

## TRANSCENDENT POLYSYNTH

By brilliant design work and the use of high technology components the Polysynth brings to the reach of the home constructor a machine whose versatility and range of sounds is matched only by ready built equipment costing thousands of pounds. Designed by synthesizer expert Tim Orr and being featured in this issue of Electronics Today International, this latest addition to the famous Transcendent family is a 4 octave (transposable over 7½ octaves) polyphonic synthesizer with internally up to 4 voices making it possible to play simultaneously up to 4 notes. Whereas conventional synthesizers handle only one at a time.

The basic instrument is supplied with 1 voice and up to 3 more may be plugged in. A further 4 voices may be added by connecting to an expander unit, the metalwork and woodwork of which is designed for side by side matching with the main instrument. Each voice is a

complete synthesizer in itself with 2 VCOs, 2 ADSRs, a VCA and a VCF (requiring only control voltages and a power supply, the voice boards are also suitable for modular systems). One of these voices is automatically allocated to a key as it is operated. There are separate tuning controls for each VCO of each voice. All other controls are common to all the voices for ease of control and to ensure consistency between the voices.

Although using very advanced electronics the kit is mechanically very simple with minimal wiring, most of which is with ribbon cable connectors. All controls are PCB mounted and the voice boards fit with PCB mounted plugs and sockets. The kit includes fully finished metallwork, solid teak cabinet, professional quality components fresistors 2% metal oxide or metal film of 0.5% and 0.1%), nuts, bolts, etc.

EXPANDABLE
POLYPHONIC
SYNTHESIZER

### **COMPLETE KIT**

ONLY

£320 + VAT

L'Single Yough

Voices - Kit price E2 + VAT-IESE - VAT If ordered with kit)



POWERTRAN

TRANSCENDENT POLYSYNTH

Cabinet size 31.1" x 19.6" x 7.6" rear 3.4" front

#### Kit also available as separate packs

ADSR IC		Pack		Price	Figure 1		Price
CEM 3310	£4.00	POLY 1	Pair of PCB's for multiplex - K B	£9.50	FULL 4	PUB 1 F V = CE   F F F	£6,80
VCO IC			contacts		PULY 15	President de la voice PCB	£4.80
CEM 3340	£6.00	POLY 2	IC's, IC sockets, Rs, Cs, t / a . / r - x / t	£8.20	Pile vite	P_8.1 ( .) ( .	£8.20
		POLY 3	Superior quality keyboard	£32.25	PCL1 "	ectors for one voice	£16.30
0 1% 25 ppm		POLY 4	Contacts & bus bars	£12.00	PÜ. 🕆 😁	to des for one voice	£27.50
M.F Res	£0.50	POLY 5	Double sided plated through PCB for digital	£17.25	PUL:	167 - 1 177 1 2 120 2 <b>4</b> 0 17 0 17 0 7 7	£6.30
			control & pitch gate generator (=:		POL >	Pretendionirol	£3.90
0.5% 25 ppm		POLY 6	Rs, Cs, heat sink for fitting to Pack 5	£10.50	POLY Z	farts eg jack scokets, knobs, mains witch etc.	£13.00
M.F. Res	£0.25	POLY 7	IC's IC sockets, diodes for fitting to Park 5	£31.30			
		POLY 8	Double sided mother board (for plug in voices)	£18.90	POLY ZZ	Ritbur cable, ribbon cable connectors, mains cable	£8.45
30 ppm multilay		POLY 9	Rs, Cs, connectors for mother board	£14.10	BOLL 12		
ceramic cap	£0.50	POLY 10	IC's IC sockets, Trs, heat sinks for mother	£13.10	POLY 23	Fully finished metalwork and fixing parts	£25.60
			board		POLY 24	Solid teak cabinet	£25.80
		POLY 11	PCB for master controls fleft of section marked	£18.80		ridividually purchased packs for single	
ICs and details			VOICES)		voice ir stru	n ent	£355,15
packs in o	ur	POLY 12	ICs, IC sockets, diodes Trs, Rs, Cs for master	£9.30	Comple	te kit for 4 voice expander	
FREE			control PCB	23.00		g connectors	£295.00
CATALO	SUE	POLY 13	Pots, Switches for master control board	£1,1.80		s VAT exclusive.	

## POWERTRAN

## POWERTRAN ELECTRONICS

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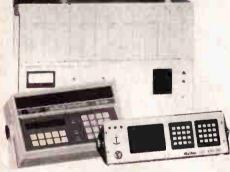
MANY MORE KITS ON PAGE 8



Our thanks to Music Bank, 6 Erskine Road, London NW3, who provided the facilities for our cover photograph



