, 0 68 7p, 1 0 10p, 2.2 μf 14p.
2N30 IN4148 IN4005 IA400V Wo4 Zeners 400m	2p 3 ½ p Bndge l	OC71 35p IN4004 IN4007 Rect.	3 ½ p 4 ½ p 3 0p 8p	ELECTROLYTICS 2 μF 100V, 4.7 50V, 10—, 47 μf, 25 v 4p, 100, 150-25 v6p, 220 25 v, 500 25 v 8p, 1000 25 v PC mount 14p, 6800 μf 25 v 55p.
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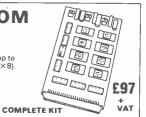
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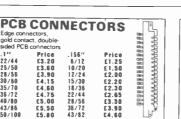
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ELECTRONICS TODAY INTERNATIONAL — DECEMBER 1979

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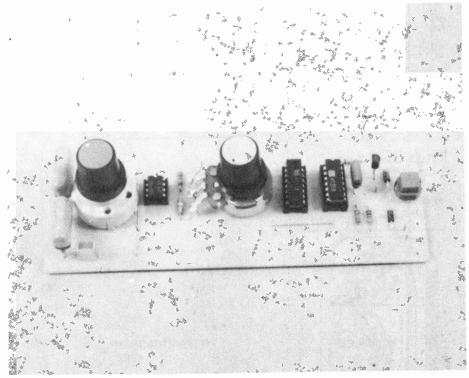
lectronic timer units have numerous home, hobby and engineering applications. They can be designed to have either analogue or digital "Time set" indicators or scales, on which the required timing period is initially set. Their relay-contact outputs can be used to control lamps, heaters, battery chargers, photographic enlargers etc.

Analogue-scale timer circuits have the advantage of low cost. Most previously published circuits of this type, however, have had very restricted maximum timing ranges (fifteen minutes or less) and have suffered from very poor long-term accuracy (20%, or worse), due to the use of electrolytic timing capacitors and high-value timing resistors. Digital-scale timer circuits, on the other hand, have the advantage of high accuracy, but the disadvantage of relatively high cost.

Our new wide-range timer gives you the best of both worlds. It is an analogue-scale device that uses digital frequency division techniques to give a very wide timing range (1 minute to 20 hours), but uses a basic clock generator with non-electrolytic timing capacitors and consequently has a high degree of intrinsic longterm accuracy (better than 1%). The timer is inexpensive, having a typical component cost (excluding the relay) of three or four pounds. The unit consumes zero current when it is in the 'standby' mode and thus does not need a separate on / off switch.

CONSTRUCTION

All of the components of this unit (including the switches and the pot but excluding the relay) are assembled on a single PCB and construction should present few problems. The three ICs should be mounted in suitable holders. The two switches are



PCB-mounting types (see components list). Note that we have made up the 1 2 value of C2 by wiring two capacitors in parallel.

Take special care to relate the circuit diagram to the PCB overlay when connecting the relay and the power supply to the unit. The PCB is provded with five external connection points (one is rather sneakily hidden to the left of push-button PB1 on the overlay). Two of these connections go to the relay coil, one goes to supply zero, one goes to one of the relay contacts, and the remaining connection goes to the other relay contact and also to the supply positive. If the relay fails to latch on when you first give the unit a functional check, suspect an incorrect connection to the

When construction is complete,

check that the unit is fully functional by momentarily closing PB1 and checking that the relay locks on for the timing period. You can then, if you wish, mount the unit in a suitable box and calibrate the RV1 scale against a clock on the two lowest timing ranges. The calibration of the top (100min-20 hours) timing range will be a factor of precisely ten above the middle (10 min - 2 hours; timing range.

BUYLINES

There should be no problems in obtaining any of the components used in the timer.

All ICs are common types available from most components shops.

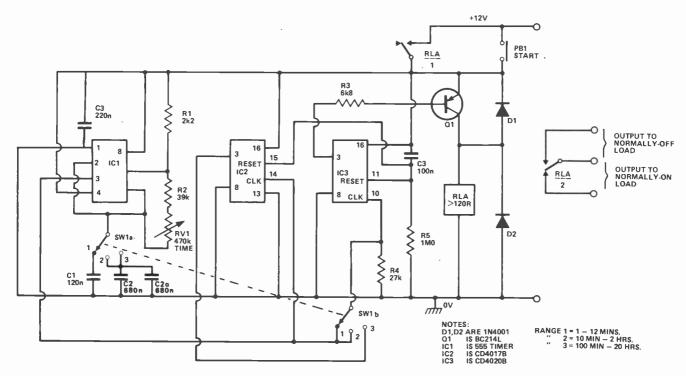


Fig. 1. Circuit diagram.

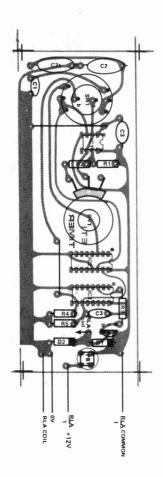


Fig. 2. Component overlay.

PARTS LIST

RESIST	ORS All %W, 5%
R1 ,	2k2
R2	39k
R3	6k8
R4	27k
R5	1M0
POTENT	IOMETER
RV1	470k
CABACI	TORS
CAPACI C1	120n nolyaarhanse
C2,a	120n polycarbonat 680n polyester
IC1 IC2 IC3 Q1 D1,2	NDUCTORS NE555 CD4017B CD4020B BC214L 1N4001
MISCELI	_ANEOUS
PB1	momentary push
	button
SW1	2 pole 3 way rotary switch
Relay to	suit.

NOTE: The value of C3, shown on the circuit diagram and component overlay, is 220n.

HOW IT WORKS

In this circuit IC1 is a 555 timer, connected in the astable mode, and is used as a clock generator for the IC2 and IC3 frequency divider circuitry. IC2 is a 4017 decade divider. IC3 is a 4020 14-stage binary counter and in this particular application effectively divides the clock frequency by a factor of 8192.

Power is applied to the circuit by momentarily closing PB1, at which momentarily closing PB1, at whi

Power is applied to the circuit by momentarily closing PB1, at which moment the two counters are set to zero via C3 and the relay is driven on via Q1. As the relay turns on it's contacts change over and maintain the power supply connections to the unit when PB1 is subsequently released. The IC1 astable starts to generate clock pulses as soon as power is applied.

clock pulses as soon as power is applied.

On range 1 (1-12 mins) the astable period is determined by C1 and R2-RV1. The clock signal is divided down by IC3, which changes state on the arrival of the 8192nd pulse and turns the relay off and breaks the supply connections to the circuit. A similar action takes place on range 2 (10 mins - 2 hours), except that the clock frequency is determined by C2 and R2-RV1.

On range 3 (100 mins to 20 hours) the clock frequency is again determined by C2 and R2-RV1, but in this case the frequency is divided by both IC2 and IC3, so that the relay turns off and breaks the supply connections on the arrival of the 81920th clock pulse.

81920th clock pulse.

The spare (RLA/2) set of RLA changeover contacts can be used to control
external circuitry.



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 $\rm XO2: XO3 - ACTIVE$ CROSSOVERS. XO2 - two way, XO3 - three way. Slope 24dB/octave. Crossover points set to order within 10%

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CHESS MACHINES SURVEY

With the Christmas of the chess computer rapidly approaching, lan Graham has been mating his way through the electronic playmates.

Well, not much mating actually. I did manage to mate with a couple of the computerised companions on their lowest level.

As my chess isn't up to comparing the programs these machines use, I decided to play them off against one another. On their lowest level, the games were evenly matched. There were lots of stalemates. The Voice Chess Challenger managed to win all but one of its games. So, once, and once only, I heard the Voice Chess Challenger announce 'I lose'.

Perhaps more differences would have shown up at higher levels of play. However (and it's a big however), if all the games were playing at a ten minute response time and if one assumes 25 moves each for black and white in each game, the E T I chess computer league would have taken over three weeks of button-pushing, 24 hours a day, to play. No thank you.

Whether you're looking for a portable or desk top game, one complete with board or complete without one, or even a game that talks to you, there's one in our survey.

At the end of the survey you'll find a table bringing together the chess games, their suppliers, prices and their most important features. Prices are changing so often that, if you're thinking of buying a system, give a few of the suppliers a ring to confirm the latest prices.

BORIS

Boris is probably the most infuriating of the computer opponents. It comments on your game. After considering your next move at length and finally plucking up enough courage to actually move the piece, you sit back with a smug grin on your face. Then the machine responds with 'RUBBISH', flashing on its display. It's enough to shake anyone's confidence in his game.

One welcome feature on both Boris and the Boris Diplomat is an easy way of checking where the pieces are on the board. There's nothing worse than manoeuvring into position to take the computer's Queen to find that it wasn't where you thought it was anyway. All the playmates will allow you to check the state of the board. Usually they assign a numerical value to each piece. The display shows the position of each square and the value of the piece on it. The two Boris's go one better. They display the square location and a stylised outline of the piece on it. The outlines are difficult to decipher at first, but soon become familiar.

A card board (a cardboard what? — No, a chess board made from card) is supplied with Boris, but I think it's totally unnecessary. If you can afford the £165 or so for Boris you're likely to have enough pennies left over for a decent board, if you haven't got one already.

Unlike the other games, which have a series of levels of play to choose from, Boris has a built-in 100 hour timer. The longer a response time you set on the timer, the longer Boris has to think about his/it's next move and the higher the level at which it plays.

Boris can be set to play either white or black. If you don't

like the situation you've played yourself into, you can change sides and make Boris take over your pieces.

You don't have to start every game from the beginning. Any problem or advanced stage of play can be set up on the board and entered rank by rank into Boris's memory. If Boris's response to one of your moves is rather disturbing, you can go back to where you were and try a different move.

As you can see, Boris comes in an attractive walnut case, with a compartment for the pieces and mains adaptor.

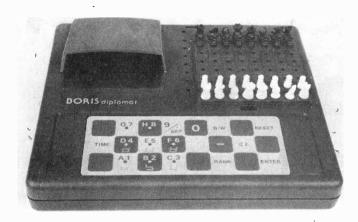


BORIS DIPLOMAT

My first impressions of the Boris Diplomat were less than favourable. I found that the flickering LED display was set at an awkward viewing angle. The keyboard, although large and clearly laid out, was unsatisfactory in use. It was absolutely rigid and, in the absence of sound effects, I had to glance at the display after each key pressing to ensure that the move had, in fact, been successfully entered. The chess board itself is even smaller than the keyboard and the pieces almost microscopic.

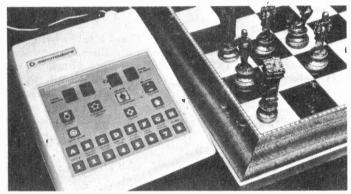
Having got all that off my chest, let me now say that I think Boris Diplomat is the perfect travelling chess computer. It's completely self-contained. You could quite happily sit on the BA shuttle to Glasgow or the 8.20 from Staines to Waterloo (the sardine special) with Boris Diplomat on your knee flashing it's gems at you.

The Diplomat shares the features of its big brother Boris. It doesn't have a series of levels. Instead it has an internal timer which can be set to give a response time of up to 100



hours. The longer you give the Diplomat to think, the higher the level of its play.

COMMODORE CHESSMATE



Commodore's Chessmate is another newcomer to the market. This computerised mate didn't stir any great feelings either for or against it, on the whole. Although it employs the same control method as Chess Champion (separate keys/touch pads for the letter and number of each square location) I didn't find it at all awkward to use. On pressing each touch pad, a trill of tones signals

successful pressing. Another trill accompanies the appearance of Chessmate's response on the display.

My only criticism is that there is no on/off switch for the sound effects. They do become a little irritating after a couple of games. The control panel is well laid out and more colourful than most.

There are eight levels of play and internal black and white 60 minute timers. Unlike all the other systems, which automatically reset to level one at the beginning of each new game, Chessmate resets to level 4 — its average level.

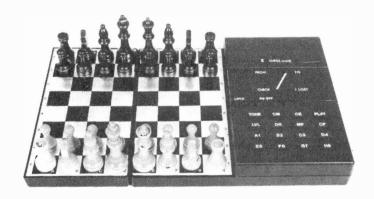
Chessmate copes quite happily with castling and en passant but it trusts you to observe the correct rules of castling. It will also check where the pieces are on the board, assigning a numerical value to each piece for identification. An illegal move is answered by a pair of flashing question marks on the display.

The computer companion's memory stores 32 familiar chess openings — from the Bishop's game to the Nimzo-Indian defence. It chooses one of these at random and tries to follow it for 16 moves, after which it has to think for itself.

CHESS MATE

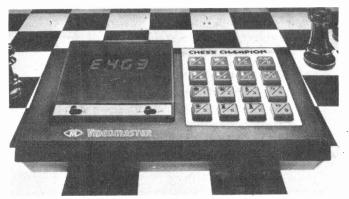
Not to be confused with Commodore's Chessmate, this Chess Mate isn't on the market yet. It's a battery (rechargeable)/mains game complete with fold out board. It will play at ten levels with average response times of from eight seconds to a day and a half. As with all the other games in our survey you can set up any problem on the board, so you don't have to start every game at the beginning.

The prototype I saw had one minor disadvantage. The board folds away very neatly to make a compact portable game. No, that's not the disadvantage. Unlike the Boris Diplomat which is self-contained with its set of on-board pieces, this game has no provision for carrying pieces. So, you have to carry around a little bag of pieces separately. However, there may be enough space in the folding board



to accommodate them when the game finally appears on the market.

CHESS CHAMPION



You have to supply your own board when you play against the Champion. The good news is that the Champ's price has come down recently. ('Wonder if it's anything to do with the competition from the new Commodore Chessmate?) It has six levels of play — from an instant

response beginners level to the marathon 2-day computing time level (for correspondence chess).

As chess computers go, the Champion is a simple animal. It will only play black. Special moves need special treatment. The execution of the en passant move is a little puzzling. To take the Champion's black pawn en passant, you enter your white pawn's diagonal move. Now, you have to remove the black pawn from the board as seen by C.C., so you have to enter what appears to be an illegal sideways move to erase the C.C.'s pawn from it's memory. Castling? The Champ castles at the first opportunity.

You may have noticed that Chess Champion has more keys than most of it's brethren. Whereas one key usually serves for both the letter and number of a square's location eg C3, Chess Champion has a separate key for each. In my humble opinion, as a fully paid up member of the button-pusher's union, the Champ would be a much more attractive proposition if it incorporated dual-function buttons or touch pads, perhaps with a button-press sound effect.

CHESS CHALLENGERS

This latest addition to the Chess Challenger range is a bit special. It talks to you. It not only repeats every move, it tells you which piece it's moving and, if it's taking something, which piece it's taking. If you're stuck for a move, the Voice C.C. will even whisper a few suggestions in your shell-like. If you're a bit slow off the mark, the machine will remind you that you really ought to get a move on. It's no slow-coach itself, with response times of about half those of its predecessors.

There are nine levels of play plus an H level. If you select H, the chatty Challenger goes on thinking about it's next move until you tell it to stop. Checking the position of pieces on the board is simplicity itself. Each time you press the PV key, the computer-generated voice tells you which piece is on each square and whose piece it is. Positions are also shown on the display. Like Chess Challenger 10, the Voice C.C. comes with magnetic pieces. However, the usual Challenger touch keypad for a pushbutton pad with a click action.

For all the Micro-men (and women) in Readerland, the Voice Challenger uses 96K of ROM for program and operational stages, 32K bits of ROM for voice generation and 8K bits of RAM for scratch pad and intermediate storage. The heart of the clever bits is a Z80-A, 8-bit CPU. The unit is preprogrammed with 48 standard opening moves which it will select either randomly or under your command.

This is by far the most expensive chess computer on sale now, but it *does* have the most powerful program yet to appear on the market. If you're a serious club player, and a wealthy one at that, the Voice Chess Challenger is the most competent opponent (non-human, that is) you can face today.

I hoped this Challenger would make full use of it's voice and show a little character by blowing a raspberry when it won, but it just said 'check and mate', like a well programmed American dalek.



Chess Challenger 10 is a ten level opponent in an attractive package with an integral board and magnetic pieces. The calculator-style touch pad has a positive click action and sound effects. The manufacturers — Fidelity Electronics of Miami — have included a sound off switch. Whilst sound effects are useful to indicate successful key pressing, they can get rather monotonous and irritating after a while. The challenger 10 has one big advantage over its star successor, the voice box — it's around £80 cheaper — but its chess program is not as powerful or as fast.

Chess Challenger 7 was the first of the Challenger series to retail at under £100 and the last to appear before the Challenger acquired the power of speech.

It incorporates all the features of its predecessors plus a few extras. It will play against you (naturally), but it will also play against itself (if you're into spectator chess). You can change sides in mid-game and see how the Challenger gets out of the mess you got into. Not surprisingly, it looks very like its predecessor, the Challenger 10.

ATARI CHESS CARTRIDGE

If you're buying a programmable TV games centre, or if Santa Claus is bringing you one, you've probably got you eyes on the Atari Video Computer Systems. It's an expensive way of playing chess - over £200, including £45 just for the chess cartridge.

I thought it would be unfair to test the chess cartridge only. To give the system a fair and complete trial I decided to try out all the games cartridges I could get my hands on. There were air-sea battles, space wars, golf, basketball, breakout and many more cartridges. About a month later I thought I was sufficiently familiar with the system to try the chess cartridge. My eyes resumed their by now customary square shape as the board appeared on the screen.

My first criticism is that the board could be much larger. It sits in the middle of the screen with a large unused border round it. The pieces are controlled by a joystick with a push button. When the cursor is moved onto a piece, the piece is 'picked up' by pushing the button, then moved with the ioystick and finally 'released' by pushing the button again. This sort of control method always seems at first to be a bit of a long-winded business, but soon becomes second nature. You have to decide for yourself whether it will interfere with your game.

There are eight levels of play. I assumed that level one was the simplest and level eight the most difficult. Silly me. Level eight is the simplest followed by levels one to seven.

The Atari Videocomputer system and chess cartridge are available from Videotime Products, who can supply the full range of games cartridges. The cartridges are mostly £14.95 each. The exceptions are chess at £45 and backgammon at £34.50.



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CHESS CHALLENGER 10	155.25	159.50	169.95	169.95	•	М	10	YES	TP	NO
VOICE CHESS CHALLENGER	229.95	245.00	249.95	249.95	•	М	10	YES	PB	YES/S
CHESS CHAMPION	•	54.50	54.95	•	•	М	6	NO	PB	NO
COMMODORE CHESSMATE	59.95		59,95	•	•	М	8	NO	TP	YES
CHESS MATE	95.00	•	•	•	•	M/B	10	YES	PB	YES/S
ATARI CHESS CARTRIDGE	45.00	•	•	•	45.00	M	8	YES	JB	YES

Power:

M — mains

Levels:

B - battery T - internal timer

Sound:

YES/S — sound effect may be switched off.

PB — push buttons Controls:

TP — touch pads

NIC - N.I.C. Models 27 Sidney Road London N22 4LT Tel: 01-889 9736

JP — joystick and push-

The list of suppliers is by no means exhaustive. Many of the High Street hi-fi stores will have a chess machine or two in the window. Prices vary a lot, so it's worth shopping around, especially with Christmas coming up and some prices coming down. STOP PRESS - Latest prices from Mountaindene: Commodore Chessmate - £58.00, Boris - £155.25, Boris Diplomat — £90.00, Challenger 10 — £155.25, Challenger 7 — £88.00, Voice Challenger — £230.00.

AJD - AJD Direct Supplies Ltd 102 Beliegrove Road

Welling Kent DA16 3QD

Tel: 01-303 9145

CGL - Computer Games Ltd Spectrum House 48 Cambridge Road Barking Essex Tel: 01-591 5654

Videotime Products 56 Queens Road Hants RG12 1REA

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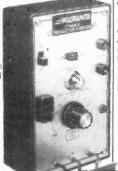
circuits. Needs two "AA batteries. 22-4034.

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equipment. Load regulation: less than 450mV at 1 amp at 24V DC. Ripple: less then 25mV. Maximum output current: 1.25 amps. Switchable colour-coded meter reads 0-25V. DC and 0-1.25 amps. Three-way binding posts take wires, banana plugs or dual banana plugs with 0.75" centres. For 220/240V AC. 22-9123

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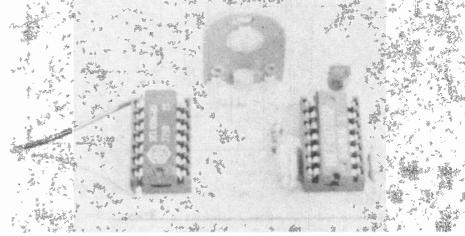


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hite, noise can be simply described as a signal containing a full spectrum of quite randomly generated frequencies or tones, all with randomly determined amplitudes, but which have equal mean power when averaged over a reasonable unit of time. The basic sound of white noise resembles that of hissing steam, but this sound can be greatly modified, to give a variety of special sound effects (such as wind, waves, surf, jet roar, etc), by passing it through low-pass or narrow-band filters.

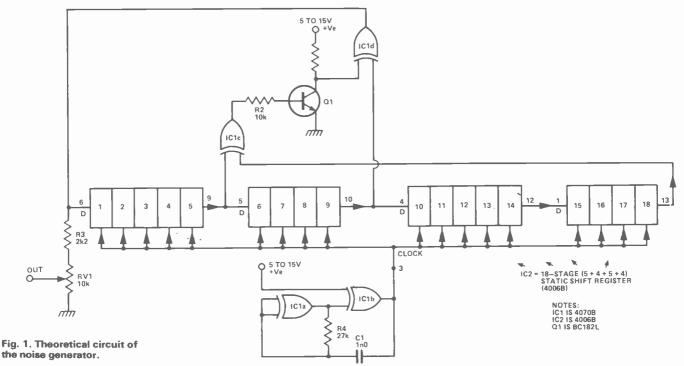
Most of the white noise generator circuits that have been published in the electronics press in recent years have been analogue designs. They have taken the relatively low-level white noise outputs of selected 'leaky' Zener diodes or of special (and expensive) 'noise' diodes and then amplified these signals to a level suitable for general use. A major problem with these circuits has been that they



have given highly unpredictable end results, with circuits of identical designs giving outputs that range from non-existent to excellent.

Our new ETI design is a digital unit, and does not suffer from the deficiencies of the earlier analogue circuits. Its output is produced via a clock generator and a pseudo- or apparently-random shift register. The

output has all of the basic characteristics of a conventional white noise signal, but in reality has a preprogrammed pattern that is faithfully reproduced in all units that are built from the design. The amplitude of the output signal is inherently large, and required no further amplification before being fed to external filter networks.



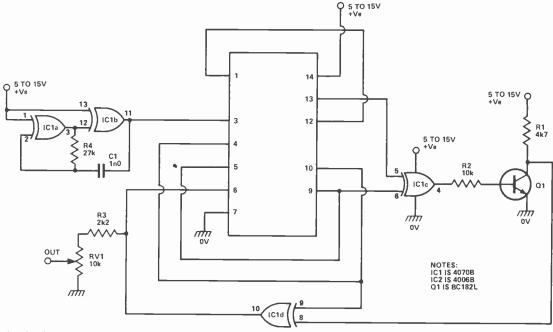


Fig. 2. Practical circuit of the noise generator.

Construction

The circuit uses only two IC's, one transistor, and half a dozen passive components, so construction is simplicity itself. As the ICs are CMOS devices, they should be handled with due care, and preferably should be mounted on the PCB via suitable

sockets or via Soldercon pins. When construction is complete, check the performance by connecting a crystal earpiece or microphone across the output terminals, and switch on. If all is well, the unit will produce a hissing noise like escaping steam.

BUYLINES

No problems here. All components are standard parts, available from most mail-order suppliers advertising in this issue.

HOW IT WORKS

The theoretical circuit of the generator is shown in Figure 1, and a more practical representation is shown in Fig 2. 1C2 is an 18-stage (5+4+5+4) static shift register, in which the logic (0 or 1) information on the Data terminal is fed forward one step on the arrival of each new pulse from the ICla-IClb 30 kHz clock generator. IClc and ICld are Exclusive-OR gates, and are used in conjunction with inverter-connected Q1 to feed various outputs of IC2 back to the Data terminal in such a way that the data feeds through the register in an APPARENTLY random or jumbled fashion.

In reality, a complex sequence of 0's and 1's flows through the register, repeating once every few seconds and producing an apparently random jumble of fundamental frequencies. Since these fundamental frequencies are produced digitally, however, they each produce a vast number of harmonics which, when subsequently (externally) filtered, produce a signal that appears to vary randomly in both frequency and aplitude, and thus to have all the basic characteristics of white noise.

PARTS LIST

RESIST	ORS All ¼W, 5%	CAPACI	TOR
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R3	2k2		
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POTEN"	FIOMETER	1C2	4006B
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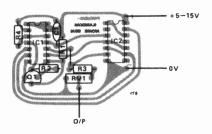


Fig. 3. Component overlay.

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COMPUTER BOARDS

rrom our haefter et. 'MP4', which is evailable
6' SAE helps, but is not essential). See
the right for board prices.
juice of micro-processors now available presents a

The reason that separate systems, one for each processor, have been necessary is due to the fact that individual microprocessor's have their own individual features, in one case to access memory a separate read strote and write strobe is required, in another a "read write" line is used in combination with a combined strobe called "valid memory address and pil-2". Write some processors, the same address but can be used for both memory and input/output ports; under the control of a "memory request" or an input/output ports; under the control of a "memory request" or an input/output ports; under the control of a "memory request" or an input/output ports; under the control of a "memory request" or an input/output ports; under the control of a "memory request or an input output services of any particular microprocessor, onto the same bus at a lair end as the same of the unrelated microprocessor, onto the same bus at a lair end as the same of the unrelated microprocessor, onto the same bus at a lair end as the same tempory and interfaces to be retained when a different MPU is used. The basic system bus consists of data and address buses together with read and write strobes By be caren the sconsists of data and put (subpost) and output (VDU) in the same memory and interfaces to be retained when a different MPU is used. The basic system bus consists of data an input (subpost) and output (VDU) in the same strobes By be caren the sead without any fundamental-change to the same strobes By be caren the sead without any fundamental-change to bus (and as a borus, users of these MPU's have all the ports entirely free for their own purposes; includes boards to implement a memory-mapped VDU, cassente interface, keyboard interface, PROM to programmer, and a number of bus (and as a total in the cards are of international Size 114 x 203 mm (a)" x 8") accept for the large prower FSU A power supply card. This little card sized on the international Size 14 x 203 mm (a)", and a floth cards a total to the safe of a standard 4" chasts m

The tange of boards in the Universal Micro System are entirely different. You book your microprocessor, memory, interfaces, etc., what a different. You book your microprocessor, memory, interfaces, etc., what a difference does not indeed, you chook whether for on all med if you level of experience does not need you chook your own. (Don't be too allarmed if you level of experience does not permit you to take his sort of docision with bootfolking-er. we are always here to differ guidance if asked, we'll even rell you if the system is unsuitable for your meds, in the unlikely event that it is.)

As mentioned on the last page, a brave attempt has been made to begin the design of a lunyersal Micro System. (b provide a sufficiently illestable arrangement to permit the system to grow over the years, and not to become obsoles ownight. To permit this flatability, wherever possible patch areas: have been provided on the boards. A patch area is an undedicated dual-natine pattern which can accommodate an extra integrated circuit for your own use. Often these can be used to add some extra memory, or some extra address these pattern which can be supply oldings can be developed using an integrated circuit regulator, or gates can be added to allow separate. Memory Request and input? Output Repotes who would lant clean away at the thought of curing printed circuit tracks, adding extra integrated circuit and bits of wire in the way described above, but it is not for these people that this sort of system has been designed. We would like to think of this system as basis on which you can build your own personal design, pethags as an alternative to the use of Venobaard or exching your own pob's a further sections give an outline of each card in tim. Although we have in mind of ormats, colour displays, Light pears, sound generators etc.) we profer to keep quiet about them until they actually exist. All of the cards to grammable VOU ormats, colour displays, Light pears, sound generators etc.) we profer to keep quiet about them until t

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400 watt uv lamp and ballast complete £31.50. Post £3 (£39.68 inc. VAT & P). 400 watt UV lamp only £11.25. Post £1.20.
£14.32 inc. VAT & P).

*

SQUAD LIGHT

40

4

Programe all

SOUAD LIGHT
A new conception in fight control.
Four channels each capable of handling 750 watts of spotlights or dozens of small mains lamps. Seven programs all speed controlled plus flash modulation, effectively giving 14 different displays. Makes sound to-light obsolete. Completely electrically and mechanically noise free. Price only £60.70 (£69.81 in CAT & P)

S.A.E. (Foolscap) for further details. Post 75p

EQUIPMENT S.A.E. (Foolscap) for details

XENON FLASH

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



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

230/240V AC Relays: Arrow. 2 c/o. 15 amp £1.50 (£1.96 inc. VAT & P).

T.E.C. open type 3 c/o. 10 amp £1.10 (£1.50 inc. VAT & P). DC Relays: Open type 9 / 12 V 3 c/o 7 amp £1.00 (£1.38 inc. VAT & P). Sealed 12 V 1 c/o 7 amp cotal base. £1.00 (£1.38 inc. VAT & P). Sealed 12 V 2 c/o 7 amp otal base. £1.25 (£1.67 inc. VAT & P). Sealed 12 V 3 c/o 7 amp 1 l-pin. £1.35 (£1.78 inc. VAT & P). 24V. Sealed 3 C/o 7 amp 1 l-pin. £1.35 (£1.78 inc. VAT & P). Sealed 12 V 3 comp 1 l-pin. £1.35 (£1.78 inc. VAT & P). Sealed 12 V 3 comp 1 l-pin. £1.35 (£1.78 inc. VAT & P). Sealed 1 C/O Other types available — phone for details. N.M.S. Very special offer. 9-12 V D.C. 2 make contacts, new 11T3 for £1.75 2 Sp 78 (pinc. VAT £2.30). Diamond H heavy duty AC relay 230 / 240V AC, two c/o contacts 25 amps resa 1250V AC £2.50 P&P 50P. (£3.45 inc. VAT + P&P). Special base 50p. ai P). T.E.C. open type 3 c / o. 10 amp £1.10 (£1.50 inc. VAT & P).

METERS (New) — 90mm

DIAMETER

AC Amp., Type 6272 0.1A, 0.5A, 0.20A AC Volt.
0.15V 0.300V DC Amp, Type 65C5 0.2A, 0.10A,
0.20A, 0.50A DC Volt. 0.15V, 0.30V All types 63.50
ea + P&P 50P, (£4.60 incl. VAT), 0.50A DC, 0.100A DC,
Price £5.00 + 50p P&P (£6.33 inc. VAT)



GEARED MOTORS

100 R.P.M. 115 lbs. ins.!! 115 ib. ins., 110 volt, 50Hz, 2.8 amp. single phase, split capacitor motor. Immense power. Continuously rated. Totally enclosed. Fan cooled. In-line gearbox. Length 250mm. Die. 135mm. Spindle Die. 15.5mm ength 115mm, ex-equipment tested £12.00 Post £1.50 (£15.63 inc. VAT & P). Suitable transformer , 230/240 volt £8.00 Post 75p (£10.06 inc. VAT & P).

GEARED MOTORS

28 r.p.m., 201b. inch 115V AC Reversible motor.
71 r.p.m. 10 lb. inch. 115V AC Reversible motor.
80th types similar to above drawing. Price either type £4.75 + 75p P&P (£6.33 inc. VAT + P&P)
80th (£6.33 inc. VAT + P&P)
80th (£6.35 inc. VAT + P&P)
80th (£ Supplied with transforms (£9.49 inc. VAT + P&P).

FRACMO MOTOR
56rpm 50lbs inch 240V AC reversible, 0.7 amp. sharplength 35mm, dia. 16mm, weight 6 kilos 600 grams. Price £15.00 P&P £1.50 (£18.98).
N.M.S.

FRACMO MOTOR
1400 rpm HP 1-30 continuously rated 115V AC fitted with anti-vibration cradle mounting. Supplied complete with transformer for 230-240V AC op. £10.00 P&P £1.00 (Total £12.85 inc. VAT) N.M.S.

PARVALUX MOTOR TYPE

S.D.2 12V DC shunt 1/30th ph motor. Continuously rated 4,000 rpm. Price £10.00 P&P 75p (£12.36 inc VAT & P). N.M.S.

PARVALUX 230/250V AC

MOTOR
Type SD18 240V AC reversible 30 rpm 50lba
Inch. Price £15.00 P&P £1.50 (£18.98 inc. VAT).
N.M.S.

CITENCO
FHP motor type C 7333/15 220/240V AC 19 pm reversible motor, torque 14.5 kg. Gear ratio 144.1. Brand new incl. capacitor, our price £14.25 + £1.25 P&P (£17.83 inc. VAT & P). N.M.S.



CROUZET — 230/240V AC 2 rpm synchronous geared motor £2.90 P&P 30p (Total £3.68 inc VAT), N.M.S.
HAYDON — 230/240V AC 1 rpm synchronous geared motor £2.90 P&P 30p (Total £3.68 inc VAT) N.M.S.

REVERSIBLE MOTOR 230V AC
General Electric 230V AC, 1,600 r.p.m. 0.25 amp. Complete with anti-vibration mounting bracket and capacitor. 0/A size 110mm X 90mm. Spinde 5/16 dia. 20mm long. Ex-equipment lested £3.00. Post 50p (£4.03 inc. VAT & P).

BIG INCH
Tiny precision-built 3 rpm USA motor size only 1 x 1," 100V. AC
operation supplied with resistor for 230V. AC, Price: £2.00 P&P 20p.
(£2.53 incl. P & VAT). 4 for £5.00 postpaid (£5.75 incl. VAT). N.M.S.

12V DC GEARED MOTOR

Notice built miniature motor, 6/12V DC operation, Incredibly

Precision built miniature motor, 6/12V DC operation. Incredibly powerful for size. Approx speed at 6V 60 rpm 40 ma. Approx speed at 9V 80 rpm 50 ma. Approx speed at 12V 120 rpm 60 ma. Size 27mm dia, 38mm length, weight 55 gram. Drive spindle 5 mm x 2

mm dia.
Price: £2.50 post paid (£2.88 inc. VAT).