Double dose of drumming p.75



All at sea p.28



Interplanetary pix p.71

# **APRIL 1981 VOL 10 NO 4**

#### **FEATURES**

Read all about it DIGEST

Touch dimmer tested KIT REVIEW 17

**ELECTRONICS IN BOATS** 28 **Boat Show reviewed** 

**TECH TIPS** Readers' circuits 35

PICKUP PRINCIPLES In the groove 44

**MICROBASICS** 55 Programming programmers 66 CMOS safety

DESIGNER'S NOTEBOOK

Aeronautics and artwork **ASTROLOGUE** 71

The Reviewer's Return **AUDIOPHILE** 82

88 Tried and tested circuits SPOT DESIGNS

THE LEPTONS 91 A subatomic story

#### **PROJECTS**

**VSCA** 21 Audio display

LOW-OHM METER Measure miniscule resistances

MUSICAL BOX Shake it all about 50

NOISE GENERATOR A Project 80 module

**DRUM MACHINE** 75 Sound design

**GUITAR NOTE EXPANDER** 95 Stretch your strings

**READER'S DESIGNS 100** Caravan lights checker

FOIL PATTERNS 104 Board meeting

#### **INFORMATION**

EXHIBITION 10 We're coming to Bristol

15 What are we going to do next NEXT MONTH'S ETI

**BOOKS** 27 Our technical book service

SUBSCRIPTIONS 63 Advance booking

ETIPRINTS 102 Give yourself a rub-down

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# Why the Sinclair ZX80 is Britain's best-selling

**Built: £99.**95

Including VAT, post and packing, free course in computing, free mains adaptor.

Kit: £79.<sup>95</sup>

Including VAT, post and packing, free course in computing.

This is the ZX80. A really powerful, full-facility computer, matching or surpassing other personal computers at several times the price. 'Personal Computer World' gave it 5 stars for 'excellent value'. Benchmark tests say it's faster than all previous personal computers.

Programmed in BASIC – the world's most popular language – the ZX80 is suitable for beginners and experts alike. And response from enthusiasts has been tremendous – over 20,000 ZX80s have been sold so far!

#### Powerful ROM and BASIC interpreter

The 4K BASIC ROM offers remarkable programming advantages:

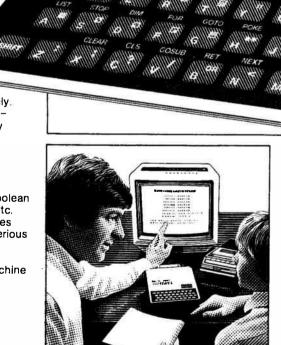
- \* Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.
- \* -Unique syntax check.
- A cursor identifies errors immediately.

  \* Excellent string-handling capability-
- \* Excellent string-handling capabilitytakes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison).
- \* Up to 26 single dimension arrays.
- \* FOR/NEXT loops nested up to 26.
- \* Variable names of any length.
- \* BASIC language also handles full Boolean arithmetic, condition expressions, etc.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- \* Timer under program control.
- PEEK and POKE enable entry of machine code instructions.
- High-resolution graphics.
- Lines of unlimited length.

#### Unique RAM

The ZX80's 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC.

No other personal computer offers this unique combination of high capability and low price.



The ZX80 as a family learning aid. Children of 10 years and upwards are quick to understand the principles of computing – and enjoy their personal computer.

## The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book (free with every ZX80). The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs.

#### Kit or built-it's up to you

In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated. If not, see the coupon.

Both kit and built versions come complet with all necessary leads to connect to your TV (colour or black and white) and cassette recorder. Plug in and you're ready to go. (Bui versions come with mains adaptor.)

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# personal computer.

# Now available for the ZX80... New 16K-BYTE RAM pack



Massive add-on memory. Only £49.95.

The new 16K-BYTE RAM pack is a complete module designed to provide you – and your Sinclair ZX80 – with massive add-on memory. You can use it for those really long and complex programs – or as a personal database. (Yet it can cost as little as half the price of competitive add-on memory for other computers.)

For example, you could write an interactive or 'conversational' program to show people what your ZX80 can do. With 16K-BYTES of RAM, they could be talking to your computer for hours!

Or you can store a mass of data – perhaps in a fairly simple program – such as a name and address list, or a telephone directory.

And by linking a number of separate programs together into one giant, but modular, program, you can achieve the same effect as loading several programs at once.

We're also confident that it won't be long

before you can buy cassette-based software using the full 16K-BYTE RAM. So keep an eye on the personal computer magazines – and brush up your chess perhaps!

The RAM pack simply plugs into the existing expansion port on the rear of the ZX80. No wires, no soldering. It's a matter of seconds and you don't need another power supply. You can only add one RAM pack to your ZX80 – but with 16K-BYTES who could want more!

#### How to order

Demand for the ZX80 exceeds all other personal computers put together! So use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

## Sinclair 2x80

Science of Cambridge Ltd.

6 Kings Parade, Cambridge, Cambs., CB2 1SN Tel: 0223 311488.

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To: Science of Cambridge	, FREEPOST 7,	Cambridge	CB21YY.
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Remember all prices shown include VAT, postage and packing. No hidden extras Please send me:

Qty	Item	Code	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s) Price includes ZX80 BASIC manual, excludes mains adaptor.	02	79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s) Price includes ZX80 BASIC manual and mains adaptor	01	99.95	
	Mains Adaptor(s) (600 mA at 9V DC nominal unregulated)	03	8.95	
	16K-BYTE RAM pack(s)	18	49.95	
	Sinclair ZX80 Manual(s) (Manual free with every ZX80 kit or ready-made computer)	06	5.00	