REDUCTION DRIVE

*

*

GEARBOX
Ratio 72.1. Input spindle ¼ × ½in. Output spindle ¼ × 3in. long.
Overall size approx.. 120 × 98 × 68mm. All metal construction.
Ex-equip. tested. Price: £2.00 + 50p P&P (£2.88 inc, VAT)

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2-CAM PROGRAMMER

Crouzet 1 rpm 115V A.C. Motor operating 2 Roller Micro switches (4 amp). Can be used on 240V AC with either 0.25 mfd 250V Condenser or 5.6K wirewound Resistor 7 watt (not supplied). Price £2.50 + 50p P&P (£3.45 inc. VAT&P)

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240V A.C. operation. Spring reserve. 10 amp contacts one on-off every 24 hours. Calibrated in two hour steps. Minimum on-off period 6 hours. Day Omission. Unusual feature with these switches is that improve the property of the period of the



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MICROFILE

Henry Budgett's comments last month spurred some of you to take up pen and phone. This month micro-man brings news from the North and gives the Beeb a plug.

y little plea for help over the problems involved in modem style connection of home computers has borne some fruit. A very helpful gentleman, who just happens to work for the PO, wrote in with a few comments. Apparently the Post Office regard acoustic modems as attachments in much the same way as answering machines and there are a considerable number of specifications to be met. Such items are the maximum sound level of —13 dBm and the maximum sound pressure at the transmitter of 0.5 Newtons per square metre. Type approval for these kinds of devices should be obtained and I gather that ad-lib experimentation may be frowned on, so take care!

It should also be noted that hard wiring of a computer to the PO lines is definitely *not* on. I didn't suggest it last month, but just in case it has crossed your mind forget it.

One other comment that was thrown in from another PO person was that there is a rather critical frequency around 2200 Hz. A tone of this frequency will cause the exchange to close down your call, slightly embarrasing. You have a bandwidth of 300 to 3500 Hz to play with so steer clear of this area. Full technical details of the specifications are contained in Technical Guide No 11, which should be obtainable from the telephone section of the Post Office.

And finally on this subject, I understand that Green-banks cassette interface for their SCMP system has provision for an op-amp to be connected for direct tape head drive. It should prove possible to use this to drive a loudspeaker for our purposes. The board is currently being re-designed so contact them soon for details. Many thanks to Mike for his helpful comments on the Post Office's position.

Standard Letters

A vast epistle squeezed its way into my mailbag this week after my diatribe on standards last month. One problem . . . there was a lot in it about misspeling and general missuse of Her Britannic Majesty's English but not a sausage (courtesy of That's Life) on computer jargon. Have you no shame, or perhaps you were all stunned into silence? Please will someone say something, hopefully polite, as the article was supposed to inspire general comment.

Plea For Clubs

Not a single word from anyone this month. Are you all too busy to write to Microfile with your news? Many thanks to

those who have filled in the little form and sent it back. If any club hasn't had one please let us know as we are trying to produce a second Club Directory for CT and we go to press in four weeks. After all, if the Beeb think it's good enough to use what have you got to lose, poetic stuff.

BBC Speaks Out

A superb pair of programmes were boradcast this month on Radio 4. Called "Machines with Mouths" and "Machines with Ears" they dealt with speech synthesis and recognition systems and techniques which are currently being used. Having worked in this area for a number of years I found them to be excellently produced and most enjoyable. A definite pat on the back for the Science Department. What was even more impressive was that it was done on radio. One would expect this mind of subject to be tackled on a programme such as Horizon. It was also amusing to hear many voices from the past (such as my old boss) expounding their views on the subject. A repeat soon one hopes, how about it?

News From The North

Microdigital have released the first of a series of Nasbus based general purpose interface boards. This one has sixteen relays and is addressable to any two consecutive ports on the Nascom. Power requirements are a modest 250 mA on both the \pm 12 and \pm 5 volt rails and the unit is supplied as a kit complete with sockets for all IC's along with a manual and sample software. Price is around the £50 mark.

The ACFA single board computer that we had a slight mix-up over a month or so back is currently being reengineered for the new 6809 CPU and some more I/O. The problems caused by the NTSC (Nasty Television System for Computers) have now been overcome and a demo model will shortly be going round the shows. Look out for it, it may suit your needs.

The Liverpool software gazette has just been launched priced at 50p per issue or £6 per year for twelve copies. It is packed with software and reviews, including a look at Pascal on the Apple. One of the most interesting items is the complete listing of the M5 language, which has now gone public, for the Nascom. For more details on the language see our review in CT May. The magazine is not intended for the beginner as it assumes a reasonable knowledge of computers. Details on all these products can be obtained from Microdigital at 25 Brunswick Street, Liverpool 2.

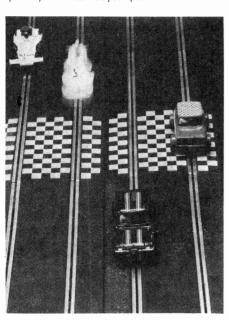
Hobby Electronics

Have we got an issue for you next month? Yes of course we have, just cast your tired eyes over this little lot. (Tired eyes can be avoided by refraining from reading lesser electronic magazines)

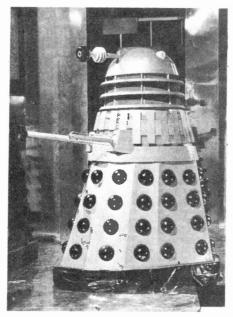
Month

SCALEXTRIC SPECIAL

Yes folks, HE's done it again. Just in time for Christmas. The HE workshop staff have been really getting their noses to the grindstones and have tirelessly, without any regard for personal health, been playing with their Scalextric set. Whilst they were doing so one of them had a bright idea, 'how about doing some projects on this lads?' He was quickly silenced and play recommenced. A little while later, after this momentous statement sunk in, they thought about it and actually all agreed, it was a good idea. So now we proudly present the last word in electronic Lap Counters, Precision Hand Controllers and other amazing things to grace your layout. Miss it at your peril.



RING MODULATOR



Where do we get them from? Now you can really sound like a Dalek. This neat little unit, designed for use on stage, at home, or just for good old fashioned fun will faithfully reproduce the dulcet tones of those amiable creatures. from the planet Skaro. If you don't want to be a Dalek then it will create an interesting range of other effects too. Maybe we'll hang one on HEBOT. You never Know. . . .

UNIJUNCTION TRANSISTOR

Our brainy chief designer Ray Marston takes time off from his train controller to look at those oft maligned, collectorless transistors that are known to all and sundry as Unijunctions. So pay attention because we might be coming round your house to ask you questions about them.

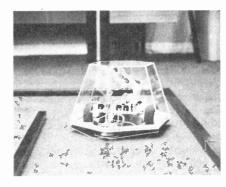
TV-THE CONTINUING STORY

This month Rick Maybury looks at the other end of the TV system, the box that sits in the corner of your living room. Find out just what happens when the on off switch is twiddled, the educated electron strikes again.

PROJECT FAULT FINDING

Gasp...your project didn't work, if it wasn't our fault (is it ever?) then it must be your fault. Keith Brindley, who has had to deal with one or two faulty projects in his time discusses the heart wrenching subject of dead projects.

HEBOT GROWS UP



We are expecting HEBOT to start a craze, (seriously) the combination of a really well designed, sturdy chassis at a very reasonable price, coupled with our unique electronic circuitry, brings the world of advanced robotics to within everyones grasp. This month after completing the basic drive circuitry we go on to explore tactile senses, optical stimuli and self survival instincts. HEBOT is the first serious attempt in this country to bring the world of Robotics into the seventies, others have tried and failed, we know we are going to succeed. Frighten the cat, amaze the neighbours but above all DO NOT MISS IT.

The December issue will be on sale November 9th

The items mentioned here are those planned but circumstances may affect the actual contents









WE'VE MOVED

Special just in full spec. 1702A (intel) £2.50 each p/p 20p. 74125 (tri-state buffers) 4 for £1.00. P&P 20p.

IS423 STUD MOUNTING RECTIFIERS 10A 400V. Silly price, 10 for £2 P&P 20p

MC1303L Dual Stereo Preamp, plus data £1

7in NYLON CABLE TIES 100 for £1.50 P&P 20p. 1 watt Audio amp pcb (LM380) 9 to 18V DC. £1.50. P&P 30p.

ML723 (TO100). Monolithic adjustable voltage regulator. Plus or minus 2v-6v, 6v-8v, 8v-37v to 150mA plus data 55p P&P 20p.

PCB KEYBOARD 65mm x 82mm 18 key clickers less key tops, ideal hexadecimal, 35p each, P&P 20p. Hewitt Packard 4 digit displays 12 pin DIL 0.11" common cathode (LED red) £1.50 P&P 20p (few only).

CANNON D-TYPES, Only ones left: 15 way socket 50p, 37 way plug 80p, 50 way socket £1.20, 50 way wire wrap socket £1.30, 25 way ribbon plugs 90p. Cinch 25-way plastic cover 60p, Metal cover and retainer 80p. P&P

FULL SPEC. SGS2N3055 30p each. 10 for £2 75 P&P 20n

SUPERSAVER 1 Haydon 240V AC 50 cycles 6 digit minute time. Panel mounting 21/2" dia approx. £2. P&P 30p.

SUPERSAVER 2 Hybrid Systems DAC 371-8 (8-bit) DIL packaged + data, ideal MPU users, brand new £2 price smash! now £1.75 each (fraction of original cost) P&P 20p.

SUPERSAVER 3. LM 323K Voltage regulator, v at 3-amp, £3.50 each, P&P 20p

MEMORIES 2708 £6.85, Character Generator MM5240 2560 bit, 64 x 8 x 5 plus data £2.95 (full spec.) P&P 20p. 2112 (200ns) £3.00. P&P 20p. 21L02 (250ns) £1.15. P&P

SUPERSAVER 4. RS338-383 miniature decade thumbwheel switch £1.35 P&P 20p.

SUPERSAVER 5. SN74116 (dual 4 bit latch) 75p P&P 20p. SN74116 (dual 4 bit laten) 75p P&P 20p. SN74181 Arithmetic logic unit/function generator 80p P&P 20p. SN74194 (4 bit shift register) 50p P&P 20p. SN74198 (8 bit shift register) 75p P&P 20p.

SUPERSAVER 6. BC108B 8p 100 for £7.00

SUPERSAVER 7, 4 digit 7 segment bubble display (NSA1540A) ex-equipment 5 for £1.00

9-WAY MALE/FEMALE connector (Elco 8129) 0.1 inch pitch, PCB mounting ideal for bussing two PCBs together 35p/pair P&P 20p.

LEDS (red) TIL209 10p, 100 @ £8.50. 0.2"
12p. ORP12 95p. Voltage regs LM340T + 5V
£1. LM340T + 12V £1. SGS 15V 3amp
£1.LM342 + 15V (250 milliamps) 45p. (v
cassette recorder motors, voltage speed regulated, terrific value 95p.) LM711 CH (voltage comparator) 25p.

Happy Christmas to all our customers and ETI staff.

All enquiries. SAE please. P&P same for quantities except where greater than £1.

Due to move we have no catalogue. A new one is being produced, available shortly.

Rush orders as some stocks are limited.

Phone orders on Barclaycard now taken for Mail Order.

New Retail Premises open now. Mon., Thur., Fr. & Sat. 9.30-6.00 (lunch 1.00-2.00). Many one-off computer bargains & components at surplus prices. We are situated at 11 Hercies Road, Hillingdon. Middlesex (just off A40) phone Uxbridge 55399. Supplies equipment/components purchased for cash.

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1500 hours continuous use battery life. 51 scientific functions. 3/4 x 23/4 x 51/2 ins. Wallet



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THE INCREDIBLE AQ-2000

Watch, full calendar, two alarms, stopwatch, time memory count-down alarm. 8 digit calculator. Displays any monthly calendar from 1901 to 2099. Memories and displays 3 optional important dates. Full memory, %, K, square roots. One year battery life, 1/4 x 21/2 x 4 7/16th ins. Wallet. (RRP £27.95.) £24.95



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Specifications as AQ-2000 but with "kiss" keys and smaller case 3/16th x 2½ x 3½ins.
Wallet with window for display. (RRP £29.95) £26.95



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Clock, auto-calendar. Two alarms, alarm/timer (3 different tunes). Stopwatch measuring net, lap and 1st and 2nd place times from 1 / 10th second to 24 hours. Calculator with full memory, %, square roots. One year battery life. 5/16th, x 4½ x 2½ ins. Wallet. Desk stand. (RRP £25.95)



CO-82 **Multi Alarm** Clock

4 independent alarms, one with snooze feature. Nightlight. Calculator with %, square roots. One year battery life. 1 ¾ x 5 ½ x 2 ¾ ins. (RRP £22.95)

£19.95

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COLLEGE FX-80

6 + 2 digit LC Display. Approx. 4,000 hrs. continuous use from 2 AA size batteries 37 scientific functions, P to R, R to P, ENG key, Pi, cube root, 6 levels (). Memory. 3/4 3 x 5% ins. (RRP £17.95)

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6 + 2 digit LC Display. 43 scientific functions. Non volatile memory. Auto power off 6 levels parenthesis. Standard deviations. R to P, O to R, ENG, FIX, SCI, RND and Random number keys, 5/32in x 2¾ x 4½in.

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CASIO FX-3200 As above but 10 digits £21.95

CASIO FX-310 As FX-2600 but 50 scientific functions. 1/4 x 21/8 x 51/4 in.

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Displaying hours, minutes, seconds, date, am/pm; or hours, minutes, alpha day, date, am/pm. With automatic 28, 30, 31 day calendar.

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4 year battery, 1/10th second chrono to 12 hrs., measuring net, lap and 1st and 2nd place times, 24 hour alarm. Hourly chimes. Backlight, Mineral glass. Stainless steel encased. Water resistant to 66 feet (RRP £31.95)





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Displaying hours, minutes, seconds, day; and with day, date, month and year automatic calendar, pre-programmed to the year 2030.

(Available soon)



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24 hour alarm Selectable hourly chime facility. Backlight, Mineral glass face.

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As above but: Stainless steel case, water resistant to 100ft. (RRP £39.95.)

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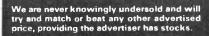
There is no present like the

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95CS-31B

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Silver oxide battery RRP £17.95

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Price includes VAT. P&P. Send your cheque, P.O. or phone your ACCESS or B'CARD number to: —

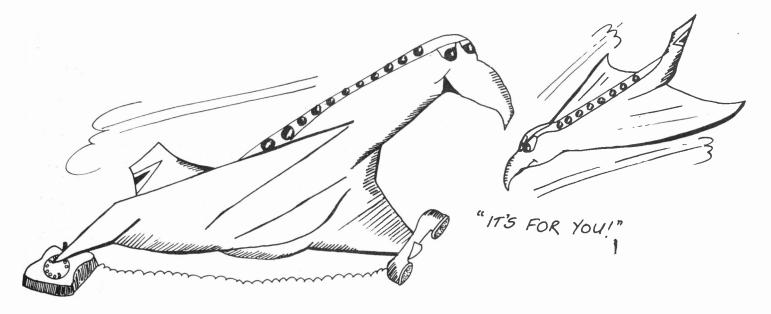


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AIRCRAFT BAND CONVERTER

Listen in to the world's airlines with the ETI Biggles detector and your own short wave radio.



omestic aircraft communications, both private and commercial, generally involve a pilot talking from his plane to a traffic controller at an airfield as well as talking to other pilots. Signals from aircraft can be heard over quite long distances as they are flying quite high and thus the horizon, from the aircraft, can be up to several hundred miles away.

There are 360 channels allocated in the aircraft band, each assigned a specific use or for use in a particular area. Amplitude modulated (AM) transmission is used which simplifies the requirements for a receiver to listen on this band.

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Why a converter — why not a complete receiver? Firstly, a shortwave listener will already have a receiver. A converter to 'change down' the aircraft band frequencies to a suitable band between

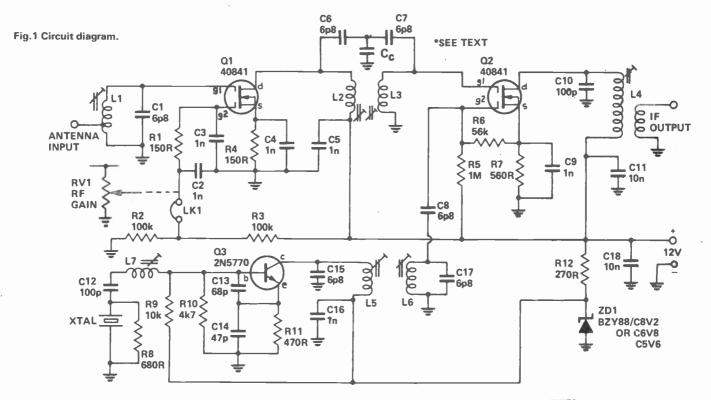
3 MHz and 30 MHz is a simple, and inexpensive, solution. For those wishing to monitor some portion of the aircraft band the output of the converter could be connected to an ordinary multi-band transistor portable to provide quite adequate results. Alternatively, a fixed frequency IF (intermediate frequency) strip with detector and audio stages could be constructed.

The converter is crystal locked — that is, a quartz crystal oscillator is mixed with the signals from the antenna, the signals then appearing at a lower frequency at the converter output. The frequency of the crystal used will determine the frequency band of the converter output.

For a number of reasons, we chose the output (or IF) frequency to be around 10 MHz. Inexpensive crystals are available for the aircraft band to give an IF output from the converter of 10.7 MHz — a standard IF frequency. The

same crystals can be employed if you wish to use a tunable shortwave receiver following the converter. There is a minor inconvenience though — the tunable receiver's dial has no simple relationship to the input frequency. The advantage is that inexpensive crystals cost around half that of a crystal made to order to provide a direct frequency relationship.