 $NB\ \ Your\ Sinclair\ ZX80\ may\ qualify\ as\ a\ business\ expense$ 

TOTAL: £

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3 <sup>3</sup> 4 x 5 <sup>77</sup> 296 p 210 p 4 <sup>3</sup> 4 x 17 <sup>7</sup> 296 p 210 p 4 <sup>3</sup> 4 x 17 <sup>7</sup> 390 p — PROTO — OEC	702 <b>75</b> 709 14 pin <b>40</b> - 709C B pin <b>35</b> 710 <b>67</b>	LD130 45; LF351 49; LF356 90; LM10 39; LM301AP 20; LM308T 9;	NE564 NE565A NE566 NE567V NE570	435 ZN423 120 ZN424E 180 ZN425E 170 ZN1034E 450 ZN1040E	195 7490 7491 7492 415 7493 200 7494 685 7495	42 74190 130 84 74191 120 50 74192 120 74193 120 74194 102 74195 75	\$472 1150 \$475 \$25 <b>74LS</b> LS00 13	LS145 120 LS147 210 LS148 170 LS151 90 LS153 85
Sport face cutter 107p   Shimboard 1 785p   IN5408   19   15p mech	741 8 pin 17 747C 14 pin 78 748C 8 pin 36 753 8 pin 185 810 159	LM311 70 LM318N 200 LM324A 50 LM339 68 LM348 90	D RC4136D S566B SAB3209 SAB3210 D SAS560	110 (TEXAS) 425 (TEXAS) 425 7400 275 7401 150 7402	7496 7497 1 11 74100 1 11 74104 11 74105	80 74196 99 76 74197 88 30 74198 160 74199 160 74221 150 34 74246 150	LS02 15 LS03 15	LS155 95 LS156 65 LS157 70 LS158 70 LS160 90 LS161 98
Combs   6	AY-1-0212 <b>595</b> AY-1-1313A <b>660</b> AY-1-1320 <b>225</b> AY-1-5050 <b>99</b>	LM349 118 LM379 418 LM380 80 LM381N 148 LM382 128 LM384 140	5 SG3402 SL414A SN76003N SN76013	7403 295 7404 275 7405 240 7406 170 7407	14 74109 18 74110 36 74111 36 74112 1	50 74247 151 54 74248 189 58 74249 189 70 74251 110	LS10 20 LS11 32 LS12 32 LS13 40	LS162 110 LS163 95 LS164 115 LS165 165 LS166 175
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DIL PLUGS	AY-5-1230 <b>450</b> AY-5-1317A <b>630</b> AS-5-3500 <b>350</b> AY-5-4007D <b>450</b>	LM2917 195 LM3900 60 LM3909N 70 LM3911 125 LM3914 240 LM3915 240	SN76131 SN76227N SN76477 SN76660 SP8629	125 7414 95 7416 175 7417 120 7420 299 7421	30 74125 30 74126 19 74128 38 74132	55 74285 350 50 74290 107 15 74293 135 55 74297 236 55 74298 185 56 74365 95	LS27 35 LS28 35 LS30 20 LS32 25 LS33 35	LS181 295 LS183 298 LS189 128 LS190 95 LS191 96
DIL SOCKETS (TEXAS) Low Wine   Frof. Wmp   8pin   10p   25p   14pin   10p   35p   2x10 way - 85p   124000   78   75 SERIES   150 SOCKETS   3A4000   56 S12   25 S12   25 S14000   78   75 SERIES   150 SOCKETS   1	CA3011 110 CA3012 175 CA3014 157 CA3018 68	LM3915 240 LM3916 255 LM13600 135 M252AA 625 M253AA 1150 MC663 50	TAA661A TAA700 TAD100 TBA120S	250 7422 155 7423 250 7425 159 7426 70 7427 220 7428	28 74141 28 74142 1 43 74143 2 32 74144 2 35 74145	75 74366 95 35 74367 95 30 74368 95 30 74390 185	LS38 36 LS40 28 LS42 66 LS47 85	LS192 95 LS193 95 LS194 125 LS195 130 LS196 120
16pn         10p         46p         2x15 way         —         99p         12A4000V         82         75108         350           18pn         16p         52p         2x18 way 115p 120p         128000V         135         75150         140           20pn         2p         65p         2x22 way 130p 135p         16A100V         103         7515a         155           2pn         2p         70p         2x25 way 143p 180p         16A400V         105         75450         95           2pn         3p         8ps         2x36 way 170p         16A800V         220         75451         70           2pn         3p         8ps         2x36 way 194p         255600V         220         75454         225	CA3020 166 CA3023 191 CA3028A 80 CA3035 235 CA3036 115	MC1204 250 MC1301 79 MC1303 68 MC1304P 260 MC1310P 150	TBA550Q TBA641-A12 BX or BX11 TBA651 TBA800	7430 7432 250 7433 190 7437 90 7438	19 74147 1 27 74148 1 36 74150 1 35 74151 32 74153	25 30 70	LS49 106 LS51 26 LS54 30 LS55 30 LS63 160	LS197
36pin 40p 109p 2x40 way 210p — 25ABOOV 295 75491 89 7549i 40p 109p 2x43 way 232p — 72BOOD 120 75492 95	CA3045 365	MC1458 45 MC1488 90 MC1489 90	TBA820	95, 7440 70, 7441 260, 7442	68 74155	re I 1	LS74 <b>35</b>	LS242 165 LS243 165 LS244 195

#### WATFORD ELECTRONICS

#### **COMPUTER CORNER**

SUPERSOARO II Series II. Ready built and tested 50Hz. No Flicker. Incl. Manuals and Programme £148 SUPERIORS.

SOHZ, No Flicker Incl Manuscott

Cassette

POWER SUPPLY 5V /3A (incl RF Modulator) for

IT (Ready-built and tested) £14 

EPSON TX-80B Dot Matrix. Tractor Feed EPSON TX-80 Dot Matrix. Friction Feed £285 SEIKOSHA GPROA Uninhammer. 80 Column. Impet Graphic, Dot Printer Only £225 SOFTY. Intelligent EPROM Programmer. Ready Elizophitand testing. built and tested
SOFTY You'vER SUPPLY (ready built)
TEX EPROM Eraser
TEX EPROM Eraser with timer
KEYBOARO 756 FUIL ASCII coded
KEYPAD 4 x 45 muilt ASCII coded
KEYPAD 4 x 50 muilt ASCII coded
KEYPAD 5 to A matrix (Reed switches)
STACK PACK 10 x C12 High Grade Cassett
the unique stackable drawers and labels
(p&p on the above items is extra) 525c

SLIDE 250V:
DPDT 1A 14p
DPDT 1Ac/off 15p
DPDT 1/2 A 13p
4 pole 2-way 24p
PUSH BUTTON 6A
with 10mm Button
SPDT 99p
DPDT 145p
SPDT 99p
DPDT 145p
Mini Non Lock
Push to Make 15p
Red, Blue, Grn., Push
to Break 25p
OILSWITCHES
SPST 4 way 85p. 6
way 95p; 8 way
115p; 10 way 145p.
i i sp; i U way i 45p.
warantene (training

ROTARY (Adjustable Stop) SWITCHES

1 pole/2 to 12 way. 2 pole/2 to 6 way. 3 pole/2 to 4
way. 4 pole/2 to 3 way.

8 POTARY: Make your own multiway switch. Shafting
Assembly Has adjustable stop. Accommodates up to
6 waters

WAFERS: (Break before Make) 1 pole/12 way.
2p/6 way. 3p/4 way. 4p/3 way. 8p/2 way.
8p/8 wars DP Switch 250V-2A to fit.
Spocers 4p; Screen 8p

O' CONNECTORS (Cannon type)
ets Covers
15p 125p Ptc
15p 150p
18p 150p
18p 284p 170p
10a 388b 185p Sockets 95p 135p 198p