As the converter has quite a deal of gain, resulting in very good sensitivity, an RF Gain control has been provided. Very strong signals on a channel near to the one being monitored may cause interference. Judicious use of the RF gain control will reduce or remove the interference while enabling you to still hear the desired signal. Then again, a very strong signal on the channel you are monitoring may overload your receiver, resulting in very distorted reception. Reducing the RF gain will remove the problem.



Construction

The printed circuit board has been specially designed for this application and no other construction technique should be employed unless you are very experienced in circuit construction at these frequencies.

It is best to commence construction by mounting the coil formers. They may be glued on the board over the pilot holes or the board drilled to the appropriate diameter for the base of the formers and then gluing the formers in place. Use the shield cans to locate and/ or hold the formers on the board. It is wise to insert the slugs in the formers after gluing to avoid accidentally gluing them to the formers. The best type of glue to use is one of the 'instant' bond glues such as "Superglue". Many glues available will not bond to substrate materials - particularly fibreglass material.

The next step is to wind the coils. They may be wound *in situ* if you wish, alternatively they may be wound on a suitable diameter former (such as a 5 mm or 3/16" drill shank) and then slipped over the formers on the board.

Take careful note of winding direction and the start and finish connections. Refer to the component overlay when soldering the coil leads in place. Do not mount the shield cans until all the minor components have been soldered in place.

When mounting the minor components take particular care with orientation of the transistors, FETs and the

HOW IT WORKS

The circuit is quite straightforward, comprising an RF stage (Q1), a mixer (Q2) and an overtone crystal oscillator-multiplier (Q3). Dual-gate MOSFETs are used in the RF and mixer stages as they have good gain, low noise figure and good freedom from crossmodulation and overload problems.

Signals from the antenna are first amplified by Q1 and passed to gate-1 of the mixer Q2. The oscillator, Q3, is set to a precise frequency by the crystal. The injection frequency to gate-2 of the mixer is derived from the collector of Q3, being two or three times the crystal frequency. The signal frequency are mixed in Q2, their difference is selected by the tuned circuit in the drain – this is the desired output frequency.

A low-Q tuned circuit, L1-C1, is used between the antenna input and gate-1 of Q1. The antenna input impedance is mismatched to the impedance of the gate towoptimise noise figure. The drain of Q1 is coupled to gate-1 of the mixer, Q2, via a double-tuned, bandpass coupling circuit consisting of L2, C6, Cc, C7 and L3. A combination of cinductive coupling and

zener diode. All components should be mounted right down on the board to minimise lead length. Stakes or pins should be used for the connections to the antenna input, IF output and dc connections.

There is provision on the pc board to mount a crystal socket for a 'style-D' crystal. These have a 12 mm pin spacing and stand about 20 mm high. Alternatively, if the smaller size crystals are used, having a pin spacing of 5 mm or pigtail connections, then they may be soldered in place under the board. Take

common-capacity coupling is used to achieve a wide bandwidth.

Gate-2 of Q1 requires a bias of +6V for full stage gain. A link between gate-2 decoupling (R1,C2,C3) and the junction of \$2-R3 allows for the connection of a gain control potentiometer.

The mixer has above 1V5 of bias applied to gate-2. The conversion frequency is injected at this gate and a small amount of forward bias improves the mixer conversion gain. The output, or IF, is coupled via L4 which is resonant at 10 MHz with C10. This is a low-Q tuned circuit for the broad bandwidth necessary if the tunable IF receiver is used.

The crystal oscillator stage, Q3, is designed to cope with either third or fifth overtone crystals and may double or triple the crystal frequency in the collector. Tuned circuit L5-C15 selects the appropriate harmonic. Energy is coupled from L5 to L6 which is resonated to the required frequency with C17. These two tuned circuits filter the injection frequency. This prevents any spurious mixing occurring in Q2.

Coil L7 is used to 'trim' the crystal.

care when doing this. Do it quickly and use the minimum amount of heat to avoid damaging the crystal.

If desired, the crystal may be mounted separate from the board. Keep lead length between the crystal and the board connections as short as practicable in this case.

The shield cans for the coil assemblies should be mounted last. It may be a wise idea to check that the converter is working before soldering the shield pins to the pc board.

The completed converter may be

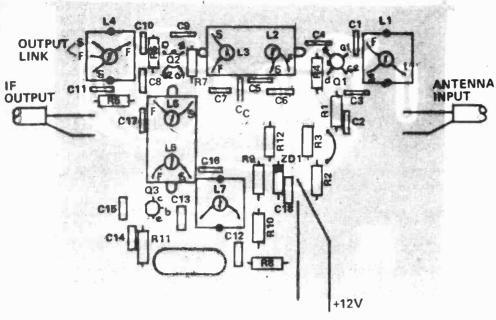
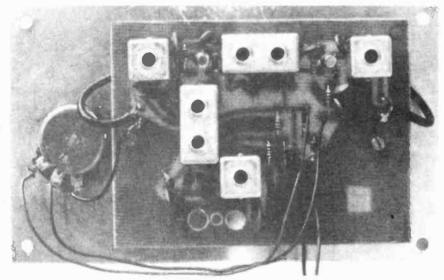


Fig.2 Component overlay,



The PCB fitted to its front panel, showing connections to the gain control, RV1.

mounted, we used a small box measuring $159 \times 96 \times 50$ mm overall. They are available from a number of component suppliers. The board was mounted on the aluminium panel using two spacers. Antenna and IF output sockets, along with the RF gain pot, were also mounted on the panel and power leads taken through a hole in the side of the box. Small lengths of coax cable were used to connect the input and output sockets to to the board connection.

Control

The particular method of alignment will depend on how you will be using the converter. To commence the alignment you will need to have on hand the appropriate aligning tool. You will need a plastic screwdriver-tip alignment tool

to suit the Neosid ferrite cores. They are readily available from many suppliers.

You will need a power supply delivering between 12 and 15 volts; the converter will draw between 30 and 50 milliamps. A receiver with a S-meter is a decided advantage when aligning the converter. You will need a signal generator, with AM modulation, covering the range of 118-126 MHz.

If you are using a tunable receiver for the IF, then the following procedure should be followed:

Connect the converter to the receiver. Use a short length of coax cable. If the converter is working you will notice an increase in the noise level on a sensitive receiver when power is applied. You can check that the crystal oscillator is working by removing the crystal tem-

PARTS LIST

Resistors a	ll ¼W, 5% *
R1,4	150R
R2,3	100k
R5	1M
R6	56k
R7	560R
R8	680R
R9	10k
R10	4k7
RII	470R
R12	270R
Potentiom	
RV1	100k
Capacitors	
Cc	22p ceramic
C1,15,1	7 6p8 ceramic
C2-C5	In ceramic
C6-C8	6p8 ceramic
C10,12	100p ceramic
C11,18	6p8 ceramic 100p ceramic 10n ceramic
C13	68p ceramic
C14	47p ceramic
C16	In ceramic
C18	10n ceramic
Semicondu	ictors
Q1,2	MFE131, 40673, 40841
Q3	MFE131, 40673, 40841 2N3563, 2N3564, 2N5770
ŽD1	BZY88/C8V2 or /C6V8
	or /C5V6 or /C5V1
Miscellane	ous
7 x 722	/1 Neosid coil formers
3 x 710	O Neosid screening cans
	O Neosid screening cans
7 x Neo	sid ferrite slugs, 4 x 5 x
	coil wire
crystal -	- see text
	e text), 2 coax sockets,
	nm, 6 BA spacers, nuts,
bolts, et	
	values may be plus or
	standard value either side

porarily — a decrease in the noise from the receiver will be noticed.

of those quoted without ill effect. Capacitor values should not be altered.

- 1. Set the receiver frequency to the middle of the tuning range of the converter's output. The converter RF gain should be at maximum all through the alignment procedure.
- 2. Tune the slug in L4 to obtain a peak in the receiver noise level.
- 3. Set all the other coil slugs flush with the tops of the coil formers.
- 4. Using the signal generator, with a fairly high output level, peak L4 again for best signal strength.
- 5. Set the generator to a frequency near 119 MHz and tune the receiver until you pick up the signal. Now adjust the slugs in L2 and L6 for best signal strength. Decrease the output of the signal generator so that these

adjustments are made on a fairly weak signal.

6. Set the generator to a frequency near 125 MHz, or the highest frequency in which you are interested, and tune the receiver until you pick up the signal. Adjust the slugs in L1 and L5 for best signal strength. Keep the generator output at a low level for best results.

7. Now set the generator to a frequency half way between these two frequencies. Tune the receiver to pick up the signal and adjust the slug in L3 for best signal. Check the adjustment of L4.

8. Return to 119 MHz and peak the slug in L2 again.

9. Repeat the procedure, 'touching up' each slug.

If the converter is to be used on one channel, or a couple of channels less than 1 MHz apart, then all the coils need only be adjusted for best signal strength on one channel.

Overall sensitivity of the converterreceiver system is very good, signals as low as 0.2 uV being clearly audible. The gain control range is about 20 dB.

CHOOSING A CRYSTAL

The frequency injected at gate 2 of the mixer FET, Q2, may be above or below the signal frequency by an amount equal to the IF frequency. For a turnable receiver used as an IF, the injection frequency should be lower than the *lowest* signal frequency by 10 MHz. Thus, as you tune the receiver upwards in frequency from 10 MHz, you will tune signals above the lowest aircraft band frequency (118 MHz). In this way there will be a simple relationship between the signal frequency and the receiver's dial. If 10 MHz equals 118 MHz, 10.5 MHz will equal 118.5 MHz, and so on. For this situation the injection frequency will be 118 - 10 = 108 MHz. As the crystal oscillator output (collector of Q3) is twice the crystal frequency, the crystal frequency should be half of 108 MHz = 54 MHz.

If you use a tunable receiver than a fifth overtone crystal at 54.000 MHz should be ordered. Tolerance and adjustment range also have to be specified. A value of 20 parts per million (ppm) for tolerance and adjustment range is satisfactory. Firms such as Bright Star Crystals or Hy-Q should be able to supply a crystal to order.

Alternatively, a crystal at one-third the injection frequency may be used. Taking the 108 MHz injection frequency, as just illustrated a 36 MHz crystal may be used.

To determine the crystal frequency required for any case, use the following formula:

Crystal = lowest signal frequency - IF

2 or 3

Inexpensive crystals intended for use in 'scanning' receivers are available from Dick Smith's. These provide an injection frequency above a particular aircraft channel frequency for the standard IF frequency of 10.7 MHz. For example, for the 125.8 MHz channel, the injection frequency is 136.5 MHz. These crystals have the channel frequency marked on them, not the crystal frequency.

SETTING THE CRYSTAL FREQUENCY If you require accurate frequency readout then the crystal frequency will need 'trimming'. Coil L7 is provided for this purpose. For best results a digital frequency meter capable of measuring to 150 MHz is necessary.

Lightly couple the DFM to L5 or L6 via a small value capacitor and see if you get a sensible reading. You may need to connect it directly across gate-2 of the mixer, Q2.

Adjust L7 until you obtain the correct injection frequency according to the crystal chosen.

BUYLINES

Components for this project are available from Catronics Ltd, Communications House, 20 Wallington Square, Wallington, Surrey SM6 8RG.

Coil Data

'Wind L2, L3, L4, L5, L6 and L7 clockwise up the former. L1 is wound anticlockwise up the former. The start of each coil is the 'cold' or 'earthy' end. All slugs are F29 type ferrite.

L1 5 turns, 22 B & S tinned copper wire spaced over 10 mm, tap at 2 turns from cold end.

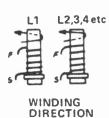
L2, L3 6½ turns, 22 B & S enamelled wire, spaced over 8 mm.

L4 25 turns closewound with enamelled wire, any gauge between 25 and 30 B & S, 5 turn link at top of former.

L5, L6 5½ turns, 22 B & S enamelled wire. closewound.

L7 *10 turns, 22 B & Senamelled wire, closewound, for crystals in the range 30 MHz to 50 MHz.

*6 turns for crystals in the range 50 to 70 MHz.



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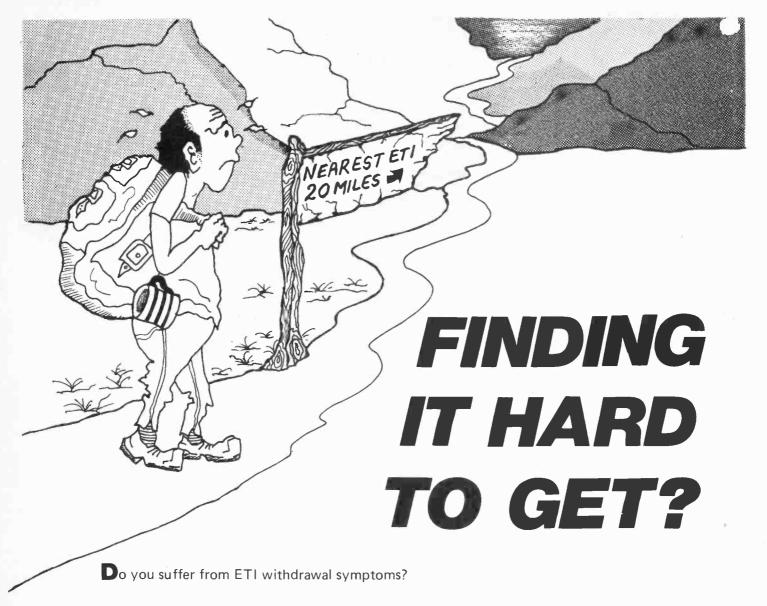
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DESIGNER'S NOTEBOOK

Project Editor Ray Marston passes around a few design problems with LEDs and chews a CMOS 555!

The path of the electronics design engineer is fraught with nasty booby traps in the form of seemingly simple little circuits which fail, in practice, to work in the anticipated manner. Take, for instance, one of the problems that faced the ETI projects team when the 'AMBUSH' game was being designed last year (see the April '79 issue).

Ambushed by LEDs

This particular booby trap centred on the LED 'attack' display that was used in the 'ambush' game. In essence, the display comprised four unequal-length lines of LEDs. All LEDs were driven from the outputs of a single 4017, but the lines were selected one at a time by a multiplexer, so that only one LED was on at any given moment. A greatly simplified diagram of the original (defective) version of this display is shown in Fig. 1. Although this diagram shows only three columns of LEDs, with a maximum of three LEDs in any one column, it does illustrate the basic 'trap' perfectly well.

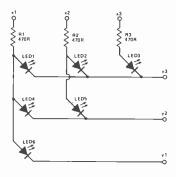


Fig. 1. A simplified view of the original Ambush LED lines.

In this diagram, the 'x' lines are driven by the outputs of the 4017, so that one line is high (at \pm 12V) at any given moment and the other two lines are at zero volts. The 'y' lines are driven by a multiplexer or multi-way single-pole switch, which pulls one line to zero but leaves the other two lines open-circuit at any given moment of time.

Figure 2 shows the results that were (rather naively) expected from the circuit under two specific operating conditions and compares them with the results that were actually obtained. In Fig. 2a, + 12V was fed to the xl line

x1	x2	х3
+12V	0V	0V
у1	y2	у3
0∨	0/c	0/c

x1	x2	х3
0∨	0V	+12V
у1	у2	у3
0∨	0/c	0/c





Fig. 2. Given the operating conditions, shown (top), these are the results which were expected (middle) and actually obtained (bottom).

and the yl line was coupled to zero volts. As expected, LED 6 illuminated.

In Fig. 2b, +12V was fed to the x3 line and the y1 line was coupled to zero volts. It was expected that no LEDs would illuminate. In practice, LEDs 3 and 6 illuminated. Equally confusing results were found to occur in certain other combinations of switching position.

If you read last month's 'Notebook,' which dealt with LED pitfalls, you'll have already figured out the cause of the 'ambush' problem(!) If not, Fig. 3. illustrates the cause of the trouble quite well. The problem arises because of the low reverse breakdown voltages (5V in this case) of the LEDs. In this particular instance, forward current was flowing through LEDs 3 and 6 via reverse-biased LED 1, which had gone into the Zener mode.

The solution to this particular design problem is shown in Fig. 4. Here, ordinary diodes are used in place of all absent LEDs in the matrix, so that a ready conducting path exists in all switching positions, and no LEDs therefore become reverse biased. When this circuit is applied to the

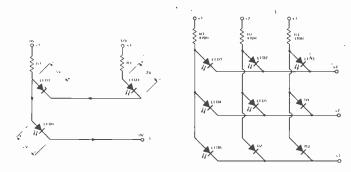


Fig. 3 (left) Low reverse breakdown voltages cause the problem here. Fig. 4 (right). Replacing absent LEDs with ordinary diodes is the solution here.

Fig. 2b situation, D3 conducts and all LEDs remain off.
As we pointed out last month, LEDs can be tricky little brutes

We ran into a rather intriguing little problem when building the hand-held remote-control unit for 'The Beast' that is featured in this month's issue of ETI. The problem was that the unit's up/down counter was giving erratic operation. We knew that the fault was one of construction, rather than design, so laboriously went through all the normal troubleshooting procedures and finally isolated the fault (by intuition, rather than anything else) to the area of the 4093B dual-oscillator circuit shown in Fig. 5.