	05p		<b>95p;</b> p;10 wa		37w	ay 2	90p 39	Bp 1	85p 
CRYSTALS	TRA	NSFORE	IFRS (M	ains Prim	220-24DV		ALUI	Й.	PANEL
100KHz 323	607	1/ Q_D_Q	/ 12.0.1	2V 100m4	A .	980	BOXI	: e	METERS
200KHz 370	1 3VA	<ul> <li>0.6V 0.6</li> </ul>	SV (PCB r	nounting)	1	75p	WITH I		FSO
455KHz 383	RVA	6V- 54	6V. 5A	9V- 4A 9V	/- 4A, 12V	- 3A	441111 F	· ,	
1MHz 323	12V	3A 15V	25A 15	V- 25A	2	20p	3×2×1"	65	60×46×
1 008M 395	12V	4 5V-1	3A 4 5V	1 3A. 6V-	1 2A 6V-1	2A;	4x21/2x2'	85	35mm
1 28MHz 392	12V	54 12V	5A. 15\	1.4A 1696	V-4A, 20V	- 3A	4x2%x11	'' B5	0-50µA 0-100µA
1 6MHz 323	20V	. 3Δ		2	(30p)	p&sp)	4x23/4x25		0-100#A
1 8MHz 323	244	A 6V.1	5A 6C-1	5A 9V-1	3A 9V 1	3A.	4x4x1½'	85	0-300#A
1 8432MHz 362	127	-1A 12V-	1A, 15\	/- 8A 15V	- 8A. 20V	6A	4x4x2½'		0-111A
2MHz 305	20V	. 64		3	<b>20o</b> (55p p	84p). 🕽	5x4x2"	95	0-10mA
2 4576MHz 382	50V	A: 6V-4A	6V-4A.	9V-2 5A 9\	/ 2.5A, 12	V-2A	51/4×23/4×		0-50mA
3 2768M 323	12V	.24 15V	-1 5A 1	5V-1 5A. 2	20V-1.2A	20∨-		130	0-100mA
3 57954M 195	1 2/	. 25V-1A	25V-1A	. 30V- 8 <b>A</b> :	30V- BA		51/ax4x11		0-500mA
4 000MHz 290				3	<b>65թ</b> (60 թ.		5 4x4x2		0-30011A
4 032MHz 323	100	VA: 121	/-4A 12	V-4A 15	V-3A 15V	-3A.	6x4x2"	120	0-2A
4 19430M 270	20V	-2 5A 2	0V-2 5A	: 30V-1	5A 30V-1	5A.	6×4×3"	148	0.25∨
4 433619M 135	40V	-1 25A 4	0V-1 25	A. 50V-1A	50V-1A 8	320p	7x5x2½		0-50V AC
5 OMHz 355					be added a	bove	7x5x3''	180	0-300V AC
5 185M 323		normal po	stai char	ge)		- 1	8×6×3''	210	"S"
5 24288M 425								_	<b>⊣</b> ,νω
6 0MHz 323		LTAGE	REGII	LATORS	3	OP	TO		445p each
6 144MHz 295		TO3	+ ve	_v			with Clips		41/4x31/4x11/
6 5536M <b>200</b>		7805	145p	790			9 Red	13	0.50µA
6 5536MHz <b>290</b>		7B12	145p	791			1 Grn.	17	0-100µA
7MHz 290		7815	145p	,,,,	2 1100	TIL21		18	0-100#A
7 168MHz 290		7818	145p		_ !		0 2" Red	14	595p each
7 680M 323				_	_		reen, Yellov		and each
8 OMHz 392		TO220		: Casing	ac ar.	ог Ап			Segment Displa
8.08333M 382		7805	60p		05 <b>65p</b>		high Bright R		1L307 6
8 867237M 362		7812	60p		12 <b>65</b> p	l ~ '	g,, bg		1L312 3" CA 1
9 375M 323		7815	60p		15 <b>85</b> p	2" F	lashing Red		IL313 3" CC 1
10 0MHz 323		7818	60p	/9	18 <b>85</b> p		ed Green		1L321 5" CA 1
10 7MHz 323			60p				re LEDs. Rec		1L322 5" CC 1
12MHz 392			92 Plastic	Casing			. Yellow		L704 3" CC
14 31818M <b>36</b> 2			30p	79L	05 <b>65p</b>		1 Intra Red	40	L707 3" CA
16 OMHz 290			30p		_		05 Detector		1747.6" CA 1
18MHz 32	0.4		30p				Infra Red		B Orange CA 2
18 432M 32			30p	79L			3 Detector		NO357 Red 1
20.0MHz <b>32</b> 3 26.69MHz <b>29</b> 4		78L15	30p	79L	15 <b>65p</b> )	BARC	SRAPH Red		ND500 1
		DOH 17	Op I	M723	38p	seam			3" Green CA 1
27 648M 32: 38 6667M 35	3 1 143			TAA550	50p	LS40	n		6" Green CA 2
		D9K 13		TBA625B	95p	OCP			3 ± 1 Red CA 1
48 0MHz 32:		17K 35	Op 2	DA1412	150o	ORP			3 - 1 Green CA
		17H 24		78HO5 + 5		ORP		85	1
116 DMHz 304	LM3		Óp		595p	2N5			VM176 18
Parts available			Ου .	78HG +5V			SOLATORS		CO 31/2 Digits
for ETI	LM3	26N 24	0ο :	A	650p	IL74	SULKIONS		CD 4 Digits
	LM3	27 <b>27</b>	Op :	79HG	850p		11 2-4		CD 6 Digits
Projects	1					, HE 1	11 2 - 4	, oe	
LS245 350	LS373	150	4016	35	4054	130	4175	120	4522 <b>15</b>
LS247 136	LS374	150	4017	70	4055	130	4194	115	4526 9
LS248 135	LS375	150	4018	76	4056	135	4408	790	4527 <b>12</b>
LS249 135	LS377	199	4019	42		2850	4409	790	4528 10
LS251 130	L\$378	140	4020	85	4059	575	4410	750	4529 15
LS253 95	LS379	215	4021	90	4060	110	4411	950	4530 9
LS257 95 1	L\$384	250	4022	85		1225	4412F	1250	4531 13

1075 105 105 115 115 99 180 250 120 115 150 215 150 885 675 750 850 420 85 140 140 210 199 275 230 140 196 245 105 270 750 850 1520 480 850 280 570 1050 850 999 350 350 LS385 LS386 LS390 LS395 LS396 LS398 LS399 LS445 LS447 LS490 LS668 LS669 LS673 LS674 4412V 4415F 4415V 4419 4422 4432 4432 4436 4450 4450 4501 4502 4507 4508 4510 4511 4512 4514 4515 4516 4517 4518 4519 4528 L\$258 L\$259 L\$259 L\$260 995
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4001 14
4002 15
4006 86
4007 19
4008 76
4009 46
4010 50
4011 18
4012 24
4013 43
4014 80
4015 82 4045 4046 4047 4048 4049 4050 4051 4052 4053

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## **DIGEST**

#### OOPS Digital Test Meter

Some constructors of the DTM (September '80) have reported problems with the DVM module blowing. This can be prevented by putting a 10M resistor in series with the IN HI pin of the module.

On page 83 the overlay for the resistance measurement board (bottom overlay) shows the common of R43, R44, R45 and C15 connected to IC7 pin 4. In fact IC7 pin 4 should go only to the -6 V takeoff point and C7 - ve. Cut the PCB track just above R45 (page 80 Fig.1 shows the correct wiring).

#### Vocoder

T wo of the ICs in the Vocoder (September '80) are listed incorrectly. In the circuit diagram and Parts List for the internal excitation board, IC5 is a 4030 and IC6 is a 4006.

#### **Breadboard 80**

In our report on Breadboard 80 (in the February News Digest), our reporter, no doubt overcome by the occasion, said that our celebrity guest was Brian Rix. In fact Mr Rix, a radio amateur, was at the show as a guest of Practical Wireless, to whom we offer our apologies.

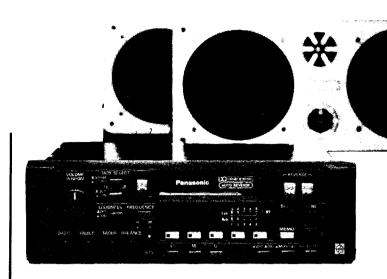
#### Take It Anywhere

New from JVC is the CX 610GB, a 6" VHF/UHF portable colour TV/monitor. This compact unit can be taken anywhere; it is capable of PAL and SECAM TV reception so you can receive programmes in any country that has one of the following TV systems - PAL B, G, or I system and SECAM B, G, D, K, or KI system (both CCIR continental and OIRT standards). The CX 610GB's colour system automatically switches to the broadcast system being used and the corresponding sound IF frequency can then be selected. The set has a newly developed JVC precision in-line picture tube, giving excellent colour pictures, and its highly sensitive swivel antenna ensures

reception wherever you are. The flexibility of this unit is further enhanced by a four-way power supply — from the household mains, ordinary batteries, its own rechargeable battery pack or from a 12 V DC car or boat battery.

The CX 610GB can also function as an on-location video monitor when used in conjunction with a colour video camera and portable video recorder. You can even record off-the-air television broadcasts out-of-doors by connecting the CX 610GB to a portable video recorder. The recommended retail price is £259 (including VAT), and further information is available from JVC (UK) Ltd, Eldonwell Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2 7AF





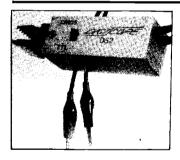
#### Panasonic Car-Fi

Panasonic has introduced what it believes to be the first full hi-fi stereo car radio/cassette that will fit into a standard DIN size dashboard aperture. The CQ 973 combines microprocessor electronics with full hi-fi specifications and according to Panasonic it is the most advanced incar system available.

For those of you who can afford the £395.95 price tag, the CQ 973 offers digital frequency readout, three waveband stereo radio, (LW/MW/FM), electronic preset tuning, autoseek tuning, an auto-reverse cassette player with a Dolby Noise Reduction system, and an output of 100 W. The

radio functions are all push-button controlled, with a total of 15 preset stations (five on each band); as an additional safety feature the driver can also keep his hands on the steering wheel and tune the radio by footswitch. The bright green digital frequency readout also functions as a clock, and at night all the major controls are illuminated.

The unit is fitted with normal/metal tape selection and both the fast forward and rewind buttons can be locked in. Separate bass, treble and loudness controls are provided. For further information on the CQ 973 and the rest of Panasonic's in-car entertainment range, contact any of Panasonic's authorised dealers.



## **Logic Monitor**

If you're in the business of developing or trouble-shooting digital circuits then you'll be interested in the Digiscope DS2 Logic Monitor. The device simply clips over any 14 or 16 pin DIL logic IC during operation, and indicates the state of each pin, either 0 or 1. Each pin has its state shown simultaneously on a 16-LED display, enabling cir-

cuit action and faults to be traced with ease. The DS2 is powered from either the circuit supply or an external source and draws negligible current from the IC under test, so circuit operation is unaffected. The input threshold is adjustable to suit either TTL or CMOS ICs. The monitor can also be used to check free packages; power is applied to the supply pins and since the DS2 pulls all the inputs high, operation can be checked by grounding the appropriate inputs and observing the effect. The DS2 is housed in a tough aluminium case and is suitable for use in industrial environments; the case is only 1" wide so several ICs may be checked side-by-side simultaneously. There is a range of accessories available including plugs and an extension lead for remote monitoring. The Digiscope DS2 costs £27.40 and further information is available from the manufacturers, J.E. Sinclare & Co., 82 Plumstead Common Road, London SE18 3RE.

#### Micro Talk

General Instrument Microelectronics have announced the introduction of a new speech synthesis chip, the SP0256. It's a 28 lead LSI device, designed to generate up to 256 discrete sequences of human speech or other complex sounds

stored in its built-in 16K ROM. External expansion can increase the SP0256's repertoire to almost 3825 sequences. Commonly used sounds can be stored once and called from memory when necessary, reducing data storage requirements. Applications envisaged include warning systems, radar, test gear and security systems.

ETI APRIL 1981

## TRANSCENDENT 2000 SINGLE BOARD SYNTHESIZER

Designed by consultant Tim Orr (formerly synthesizer designer for EMS Ltd.) and featured as a constructional article in ETI, this live performance synthesizer is a 3 octave instrument as a constructional article in ETI, this live performance synthesizer is a 3 octave instrument transposable 2 octaves up or down giving sweep control, a noise generator and an ADSR envelope shaper. There is also a slow oscillator, a new pitch detector, ADSR repeat, sample and hold, and special circuitry with precision components to ensure tuning stability amongst its many features.

The kit includes fully finished metalwork, fully assembled solid teak cabinet, filter sweep

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

Comprehensive handbook supplied with all complete kits! This fully describes construction and tells you how to set up your synthesizer with nothing more elaborate

than a multi-meter and a pair of ears!