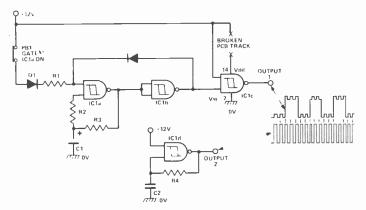


Fig. 5. A broken track caused problems in this 4093B dual oscillator, but proved difficult to find.

As you can see from the circuit, the fault was actually caused by a broken track connection to the IC's positive supply terminal. In practice, however, this simple fault was the devil's own job to find, for the following reasons:

First, the PCB was double-sided, which made it difficult to trace some of the tracks on visual inspection. Next, normal test-meter checks showed that a near-enough 12V supply did in fact appear on positive supply terminal 14 of the IC. Finally, oscilloscope inspection of the output terminals of the IC showed that the two oscillator waveforms of the circuit (see Fig. 5.) were indeed present, further strengthening the belief that the positive supply connection was OK. Suspicion was caused, however, by the fact that the waveform from output 1, which should have been a clean square wave, showed signs of being amplitude modulated by waveform 2. The fault was eventually located visually.

Figure 7 illustrates how the circuit managed to work and produce a ''supply voltage' on it's pin-14 V_{DD} terminal, in spite of the broken supply rail track connection. The diagram shows the internal gate protection network that is fitted to each one of the input terminals of the 4093B. On gates IC1c and IC1d one of these inputs is taken directly to the positive supply rail, enabling supply current to flow to the V_{DD} terminal via RA and D1, and thus power the oscillator circuits!

So how's that for an unusual 'beasty' story?

CMOS 555 -- 7555

If you've ever played with the ubiquitous 555 timer chip (and who hasn't?), you'll know that it has a few inherently unpleasant characteristics, as well as a whole stack of good ones. It does not, for example, like supply voltages that are significantly below 5V, and it typically draws a hefty 10mA of quiescent current when operating from a 15V supply. Worst of all, it draws a massive 400mA 'spike' of current from the supplies as it transitions from one state to another, and this spike tends to play havoc with any digital circuitry that is powered from the same supply lines.

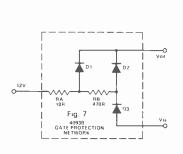
Fig. 6. (Below). A rationalised comparative summary of the bipolar and CMOS 5555.

PARAMETER	TEST CONDITION	BIPOLAR 555	CMOS 555	UNITS
SUPPLY VOLTAGE RANGE		4.5 to 16	2.0 to 18	V
OPERATING TEMP, RANGE		0 to +70	-20 to +70	°C
SUPPLY CURRENT, TYP.	Vcc = 15V, RL = ∞	10	0.1	mΑ
OUTPUT CURRENT, MAX		200	100	mΑ
POWER DISSIPATION, MAX		600	200	mW
TRANSITION 'SPIKE'	Vcc = 15V	400	10	mA
CURRENT, TYPICAL				
TIMING ERROR, MONOSTABLE	R = 2k0 to 100k	1	2	%
INITIAL ACCURACY, TYP.	C = 100n			
THERMAL DRIFT, TYP	Vcc = 15V	50	50	ppm/ ^o C
DRIFT WITH Vcc, TYP		0.1	1.0	% /V
THRESHOLD CURRENT		100	01	nA
TRIGGER CURRENT		0.5	10 5	uА
RESET CURRENT		0.1	2 x 10 ⁸	mA
OUTPUT RISE TIME, TYP	RL = 10M, CL = 7pF	100	40	nS
OUTPUT FALL TIME, TYP	RL = 10M, CL = 7pF	100	40	nS
PROPAGATION DELAY OF	Vtrig MINIMUM LEVEL	100	310	nS
TRIGGER PULSE, TYP	= 0V, TEMP = 25°C	100	310	110
MINIMUM PULSE WIDTH	Vtrig MIN LEVEL = 0V	20	90	nS
REQUIRED FOR TRIGGERING	Vcc = 15V. TEMP = 25°C	20	55	113

You'll be pleased, therefore, to hear that Intersil have recently introduced a CMOS version of the 555 timer, known as the ICM 7555, which does not suffer from the basic defects of the bipolar version. Specifically, it can operate over the supply voltage range 2VO to 18V, typically draws only 100uA quiescent from a 15V supply, and draws a trivial 10mA 'spike' of current when transitioning. Additionally, the required threshold, reset, and trigger currents of the CMOS device are several orders of magnitude down on the bipolar version, enabling timing resistors (for example) to be given values of hundreds of megohms.

Twice As Nice?

On the debit side, this new CMOS chip costs twice as much as the bipolar version, has worse initial-timing-accuracy and drift-with-voltage characteristics, has poorer output current drive and power dissipation capability, and



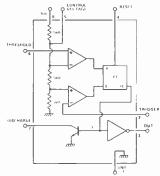


Fig. 7 (left) the internal gate protection network of the 4093B. Fig. 8 (right) The internal circuitry of the familiar bipolar 5555.

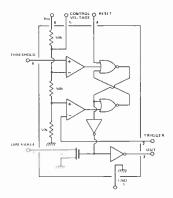


Fig. 9. The internal circuitry of the CMOS 555.

has worse propogation delay and pulse-triggering characteristics. A 'rationalised' comparative summary of the characteristics of the two devices is shown in Figure 6.

Figures 8 and 9 show the simplified internal circuits of the two devices. Note particularly the great differences in the relative values of the voltage divider chains that are used in the different versions of the IC.

The CMOS and bipolar versions of the IC are housed in identical packages. The CMOS chip can be used as a plug-in replacement in existing 555 bipolar circuits. The reverse is not necessarily the case, since the CMOS version can use timing and other resistance values that are several orders of magnitude greater than is possible with the bipolar version.

If you want to play with the ICM 7555, you can buy it from Watford Electronics, whose advert appears elsewhere in this issue.

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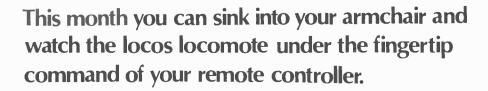
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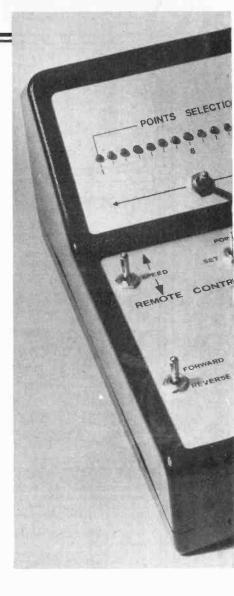
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Encoder/Transmitter

The major part of the encoder (Fig 2) circuit is wired up on a double-sided PCB, with the LED Readout circuitry implemented on an additional single-sided board. The display board is identical (apart from component numbering) to that used in the Train and Points-Controller units, and construction should present no problems.

The most important point to notice on the double-sided PCB is that wirewrap IC sockets are used in the construction, to enable solder connections to be made to tracks on either or both sides of the PCB where necessary. All pin-throughs and other components that pass through tracks both sides of the PCB should, naturally, be soldered to both tracks. Bearing these points in mind, construction should present few problems if the overlay is followed with due care.

When construction of the two boards is complete, you can temporarily interconnect the two circuits and

give them a functional check, in conjunction with the 'How It Works' section. The 16-LED display should be fully variable via Points Selector switch SW4. If you have a 'scope, you can check that the output waveform conforms to Fig 1 by triggering the 'scope-via pin 9 of IC5.

When the boards have been given a functional check, fit the into a suitable box and couple them up to their controls and indicator LEDs. If you are

using a 2-wire control system, you wilo have to fit a couple of 6 volt cells into the controller to provide a 12V supply. In the 3-wire system, the 12V supply is derived from the decoder/data distributor unit via the third wire. You an if you wish, fit the controller with an ON/OFF switch wired in series with the positive supply line.

On our prototype unit we used a 2-pole 4-way DIL switch in the SW1 'System Select' position, the switch is

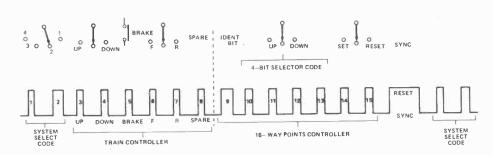
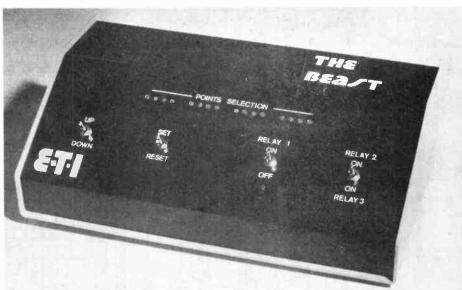


Fig. 1. The 15-bit 'simultaneous' code used by the remote control system.



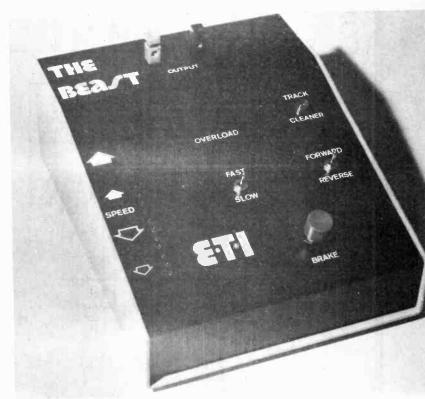


The points controller (above) can control up to sixteen sets of points or relays. It can activate several times per second. The set of points chosen is shown on the row of LEDs on the front panel. Think about your own particular points control needs before you start to build this unit. The data distribution unit is shown on page 91.

epoxied to the front panel. Our controller unit connects to the decoder/data-distributor unit via approximately 3.5 metres of 3-core coiled cable and a 3-pin DIN plug and socket.

The main power supply unit (below) has electronic overload on its output and can power up to four sets of track systems simultaneously.

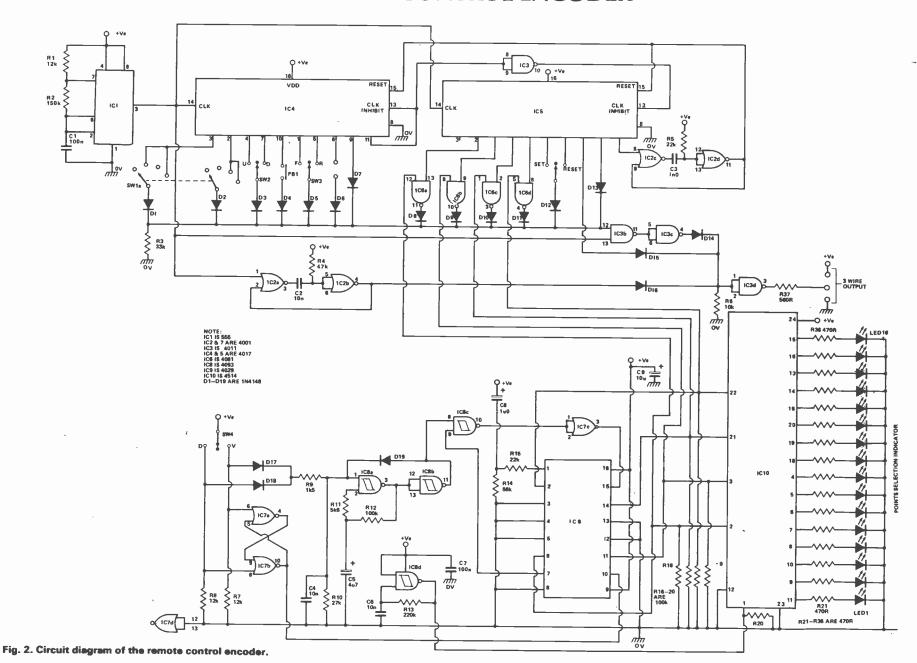




The train controller (above) gives exceptionally fine speed control, from crawl to supersonic (well nearly). There's also a built-in track cleaner to keep things running smoothly.

ELECTRONICS TODAY INTERNATIONAL — DECEMBER 1979

REMOTE CONTROL ENCODER



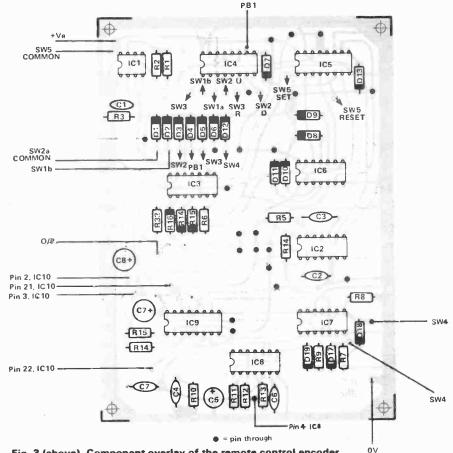
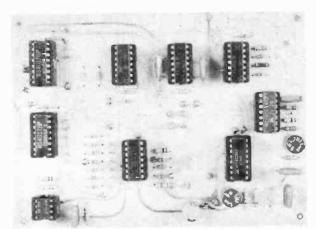


Fig. 3 (above). Component overlay of the remote control encoder. The completed PCB is shown below.



HOW IT WORKS

The circuit of the remote-control encoder is shown in Figure 8. Here, IC4 and IC5, together with IC2c and IC2d and IC3a, are wired together as a 17-stage 'decade' counter with 17 decoded outputs, and are clocked at a 500 Hz rate via IC1. IC2a and IC2b form a monostable multi-vibrator that produces a narrow pulse on the arrival of each clock pulse, and it's outputs are 0Red with the outputs of the counter via D14-D15-D16 and R6, to form a serial chain of negative-going output pulses from R32.

Bits 10 to 13 of the code (derived via IC6) originate as the 4-bit outputs of up/down counter IC9, which functions in the same way as the 'Points Select' counter of the F 6 'Power-Switch Selector' circuit. The 4-bit output of IC9 is decoded and fed to a 16-LED display on the hand-held transmitter/encoder unit, to give the operator a visual indication of the number of the point that has been selected.

The optional remote-control system uses a serial 15-bit 'simultaneous' code, as shown in Figure 7. The code comprises the fifteen bits, each separated by 2 mS, plus a 3 mS reset or synchronisation pulse, all transmitted within a 34 mS frame. A narrow code bit represents a '0' or OFF logic state, and a wide code bit represents '1' or ON logic state.

The first two bits of the code are used to select the desired (one of four) track system. Bits 3 to 8 are used to control the train on that track. The remaining seven bits are used to select and activate the (up to 16) points on that track system.

When the remote control system was being developed, we considered the possibility of using an ultra-sonic, infrared, or radio 'link' between the transmitter/encoder and the receiver/decoder, but rejected all three systems on sound technical and/or ergonomic grounds. We finally settled on the use of a 2- or 3-wire flexible link, that can be simply plugged into any one of a number of jack sockets scattered around the layout at (typically) 4 metre intervals. The two control systems are identical, except that the 2-wire transmitter/encoder uses it's own 12 volt battery supply, while the 3-wire unit derives its 12 volt supply from the receiver/decoder unit.

PARTS LIST

Resistors all ¼W 5%		C3	1n0 polyester
R1,7,8	12k	C5	4u7 15V electrolytic
R2	150k	C8	1u0 15V electrolytic
R3	33k	C9	10u 15V electrolytic
R4	47k		
R5,15	22k	SEMICOND	UCTORS
R6	10k	IC1	555
R9	1k5	IC2,7	4001
R10	27k	IC3	. 4011
R11	5k6	IC4,5	4017
R12,16-20	100k	IC6	4081
R13	220k	IC8	4093
R14	56k	IC9	4029
R21-36	470R	IC10	4514
R37	560R	D1-19	1N4148
		LED1-16	TIL 209
CAPACITORS C1,7 C2.4.6	100n polyester 10n polyester		IEOUS pole 4 way rotary switch pole changeover switch

REMOTE CONTROL DECODER

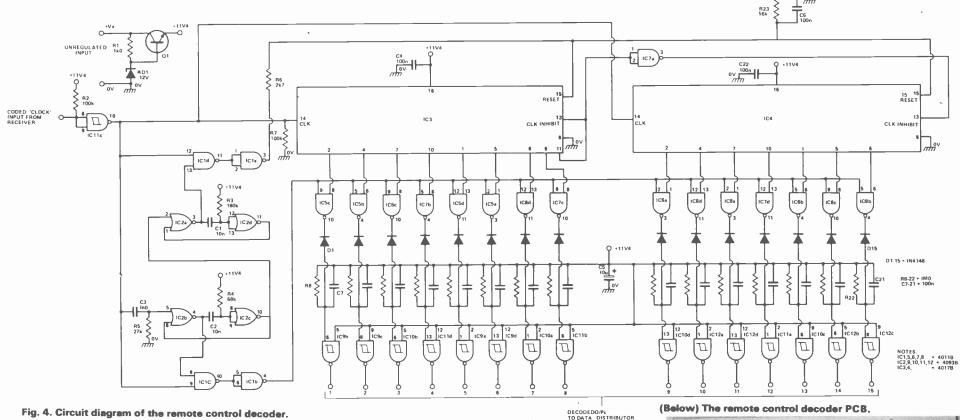


Fig. 4. Circuit diagram of the remote control decoder.

HOW IT WORKS

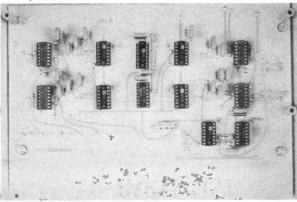
The 15-bit-plus-sync-pulse serial code signal from the transmitter/encoder is received and inverted by IC12d, and is then distributed to various points in the circuit, IC3-IC4 and IC5a form a multistage 'decade' counter with 15 'decoded' outputs, and is clocked by the IC12d output signal. The synchronisation bit of the code signal is detected by the IC2a-IC2b monostable and the IC1a-IC1b logic network, and is used to reset the counter at the end of each transmission frame.