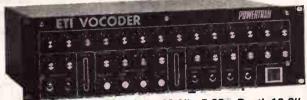
COMPLETE KIT ONLY £168.50 + VAT!



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

## **COMING SHORTLY!**

#### 1024 NOTE COMPOSER/SEQUENCER — LESS THAN £100



Panel size 19 0" x 5.25". Depth 12.2"

#### ETI VOCODER

#### COMPLETE KIT ONLY £195 + VAT!

Kit includes FREE foot control and test oscillator!

Featured as a construction article in **Electronics Today International** this design enables a vocoder of great versatility and high intelligibility to be built for an amazingly low price.

14 channels are used to achieve its high intelligibility, each channel having its own level control. There are two input amplifiers, one for speech either from microphone or a high level source.

29. mixer or cassette deck and one for external excitation (the substitution signal) from either high or low level sources. Each amplifier has its own lever control and a rather special type of tone control giving varying degrees of bass boost with treble cut or treble boost with bass cut. The level of the speech and excitation signals are monitored by LED PPM meters with 10 lights.

7 green and 3 red which indicate the level at 3dB steps. There are three internal sources of excitation — a noise generator and two pulse generators of variable frequency and pulse width. Any of the internal sources and the external source can be mixed together. There is a voiced / unvoiced detector which substitutes noise for the excitation signal at the points in speech where the vocal chord derived sounds of the speaker are substituted for by the unvoiced sounds of sibilants, etc. There is a slew rate control which smooths out the changes in spectral balance and amplitude enabling a change of the speech into singing or chanting and other special effects. A foot switch is provided to permit a complete freeze in spectral balance and whenever required. An LED on this indicates when the freeze is in operation.

An output mixer allows mixing of the speech, external excitation and occoder output. The majority of the components fit into the large analysis/synthesis board with the rest on 8 much smaller boards with the controls and sockets mounted on them for ease of construction. Connectors are used for the small amount of wiring between the boards.

The kit includes fully finished metalwork, professional quality components (all resistors 2% metal oxide) nut

## TRANSCENDENT DPX

#### **MULTI-VOICE SYNTHESIZER**

Another superb design by synthesizer expert Tim Orr published in **Electronics Today International** 

COMPLETE KIT ONLY £299 + VAT!



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

The Transcendent DPX is a really versatile 5 octave keyboard instrument. These 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 as 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 or should you prefer — strings on the top of the keyboard and brass as 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 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 vibrator comes in only after waiting a short time after the note is struck for even more realistic string sounds.

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. The

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. The 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.).

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!

POWFRTRAN

MANY MORE KITS ON PAGE 107. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER

All projects on this page can be purchased as separate packs, e.g. PCBs, components sets, hardware sets, etc. See our free catalogue for full details and prices.

# BRISTOL EXHIBITION **EXHIBITION**

COMPUTERS • AUDIO • RADIO • MUSIC • LOGIC • COMPONENTS • CB **HOBBY ELECTRONICS GOES WEST** 

London has more than its fair share of electronics shows, but we know that electronics enthusiasts are by no means limited to the capital. For that reason the first annual Hobby Electronics Show is to be held in Bristol - centre of the South-West.

## What's to see there?

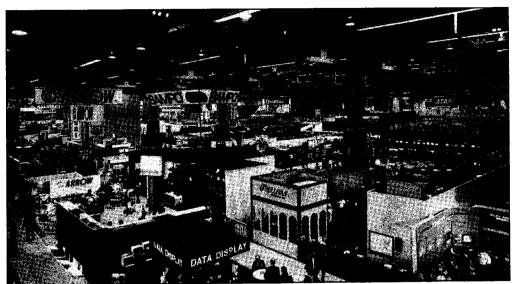
- major electronics component suppliers
  - special exhibition offers
- Wales & West schools' electronic project competition (\*has your school submitted an entry yet? Available from Hobby Electronics 81)

TICKETS — at the door — ADULT: £1.00. CHILD, STUDENT, OAP: 50p. GAMES ● KITS ● TEST GEAR ● MAGAZINES ● SPECIAL OFFERS ● BOOKS

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Friday May 29th : 10am — 7pm ● Saturday May 30th : 10am — 6pm ● Sunday May 31st : 10am — 4pm

Order sour rickers now from: AS Charing Cronics & Charing Cronics & Charing Cross Poak HIBITION



**Vegas** 

The Winter Consumer Electronic Show keeps breaking its own records, and this year's event will be no exception. The Show organisers said that more than 850 exhibitors are showing off their new products at the Las Vegas Convention Centre, up from 757 at last year's Winter Show.

By the end of the year, it seems improbable that anyone will not have heard of the Video Disc. The long wait for the disc to become a functioning reality is over, and by next Winter's CES, close to 25 manufacturers will have a system on the market. The most carefully orchestrated and the most expensive promotion, advertising, and distribution programmes ever seen for an electronic product will forcefeed the video disc message to the American consumers in 1981.

Much of the attention is still focused on the competition between the Philips-made optical laser disc format and the RCA-patented CED Disc system. Matshushita's VHD system, which will be a later entry into the field, can be expected to buck the other two, benefitting from the publicity about discs created by the optical — CED dogfight.