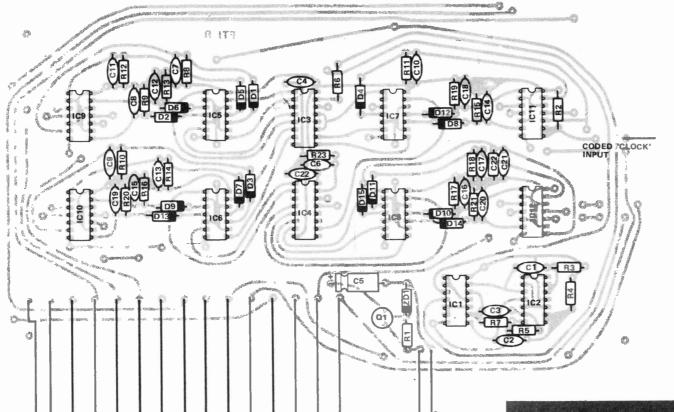
The IC2c-IC2d monostable produces a narrow 'reference' pulse on the arrival of

each code pulse. The width of each incoming code pulse is compared with that of the reference by the IC1c-IC1d logic network, which produces a 'O' output if the code pulse is narrow or a '1' output if the code pulse is wide. The output of IC1d is NANDed with each of the outputs of the counter, so that each NAND stage produces a single brief negative-going pulse in each frame only if it's respective 'code' pulse represents a '1' or ON command. Each narrow pulse (if it is present) is expanded to a width greater than that of a single frame by a diode(D1-D15) resistor- (R8-R22) capacitor-(C7-C21) inverter (IC9a-IC12c) network. so that each of the final fifteen decoded outputs of the unit forms a true DC. On (high) or OFF (low) representation of the respective command instruction that was given in the transmitter/encoder unit. These decoded outputs are fed to the model railway control units via a data distributor unit.

Q1 is a simple voltage regulator, and provides an 11V4 supply to the decoder and the data distributor, and also to the encoder if a 3-wire control system is used.

(Below) The remote control decoder PCB.





PARTS LIST

Resistors all ¼¼ R1 R2,7 R3 R4 R5 R6 R8-22 R23	1 k0 100k 180k 68k 27k 2k7 1 M0 56k
CAPACITORS C1,2 C3 C4,6,7-22 C5	10n polyester 1n0 polyester 100n polyester 10u 15V electrolytic
SEMICONDUC IC1,5,6,7,8 IC2 IC3,4 IC9,10,11,12 D1-15 ZD1	TORS 4011B 4001 4017B 4093B 1N4148 12V, 400mW zener

Remote Control Decoder

is built on one double-sided PCB. This board uses conventional IC holders, and construction should present few problems if the overlay is followed with care.

DECODED OUTPUTS TO DISTRIBUTOR

When construction is complete, connect the board to an 18 volt power supply, connect the input signal from the encoder/transmitter, and give the circuit a full functional check in conjunction with the 'How It Works' sec-

tion. Should the circuit fail to work correctly, suspect (1) a wiring error, (2) a component failure, or (3) and out-of-tolerance component in one of The complete decoder (Fig. 4) circuit the two monostables built around IC2.

Fig. 5. Component overlay of the

remote control decoder.

The Beast is then complete and ready to use. If you want to get maximum value from the remote control facility, you can fit a three-wire 'ring' circuit around your complete model railway layout, with 3-pin DIN sockets wired into the ring at roughly 4 metre intervals, so that you can operate the remote controller from any position around the layout!





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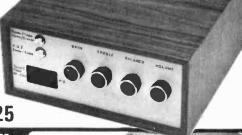
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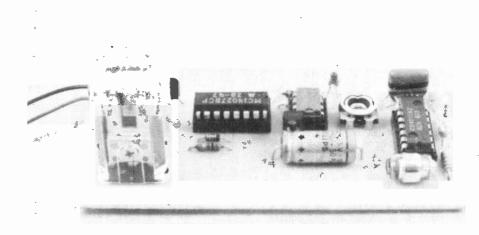
ost touch switch circuits published in recent years use a pair of metal contacts as sensors. When human skin resistance bridges these contacts, a readily-detectable indication of the touch action is given. A major problem with this type of circuit is that, since it is simply a resistance-sensing system, it can easily be disabled by any conductive medium, such as dirt or moisture, that bridges the contacts.

The ETI touch switch does not suffer from this problem. It is activated via the capacitive loading that occurs when a person touches or is 'coupled' to a single sensor contact. This contact can take any one of a large variety of forms. It can be a piece of metal the size of a pin head, or a piece of wire with a length variable from a fraction of a centimetre to several metres, or a large plain or highly decorated metal plate or printed circuit board. In the latter two cases, the plate or board can even be covered in an insulating material, such as plastic or varnish, since it is not necessary to actually touch the metal of the sensor to cause circuit operation, but merely to be capacitively coupled to it.

Our touch switch has a relay output and gives bistable operation. If you touch the sensor contact once, the relay turns on and latches into that state until the next time you touch the sensor, at which point the relay turns off. You can use the relay contacts to control house lights, etc, in which case you get alternate touch-ON, touch-OFF, touch-ON, etc, operation.

Construction And Use

All electronic components are mounted on a single PCB, leaving only the battery and relay output con-



nections and a single lead to the touch pad to be soldered, so you should have no trouble in construction. Use IC sockets and double check that all semiconductors are inserted correctly before initial switch on. When construction is complete, connect a suitable touch pad (a length of wire, or a metal plate, etc) in place, connect up the relay and apply power to the circuit.

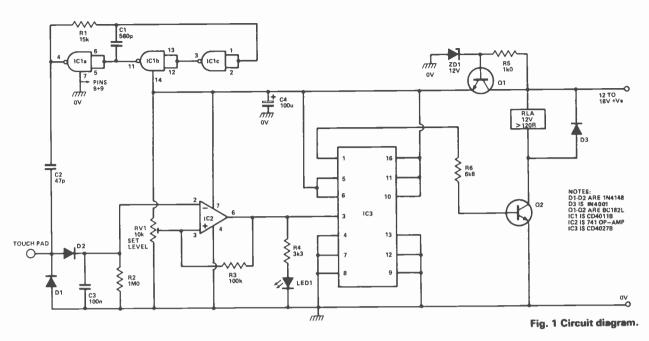
Initial setting up of the circuit is quite simple, but is necessary whenever a different touch pad is connected to the unit. Turn the present pot fully anti-clockwise and then, with the touch pad untouched, adjust the pot clockwise until LED 1 just comes on and the relay is heard to operate. Note the setting of the pot. Now touch the sensor pad firmly, and turn the pot slowly anti-clockwise until the LED just goes out. Note the new setting of the pot. Release the touch pad and adjust the pot to half way between the two settings. You should now find that the LED and relay activate whenever you touch the sensor and that the LED turns off again (but the relay does

not) when the sensor is released. This setting up procedure gives an optimum sensitivity/stability performance.

Scope For Proximity

There is plenty of scope for experimenting with this circuit. If a touch pad with a large surface area (a metal plate or an area of foil) is used and the circuit is set for maximum sensitivity, it will act as a proximity switch. The proximity range can be maximised by taking the negative supply line of the circuit to earth via the mains ground line.

You'll notice from the circuit diagram that only one half of dual J-K flip-flop IC3 is used. Consequently, if you want to make two touch switches and are capable of doing a little of your own design work, you can make the second switch by simply duplicating the C2, rectifier, and IC2 circuitry, using the spare half of IC3, and feeding the new C2 from the output of the existing IC1 oscillator circuit.



HOW IT WORKS

IC1 forms an astable multivibrator clocking at a frequency in the region of 100 kHz. Capacitor C1 forms a capacitive voltage divider effect with stray capacitance of the touch pad, which, after rectification via D1 and 2, charges capacitor C2. This voltage varies according to the capacitance of the touch pad, which in turn varies as it is touched. The voltage across C2 is, therefore, dependent on whether the touch pad is touched or not.

IC2 forms a comparator, using only a small amount of positive feedback, which compares the voltage across C2 with that from the wiper of level preset RV1. As the voltages cross, upon touching the pad, the output of IC2 goes high and LED 1 lights. Preset RV1 can be adjusted to suit any form of touch pad.

any form of touch pad.

The output of IC2 is fed to the clock input of IC3, a dual JK type flip-flop. This device output changes state ie on/off or off/on, with every pulse input and consequently turns the relay on and off

via transistor switch Q2.

Transistor Q1 forms a series pass regu-

lator with R5 and ZD1 to maintain a stable voltage for the main part of the circuit, so that the delicate balance is not upset with variations in applied voltage.

BUYLINES

There should be no problems in obtaining any components for this project.

PARTS LIST

RESISTORS All %W, 5%

RI		IDK
R2		1M0
R3		100k **
R4	2.1	3k3
R5		1k0
R6		1k0

POTENTIOMETER

RV1 10k min horiz preset

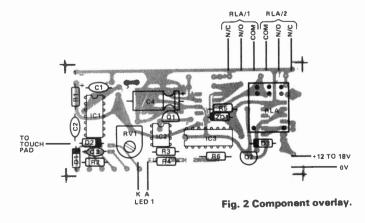
CAPACITORS

C1	560p polystyrene
C2	47p polystyrene
C3	100n polyester
C4	100u 16V electrolytic

SEMICONDUCTORS

101	4011
IC2	741
IC3	4027
Q1,2	BC182L
D1,2	1N4148
D3	1N4001
ZD1	12 volt 400mW
LED 1	TIL 220 or similar

MISCELLANEOUS
12V relay 120R coil or greater



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81LS98 .66 8T28 1.61 8T95 1.44 8T96 1.44 8T98 1.44	7451 .20 .12 7453 — .12 7454 — .14 7460 — .12 7470 — .22	74175 — .58 74180 — .43 74181 — 1.44 74184 — 1.14 74185 — 1.21 74188 POA 2.02	75 series 75107AJ 1.15 751078J 1.15 75108AN 1.03 754528 .29

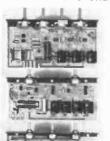
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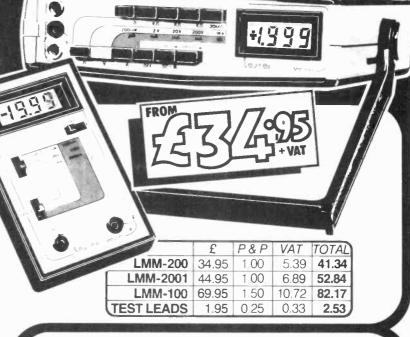
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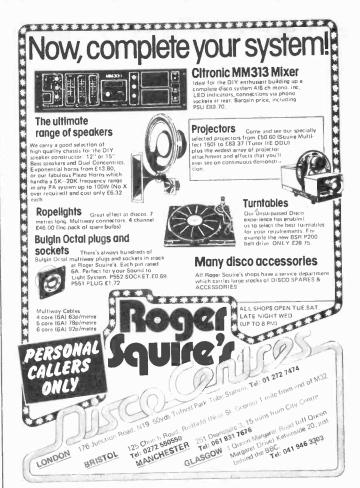
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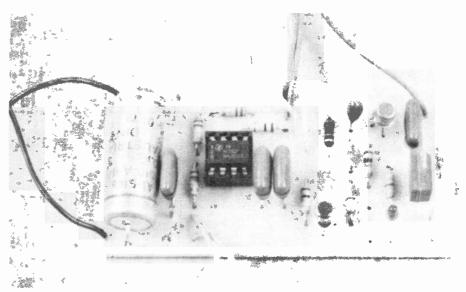
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FLASH TRIGGER

Fascinating freeze frame photos from frenetic action with our phenomenal flash trigger.

F raindrops keep falling on your head, now is the time to build ETI's fabulous flash trigger and catch them bouncing back. See astounding shapes as everyday objects perform a dynamic ballet (Usually too fast for the unaided eye to see).

Of course, you will need a camera and a flash gun. However, even the cheapest electronic flash guns usually have a flash duration of one thousandth of a second or less - fast enough to catch drops of liquid performing their complex aerobatics or freeze a shattering light bulb. If you want to stop a humming bird in flight or investigate instant insects then you will probably have to look elsewhere for your equipment. The attraction of this unit is that it needs no fancy ancillary equipment; you don't need an SLR, just a simple camera whose shutter can be locked open and something to photograph. With a powerful flash gun, even a pinhole camera will do!



SCR1. Check polarity with a voltmeter but carefully as there may be several hundred volts present.

In use, the unit is switched on and adjusted until it triggers reliably from the chosen sensor. Set up your

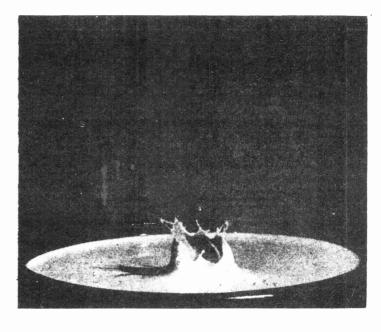
camera according to the guide table supplied with the flash. Remember that the apertures given relate to the flash-to-subject distance. Place your camera for the best picture (open the shutter) and enjoy instant exposure!

Construction

The unit is assembled on one PCB with flying leads connecting the controls. Power is supplied by a PP3 battery or any nine volt DC source.

There are no links to make on the board and none of the components are sensitive to static electricity or otherwise delicate making this an attractive project for assembly by a beginner or student.

A socket is recommended for IC1. These chips do not often fail but it can be infuriating to have to desolder one of you suspect it. In any case, a socket removes any chance of damage from excessive heat. The only point to watch is the orientation of the semiconductors. Use the ones specified; they're cheap and readily available. Make sure you connect the flash gun the right way round across



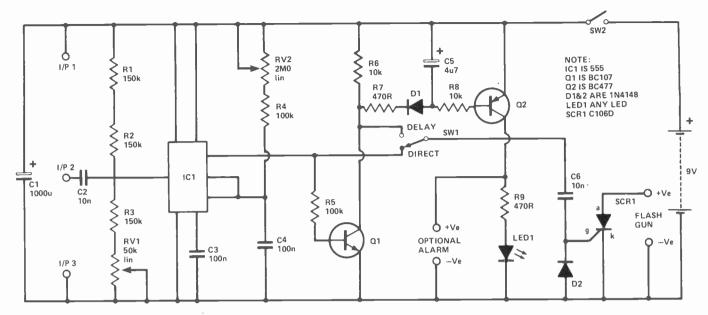


Fig. 1. Circuit diagram for the Flash Trigger project.

HOW IT WORKS

IC1 is a 555 timer connected in the monostable mode. The timing period is determined by RV2, R4, C4 and is adjustable between 11mS and 231mS with the values shown. The trigger input of the chip is held just above its firing potential of one third supply voltage by adjustment of RV1 which acts as a sensitivity control. A negative-going signal is coupled to the input by capacitor C2. Note that the values of R1,2,3,RV1 provide a medium input impedance and screened cable may be required when the sensor must be separated from the unit.

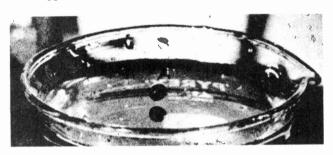
When IC1 is 'fired', its output (pin 3)

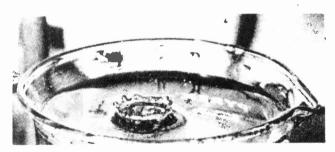
When ICI is 'fired', its output (pin 3) goes high for the monostable period. With SWI switched to 'direct', this positive going pulse will fire the SCR and discharge the flash enabling the unit to be used as a slave flash. There will be a finite delay owing to rise time of phototransistor response, propagation delay within ICI and rise time of its output. However, this will be measurable in microseconds and

should be negligible.

When used in the 'delay' mode, the output pulse is inverted by Q1 causing the flash to fire on the trailing edge of the monostable pulse. To avoid repeated use of the flash when setting up the unit, indicator LED 1 is provided. Each negative excursion of Q1 collector causes C5 to charge via R7, D1 effectively stretching the monostable pulse and providing a clearly visible flash. An optional alarm; for example a solid-state-buzzer, can be connected into the circuit providing audible indication of triggering. C1 provides overall decoupling. Supply current is about 10mA.

Below: what to do with it once you've built it. Taken with an ETI Flash Trigger.







ELECTRONICS TODAY INTERNATIONAL -- DECEMBER 1979

PARTS LIST

RESISTORS All ¼W, 5%

R1,2,3 150k 2 R4,5 100k 10k R6,8 10k R7,9 470R

POTENTIOMETERS

RV1 50k lin RV2 2M lin

CAPACITORS

C1 1000u electrolytic C2,6 10n polyester C3,4 100n polyester C5 4u7 tantalum

SEMICONDUCTORS

IC1 555 Q1 BC107 Q2 BC477 SCR1 C106D D1,2 1N4148 LED 1 any LED

MISCELLANEOUS

SW1 SPDT SW2 SPST PCB flash-gun-connector, photo-transistor, crystal mic. 9V battery

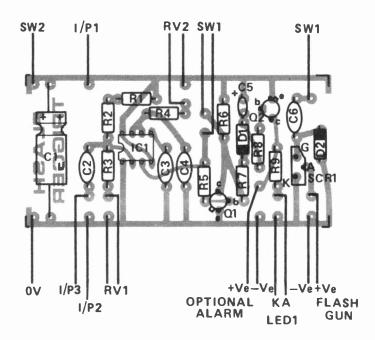
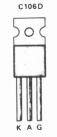


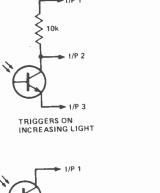
Fig. 3. Component overlay.





BUYLINES

The electronic components will be available from major component suppliers. A suitable flash gun connector should be obtainable from photographic equipment dealers.



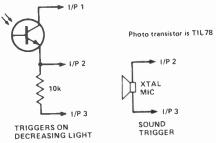
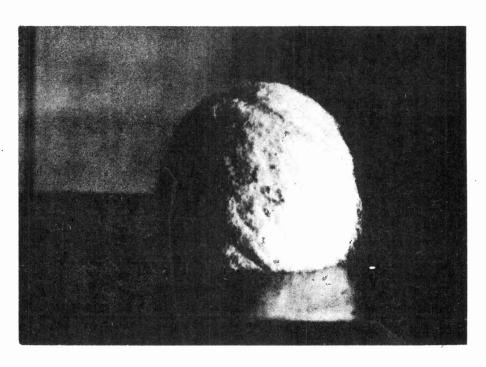


Fig. 2. Wiring details for different triggers.



Just a little bit more...

Z-80A 4MHZ. CPU: The most powerful 8-bit processor on the market.

8K Basic: resident on board, MICROSOFT Basic, the Industry standard, with extensions for on-screen editing, graphics, machine code interfacing. Optimised for speed (see benchmarks below).

Full 57 Key Licon solid state keyboard: switch mechanisms are contactless, high reliability professional units for long trouble free life. Keyboard is mounted separately to avoid straining main P.C.B.

'Total of 20K on-board memory: 2K monitor (Nas-Sys 1), 1K Video RAM, 1K Work space RAM, 8K Microsoft Basic, 8K user RAM.

space nam, on microsuit paste, on user nam.

Kansas City cassette interface; for reflable storage of programs and data at 300 or 1200 baud, with full checksum error defection.

Nas-sys monitor: A powerful 2K machine code monitor provides an ideal environment for learning about and developing machine code programs. Nas-sys uses a bilinking non destructive cursor, with 22 commands. ASCII terminals are fully supported via the serial interface; users can add their own I/O drivers via the system I/O vector table to support other devices.

Commands are:	
A—Hex arithmetic	N-return to normal
B-set breakpoint	O—Output to P.I.O.
С—Сору	Q-Query Input port
E-Execute	R—Read tape
G-Generate	S-Single step
H-Operate as half duplex.	T—Tabulate memory
terminal.	U-activate user I/O drivers
IIntelligent copy	VVerily tape
J-Execute at FFA	WWrite tape
K-set keyboard options	X-set external device
L-load from tape	Z-execute at FFD
M—Memory modify	

An uncommitted P.I.O. (MK 3881) giving 16 programmable I/O lines with handshake

On board RS-232-Will interface directly into any standard teletype — allowing use of BASIC or Nas-sys from the teletype.

Full on-screen editing: a complete screen editor with cursor movement (UP, DOWN, LEFT, RIGHT), insert and delete, backspace etc.

Screen display of 16 ilnes x 48 characters: Stable, clear display to British television standards. Full 128 ASCII character set; option for further 128 graphics characters.

Fully buffered NASBUS compatible: Well defined bus structure with a range of expansion cards; including (shortly) a floppy disc system with CP/m — the industry standard operating system.



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BM 5	8.9	12.6	15.0	21.7
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nterest in digital electronics has grown rapidly in the past few years with the advent of microprocessors and large scale integration. The most essential test instrument for experimenting with digital circuitry is a logic probe.

In its most basic form this should provide an indication of the logic level at any point in a circuit without overloading the section being tested. Other desirable features are the ability to follow high frequency pulse trains (preferably over 1 MHz) and to detect isolated, narrow pulses less than 1 uS in width. Finally, the instrument should be compatible with both TTL and CMOS ICs and be able to operate from a wide range of supply voltages (say five to 15 volts).

Commercial logic probes that satisfy all these requirements are available, but they invariably cost over £30. The probe design described here offers comparable performance for less than £4. combined with an excuse to enjoy a good cigar — a cigar tube is used for the case!

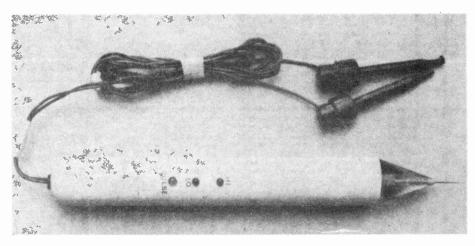
Indication is by means of three LEDs. Two red LEDs indicate either a HIGH or a LOW condition on the point under test, a green LED is used to indicate that a pulse train is occurring.

The circuit uses a single CMOS IC and a handful of resistors and capacitors. The components are mounted on a small board and housed in a tubular case such as an aluminium cigar tube or a length of plastic conduit. The power is supplied from the actual circuit under test and the performance characteristics of the prototype are described in the specification listed here.

Construction

A printed circuit board is recommended for this project to provide consistent performance characteristics.

Before attempting to mount the components on the printed circuit



The logic probe in a cigar tube, showing the Hi, Lo and Pulse indication LEDs.

board check to see that it fits easily into the case. The board must be a loose enough fit to allow it to be moved up and down within the case over a range of at least 5 mm. (Refer to the diagram).

Mount the wire links, the resistors and the capacitors on the board, keeping all components as close to the board as possible. Note that C3 is mounted on the underside of the board. Next, install the three LEDs. The height of the LEDs above the board must be such that the assembly will slide into the case with the board pushed down against the bottom of the case (see diagram). For a 20 mm diameter case this height should be about 12 mm. If the LEDs are not high enough, then it will not be possible to push the assembled board up into a position where the LEDs project through the holes in the case.

Next, add the power leads (without clips or E-Z hooks at this stage) and the 10 cm wire to the probe tip. Last of all solder IC1 into position, observing all

the usual precautions — shorted pins, heat sink, earthed soldering iron, pins 8 and 16 soldered first.

Drill the 3 mm holes for the LEDs at 10 mm intervals, starting 75 mm from the front of the case. The hole for the supply leads is drilled in the back of the case and fitted with a small rubber grommet (or plastic LED housing) to prevent the case rubbing through the insulation on the leads.

Before mounting the assembled board in the case check the circuit for dry joints, solder bridges, incorrectly mounted components, etc. Then test the device as follows. Connect to a five volt supply and observe the three LEDs. None should light with the probe tip isolated. If the LOW LED (LED 2) comes on or flashes, then R2 is too small and must be replaced by a slightly larger resistor (say 820k). Touching the probe tip with the fingers may cause LED 2 to light, but this should go off when the tip is isolated. Touching the probe tip to either supply rail should

WORKS

Three of the six inverter/buffers in IC1 are used in the high/low detection circuit. IC1c is connected to the probe tip via R9. When the input goes HIGH (logic 1), IC1c output goes low and illuminates LED 2 through R5. Similarly when the input goes LOW (logic 0), the series pair IC1e and filluminate LED 1 through R4. The resistor network R1, R2 and R3 ensure that the outputs of both 'speed-up capacitor' to me pulse shape into IC1e and ability to follow high trains (over 1MHz). is 'floating'. R3 ensure that the outputs of both c and IC1f remain high when the input floating. C1 is connected across R2 as a ged-up capacitor, to maintain a sharp se shape into IC1e and so improve the frequency pulse

The two inverters ICla and b form a monostable circuit that stretches short pulses (less than 500 nsec) out to 15 msec (0.7RC) using C3 and R8. The input of the monostable comes from the output of IClc and is isolated from the DC level of this output by C2. The combination of R7 and D1 normally holds IClb through C2, the output goes high, forcing ICla to go low and illuminate LED 3. Diode D1 ensures that the input to IClb is kept low (0V7 above zero) so long as the output of ICla remains low. This prevents subsequent pulses from retriggering IClb until the monostable itself retriggers via discharge of C3 to earth a through R8, and allows ICla output to go high switching off IFD 3.

through R8, and through R8, and through R8, and through R8, and R5 (optional) confer Capacitors C4 and C5 (optional) confer C4

70

MOR

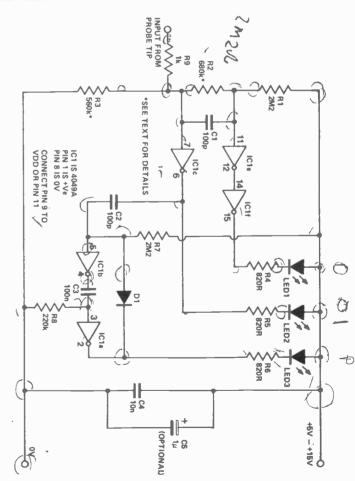
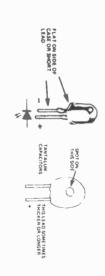


Fig.1. Circuit diagram. Note the polarity of LEDs 1, 2 and 3.



NOTE C5 IF USED IS MOUNTED ACROSS C4 (OBSERVE POLARITY)

CONNECT RESPECTIVE LETTERS TOGETHER ATO A B TO B etc.

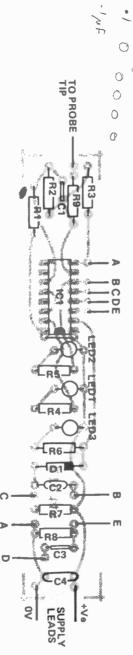


Fig.2. Component overlay.

SIT

Semiconductors IC1 40	Capacitors C1,2 C3 C4 C5	R1,7 2M2 R1,7 680k* R2 680k* R3 560k* R4.5,6 820R R8 220k R9 1k
ictors 4049A	100p Ceramic 100n Polyester 10n Polyester 1u (Optional)	2M2 680k* 560k* 820R 220k

LED 1,2 LED 3 3mm red 3mm green 1N4148 (or equivalent)

Miscellaneous cigar, case (or equivalent) - minimum dimensions 20mm ID, alligator clips or E-Z hooks; \square PCB; red and black leads with

be altered slightly (in the range 470k to 820k) to suit the transfer characteristics of IC1 – see text. Resistors R2 and R3 may have to

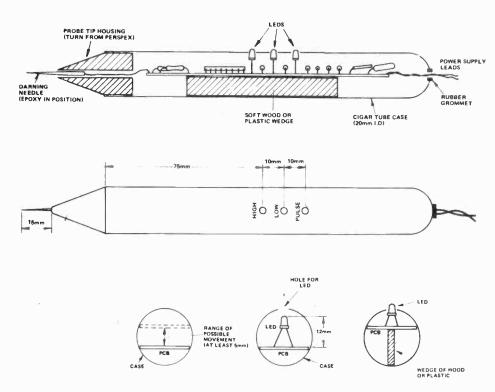
140mm long; probe tip housing

BUYLINES

readily Once from just as well Make sure the components you buy will you're not a cigar smoker, plastic piping from your local hardware store will do into the again, available from most suppliers. container components should be you choose.

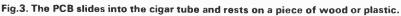


it's finished. The long thin PCB should look like this when



light the appropriate LED, with the PULSE LED flashing when the tip first touches the positive rail. If the LOW LED does not light when the probe is connected to 0V, then R2 is too large. Change R2 to 560k and repeat the sequence above.

Now try a 15 volt supply. Again, all LEDs should be extinguished when the probe tip is isolated. The HIGH LED (LED 1) may glow very faintly. If this glow is too strong, reduce the value of R3 to say 470k. However, if R3 has to be altered it will be necessary to recheck the circuit at 5V to see that the low voltage performance is still satisfactory. At 15 volts repeat the process of touching the probe tip to the two supply rails. The results should be the same as in the case of the 5 volt supply, but the LEDs will be considerably brighter.







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MEF4001 17 MEF4046 106 MEF4514 250 MEF4006 95 MEF4049 87 MEF4515 299 MEF4008 95 MEF4049 87 MEF4515 1299 MEF4008 95 MEF4050 45 MEF4516 101 MEF4017 17 MEF4050 45 MEF4517 382 MEF4018 11 MEF4057 47 MEF4518 94 MEF4017 17 MEF4057 77 MEF4017 17 MEF4017 17 MEF4017 17 MEF4017 18 MEF4017 18 MEF4017 18 MEF4017 18 MEF4018 19 MEF4018 1	\(\text{VAOIN} \) 14 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	174127N	73 N74LS30N 19 N7 75 N74LS31N 27 N7 75 N74LS31N 35 N7 76 N74LS31N 35 N7 77 N74LS31N 35 N7 77 N74LS31N 35 N7 77 N74LS31N 35 N7 78 N74LS40N 27 N7 99 N74LS40N 27 N7 99 N74LS51N 44 N7 N74LS78N 46 N7 N74LS78N 46 N7 N74LS78N 100 N7 19 N74LS38N 100 N7 10 N74LS38N 10 N7	74LS138N 99 N74LS253N 117 74LS139N 99 N74LS257N 117 74LS139N 99 N74LS258N 117 74LS159N 81 N74LS258N 117 74LS156N 93 N74LS26N 34 74LS156N 93 N74LS26N 54 74LS156N 93 N74LS278N 137 74LS156N 93 N74LS278N 137 74LS156N 93 N74LS278N 137 74LS156N 19 N74LS28N 119 74LS156N 19 N74LS28N 119 74LS16N 19 N74LS29N 119 74LS16N 119 N74LS36N 121 74LS16N 119 N74LS36N 121 74LS170N 121 N74LS378N 121 74LS170N 121 N74LS378N 121 74LS18N 119 N74LS378N 121 74LS18N 119 N74LS378N 121 74LS18N 121 N74LS39N 126 74LS18N 120 N74LS39N 12	LINEAR CAJB68 84 CAJB68 87
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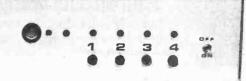
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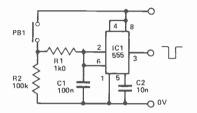
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DELTA TECH & CO.	CA3080	90p	4042	58p	7448	62p	74182	30p	BD139	35p	ZTX341	22p
	CA2140	45p	4043	83p	7450	10p	74190	75p	BD140	35p 24p	ZTX500	16p
62 NAYLOR ROAD, LONDON, N20 OH	LF351N	65p	4044	90p	7451	12p	74191	70p	8F180 BF181	24p 8p	ZTX501 ZTX502	16p 21p
All prices VAT inclusive	LF356N	75p	4047	90p	7453 7454	12p	74192 74193	50p 64o	BF184	21p	ZTX502	17p
THE RESIDENCE OF THE PARTY OF T	LM301AN		4048	55p	7460	12p	74193	68p	BF185	25p	ZTX504	28p
RESISTORS (1/4 W E12) OPTO/DISP		60p	4049 4050	30p 30p	7470	17p	74195	65p	BF194/5	10p	2N696	33p
	5p LM318N 5p LM324N	200p	4066	38p	7472	21p	74196	80p	BF196/7	10p	2N697	13p
	60p LM339N	60p	4069	15p	7473	24p	74197	40p	BF244B	35p	2N698	30p
	10p LM348N	90p	4070	15p	7474	24p	74198	107p	BF259	25p 32p	2N706	14p
LOG AND LINEAR MAN74 1	10p LM377N	175p	4071	15p	7475 7476	30p 26p	74199	80p	8FR39 BFR79	32p	2N914 2N918	34p 33p
1 Kohm to 2 Mohms 28p 125" & .2		75p	4072	15p	7480	25p	TRANSIS		BFX29	25p	2N1131	20p
VEROBOARDS (0.1" Copper) LEDs:-	LM381N	140p	4073	15p	7485	66p	AC126/7		8FX84	25p	2N1302	38p
	10p LM382N 14a LM1310N	130p	4081 4082 *	15p 15p	7486	22p	AC128 AC128/1	20p	BFX87	22p	2N1303	60p
	14p LM1310N 14p LM3900N		4082	66p	7490	32p	- AC128/1 Mt. pr.	40p	BFX88	27p	2N1304	55p
2.7V to 33V	3p LM3909N		4510	73p	7491	28p	AC176	20p	BFY50/1	22p	2N1613	25p
TRANSFORMERS (240V) 2" clip	4p MC1496P		4511	99p	7492	17p	AC187/8		BFY52 BRY39	18p 45p	2N2222A 2N2369	21p 17p
9-0-9V, 100mA 90p	NE531	105p	4516	95p	7493 7494	32p 30p	AD149	60p	BSX20	22p	2N2369 2N2484	30p
0-15V, 0-15V, 200mA 100p	IOp NESSS	25p	4518	72p	7495	30p	A0161/2	40p	BU205	140p	2N2646	50p
CERAMIC CAP (SOV)	On INESSO	60p	4520 4528	69p 99p	7496	42p	AF116	35p	BU208	200p	2N2904	23p -
22pF to 50nF POLYSTYRENE CAP (160V)	8p NE566 TBA641A	140p 200p		aah	7497	200p	AF117 AF124	35p 34p	MJ 2955	110p	2N2905	23p
100E to 1 0000E	bp TRAGAIR		TTL		74100	60p	AF139	35p	MJE340	70p	2N2906	17p
POLYECTER CAR (100V)	9p T84800	75p	7400 7401	11p	74105	43p	AF239	45p	MJE2955 MJE3055	104p 85p	2N2907	23p
1 aE to 100 aE	TBA810S		7401	11p 11p	74107	20p 25p	8C107	10p	MPF102	40p	2N2926G 2N3053	11p 22p
15, 22, 33, 39uF 5p 1N4148	4p ZN414	100p	7403	11p	74109	40p	BC108/9	10p	MPF103	40p	2N3054	50p
.47, .68uF 9p 1N4002	4p ZN1034	200p	7404	13p	74118	88p	BC147	8р	MPF104	40p	2N3055	50p
1 uF: 12p 2.2uF: 20p 1 NAOO3	5p CMOS		7405	13p	74121	d ≥ 26p	8C148	10p	MPF105	40p	2N3442	150p
3.3uF : 26p 4.7uF : 30p 1N4003 ELECTROLYTIC CAP (uF/V) 1N4004	6p 4000	14p	7406	15p	74122	22p	BC149 BC157	9p 10p	MPF106	46p	2N3702 to	
1/25/10 50/25// 5p 1N4005	6p 4001	14p	7407 7408	20p	74123	40p	BC158/9		MPSA06	26p	2N3711	11p
69/E0V 100/3EV En 1N4006	8p 4002	14p 60p	7408	13p 13p	74125	34p	BC167	13p	MPSA56 MPSU06	26p 61p	2N3772 2N3773	180p 330p
150/40V, 220/12V 7p 1N4007	8p 4006 13p 4007	15p	7410	13p	74126	34p 48p	8C169C	13p	OC35	86p	2N3773 2N3819	21p
220/25V	14p 4008	84p	7411	176	74141	45p	BC173	6р	TIP29	35p	2N3820	55p
330/12V, 500/30V 12p 1N5402	15p 4009	32p	7412	15p	74142	200p	BC177/8		TIP29B	40p	2N3823	70p
1,000/10V:13p	16p 4010	42p	7413	27p	74145	55p	BC179B	18p	TIP30	35p	2N3866	60p
1,000/25V : 18p 1,500/25V : 24p DIL SOCKET	s 4011	15p	7414	48p	74150	69p	BC182/3 BC184	10p	TIP308	40p	2N3903	10p
2,200/6.3V : 20p 8 pin	44n 4U12	15p	7416 7417	25p 25p	74151	48p	BC209	11p	TIP31 TIP32	35p 35p	2N3904 2N3905	10p 10p
14 pin	13p 4013	32p 85p	7420	13p	74153	52p 89p	BC212/3		TIP33	40p	2N3905 2N3906	10p
VOLTAGE 16 pin	14p 4015	63p	7421	21p	74154	54p	8C214	14p	TIP33C	60p	2N4037	33p
BRIDGE 18 pm	18P 4016	37p	7422	16p	74156	30p	BC214L	14p	TIP34A	65p	2N4058	14p
0.75/200V 25n 320H-05 40p 22 pin	22p 4017	57p	7427	25p	74157	52p	BC261B BC461	14p 34p	TIP35C	200p	2N4059	12p
0.75 / 600V 30p 320H-24 40p 28 pip	200 4018	68p	7428	28p	74160	64p	BC461 BC477	23p	TIP36A	220p	2N4060	14p.
14/50V 22n 7805 70p 40 sin	4019	45p	7430 7432	13p 18p	74161	50p	8C478/9		TIP41A TIP42A	60p 60p	2N4061 2N5457	14p 35p
1A/100V 27p /812 /0p	4020 4021	92p 90p	7432	30p	74162	66p 66p	BC547/E	3 12p	TIP2955	70p	2N5457 2N5458	35p
TAZZOOV SZP ZOLO ZO- CIRCUITE	4021	85p	7437	15p	74164	66p	BC549	13p	TIP3055	55p	2N5459	35p
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7918 90p CA3018 7924 90p CA3028A	70p 4028 85p 4029	54p 63p	7444	78p	74175	60p 64p	BD115	40p	ZTX302	200		
/924 30p CA3028A	9023	03р	1		74170	o-vp		-			-	



TECH TIPS



555 Micro Input Reset

P. Davidson

When dealing with a microprocessor system, there are several features which place requirements on the duration of their input leg reset. These

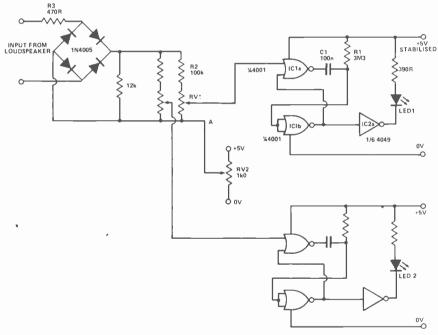
signals are usually negative (in the author's experience) and so, with the use of a 555, these requirements can be filled reliably (as opposed to the normal flip-flop debounce circuit). The circuit saves on logic used to invert the normal 555 monostable action

LED Audio Power Indicators

M. P. Downes

The circuit diagram shows the input circuitry from the loudspeaker terminals. For simplicity only two of the monostable and LÉD driver cuits are shown. Six of these circuits can be constructred using three 4001s and one 4049 CMOS ICs. The circuit is based on the fact that CMOS has an input threshold of approximately half the supply voltage (actually 0.45 - 0.55 supply volts). IC1a and IC1b are dual input NOR gates connected in a monostable configuration with timing components R1 and C1. When the input to IC1a exceeds the threshold voltage, the monostable's output goes high for a period determined by R1 and C1 (with values shown approximately 200 mS). This output is inverted and buffered to drive a LED for this period. The input to trigger the monostable comes from the speaker terminals where it is full wave rectified and appears across RV1. R3 is a safety resistor in case of bridge failure. IN4005 diodes have the desired voltage and frequency characteristics for the bridge. R2 is to limit the current flowing into IC1a's internal protection diodes under large signal conditions and the value of RV1 depends on the desired input triggering vol-

The lowest input voltage that can trigger the monostable is limited by the voltage drop across the bridge (OV8) and the threshold voltage of IC1a (approximately 2V5). The



threshold limit is largely overcome by using RV2 to bias point A to just below the threshold voltage. In practice, the circuit operates on an input frequency of from less than 5 Hz to more than 50 kHz sinewave and at an input voltage of from approximately 1V4 RMS (0.25 W into 8R) to more than 90 V RMS (1 kW into 8R). A single positive or negative 4 uS wide pulse will also operate the circuit.

The +5 V supply must be stabilised to ensure stable threshold levels and the usual decoupling of ICs and supply is advisable. If two units are

required for stereo use, two completely separate + 5 V power supplies are essential to prevent partial shorting out of the input bridge, due to a possible common loudspeaker terminal in the amplifier. Greater input sensitivity can be achieved by using 0A91 diodes in the input bridge, but with slight loss in high frequency response and a lower maximum input voltage. If there is a variation in the threshold voltage of individual ICs then the lower threshold ICs should be used in the most sensitive positions of the circuit, i.e. 0.25W.

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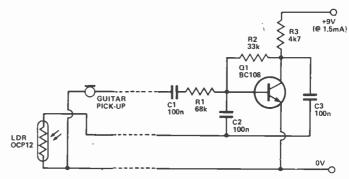
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Autowah Without Tears

S. N. Goodwin

The main disadvantage of a simple wah-wah circuit is that it requires a manual trigger for the effect, usually provided by a foot-pedal, which needs (and often expensive) mechanical construction and also prevents the guitarist from moving freely about the stage. After a couple of hand-made pedal systems collapsed in use, the standard wah-wah circuit was modified as follows: A light dependent resistor was mounted on the soundboard of the guitar about 2 cms from the highest string, pointing out about 1 cm from the front of the instrument. The shadow of the player's hand moving across the guitar triggers the effect — the more light



shining on the LDR, the higher the frequency-range boosted by the circuit.

It is tolerant of quite a wide range of light levels and if the range is found to be incorrect this can be rectified in two ways. Lenses or filters can be put across the LDR, or resistors can be connected in series/parallel with it.

Fluorescent lights could give problems with mains hum, but, under normal incandescent lighting, none were experienced. The wire to the LDR should ideally be screened, but over short distances this is not vital. Avoid bending its leads close to the body, as they can be snapped off very easily.

A Simple Sequencer

P. Hill

A simple sequencer can be constructed using shift registers.

A logic 1 is shifted down the shift registers (IC4, 5) outputs, otherwise at logic 0, at each clock pulse. This places a voltage across the variable

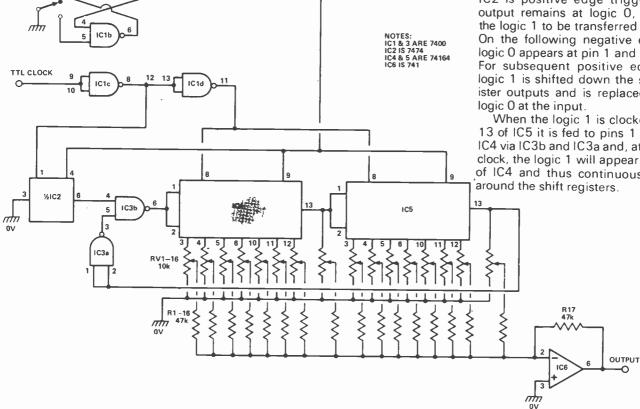
IC1a

resisters RV1 - 16 in turn. A preset DC voltage is thus available at the output, after being buffered by R1 -16 and IC6 for each clock pulse. A sequence of control voltages can be set up and used to drive a voltage controlled oxillator.

The sequencer is reset by S1. The switch is debounced by IC1a and IC1b. Resetting zeros all shift register outputs and results in a logic 1 appears at the input of IC4.

When a clock is applied a positive going edge at pin 8 of IC4 and 5 corresponds to a negative-going edge at pin 1 of IC2, due to inverters IC1c and IC1d. The first positive going edge at pin 8 of IC4 and 5 causes the logic 1 at pin 1 and 2 of IC4 to be transferred to pin 3. Since IC2 is positive edge triggered it's output remains at logic 0, allowing the logic 1 to be transferred to pin 3. On the following negative edge the logic 0 appears at pin 1 and 2 of IC4. For subsequent positive edges the logic 1 is shifted down the shift register outputs and is replaced by the

When the logic 1 is clocked to pin 13 of IC5 it is fed to pins 1 and 2 of IC4 via IC3b and IC3a and, at the next clock, the logic 1 will appear on pin 3 of IC4 and thus continuously cycle



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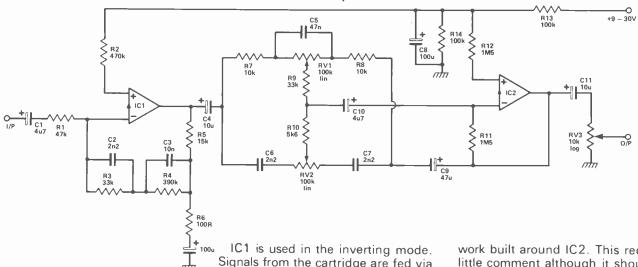
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work built around IC2. This required little comment although it should be noted that individual volume controls are employed four each channel. This not only reduces crosstalk between channels but also works out cheaper in that only two single gang potentiometers are used.

Performance is good with overall distortion below 0.1% and a S/N ratio of —67db unweighted, ref 500 mV out.

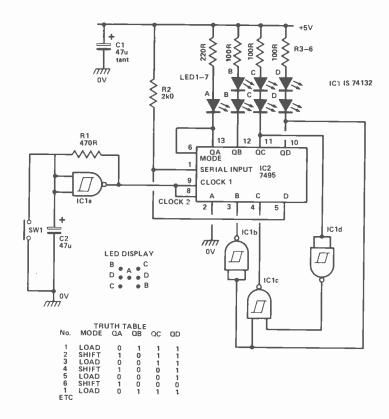
2 Chip Electronic Dice

P. Adams

sequence.

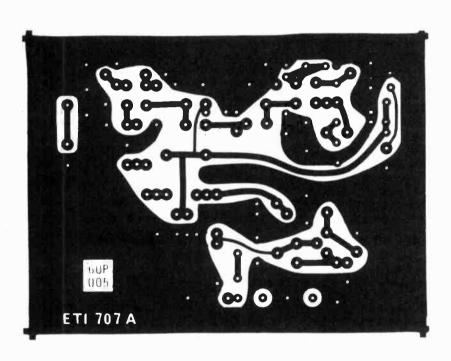
This electronic dice produces a true dice display using only two IC's — a 74132 and a 7495. The 7495 is a 4-bit parallel-access shift register. It can either operate as a shift-register or be parallel (broadside) loaded at inputs A-D. Control over these two functions is by a mode control unput. When the mode is high data is loaded into Ωa — Ωd from inputs A - D on the next negative-going clock edge. When the mode is low data is shifted on Ωa — Ωd on the next negative-going clock edge.

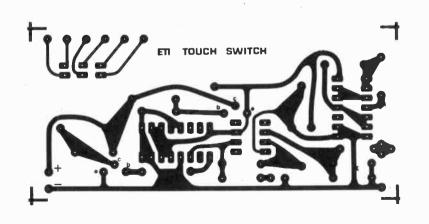
By connecting the mode control to Oa so that the register alternates between load and shift and making the input word a function of the existing output word, with some simple logic, the register can be made to execute a count that will drive LEDs in a dice display. Note LEDs are lit when outputs are low. IC1a is connected as a conventional Schmitt oscillator providing clock pulses to the register. SW1 stops the oscillator and halts the count. On switch-on the register may start on an invalid count, but in a couple of clock cycles it will produce a valid count and then remain in that

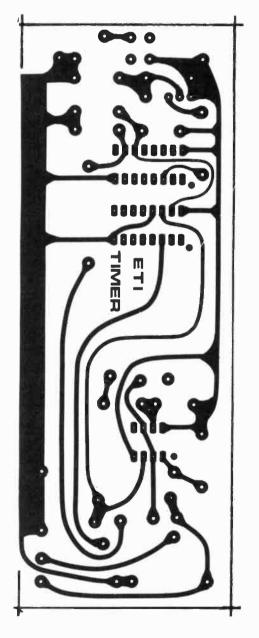


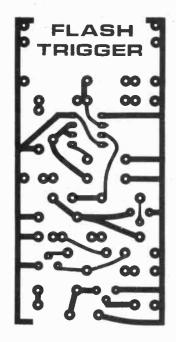
PCB FOIL PATTERNS

We didn't have room in this issue to pack in all the foil patterns. Never fear, if you're anxious to get started on your PCBs, send us a large sae and they'll be on their way to you. If you can bear to wait until next month's issue, we'll find a little space somewhere for them. Rest assured, they will all appear on Etiprints.

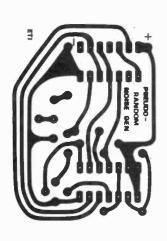


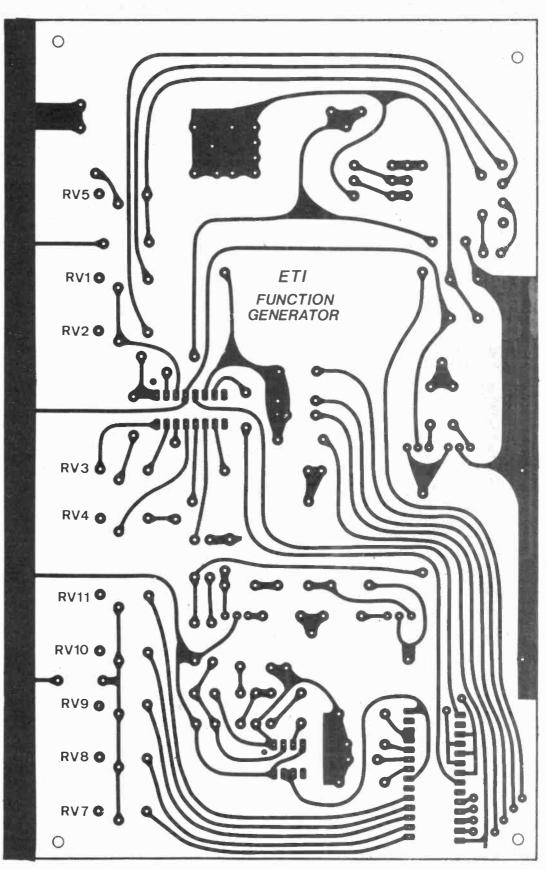












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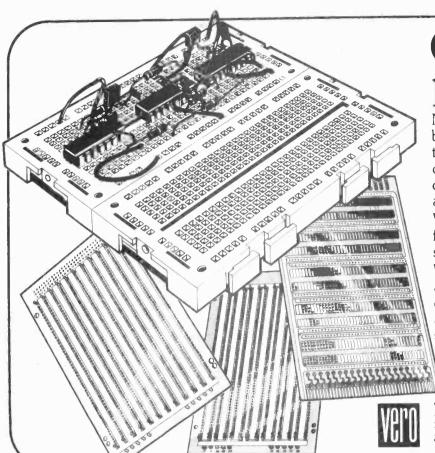
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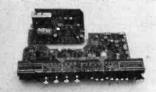
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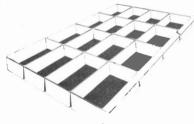
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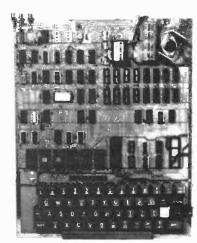
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