Another Atari first is their new remote control console which combines sleek, futuristic styling and advanced technology and simply makes the game more enjoyable. Two quick-action remote controllers allow the players to move around the room freely without clumsy controller wires interfering with game action. Now the players can select, play and reset games on this new system without ever having to get up. Fingertip touch controls and LED signals are built into the hand-held remote controllers for game select and game reset options and the combination joystick and pedal controllers respond quickly and easily to the players' touch. Activision also showed some new cartridges they have lined up which are compatible with the Atari system. One is Cen-

ly or by the full remote control unit

supplied. The recorder incorporates

a new Edit Start Control system for

minimising picture break-up bet-

ween recordings, as well as a picture scan facility which operates at 10 times normal speed, both forward and reverse. Other facilities include

still frame, single frame advance and

variable slow motion. A new quick-

trecourt Tennis, which offers everything from lightning-quick serves to breathtaking back-hand cross-court returns. Charging players can rush the net or lay back and play the baseline. Laserblast casts you as the commander of a fleet of spacecraft; you come upon some very unfriendly alien types — just get them before they get you but remember the bad guys don't miss very often.

Finally, Studer/Revox enter the cassette equipment market with their model No. B710, utilising the same professionalism inherent in the company's other audio products. It is aimed to achieve the same high level of acceptance and respect by consumers that has been accorded to previous Studer/Revox audio equipment. Two peak reading LED bar displays are used for level indication and feature a resolution of 1 dB from – 10 to +6 dB, with 2 dB intervals between – 20 and – 10 dB. A 0 dB indication represents "Dolby level". Stylistically, the B710 matches the other components in the Revox line.

Gerald Chevin



#### Versatile Video

Supplies of the new Ferguson Videostar VHS Portable video cassette recorder, model 3V24, are soon to become available. The 3V24 is expected to be the most lightweight recorder on the market, weighing in at 5.2 kg. The 3V24 has a microprocessor-assisted, fully electronic logic control cassette deck which can be operated either direct-



#### Telly Type

Delpa Systems have just announced their new Video telex which is capable of overcoming many of the inherent problems of ordinary telex machines. The Video telex uses a VDU and so the typing of messages takes half the normal time. The machine offers full correction and editing facilities, including the correction of spelling mistakes and the deletion of lines or paragraphs. It also provides full tabulation which means more attractive layouts, par-

ticularly useful in reports and orders. On existing machines where punch tapes are used, error correcting is extremely awkward and any incoming calls will interrupt the process, but the Video telex does not punch the message until it is 100% correct. The machine can either be used in the telex room or by other staff throughout the office building. Each station costs around £900 and further details can be obtained from Delpa Systems (UK) Ltd, Data Transfer Division, 56 Chiswick High Road, London W4 1SZ.

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Electronics Today Limited has advertised in our magazine, as "Metac", but so as to prevent any further confusion we wish to make it clear that Electronics Today Limited is not owned or managed by any member of the Argus Press Holdings Limited Group of Companies.

71Ls b	y TEXAS	74290 74293	15 <b>0p</b> 150p	4020 4021	100p 110p		74S SERIES 74S00   60p	745114 120p	TRANSISTORS	BFR4			2N3055 <b>48p</b> 2N3442 <b>140p</b>	3N204 <b>120</b> o	, 6A 50V <b>80p</b> :
74500 7401 7402	60p 12p 12p	74298 74365 74366	200p 100p 100p	4022 4023 4024	100p 27p 50p	9302 <b>175</b> p 9308 <b>316</b> p	74S04 60p 74S05 75p 74S03 75p	745124 300p 745132 160p 745133 75p	AC127 B 20p AC176 25p	BFR7 BFR8	9 <b>25p</b> TIP3 30 <b>25p</b> TIP3	1A 58p 1C 62p	2N3553 <b>240p</b> 2N3565 <b>30p</b>	40290 <b>250p</b> 40360 <b>40p</b> 40361 2 <b>75p</b>	6A 100V 100p 6A 400V 120p 1DA 400V 200n
7403 7404 - 7405	14p 14p 18p	74367 74368 74390	100p 100p 200p	4025 4026 4027	20p 130p 50p	9311 <b>275</b> p 9312 <b>180</b> p	74\$10 <b>60p</b> 74\$20 <b>60p</b> 74\$30 <b>60p</b>	74S13R <b>225p</b> 74S139 <b>225p</b> 74S157 <b>250p</b>	AF116 <b>50</b> p AD149 <b>70</b> p	BFX3	9 <b>40p</b> TIP3 0 <b>34p</b> TIP3	2C 82p 3A 90p	ZN3584 <b>250p</b> 2N3643 4 <b>48p</b> 2N3702 3 <b>12p</b>	40364 120p 40408 90p 40409 100p	25A 400V 400p <sub>3</sub>
7406 7407 . 7408	36p 36p 17p	74393 74490	200p 225p	4028 4029 4030	84p 100p 55p	9316 <b>225p</b> 9321 <b>225p</b>	74S32 90p 74S37 90p 74S64 60p	745174 <b>250p</b> 745175 <b>320p</b> 745194 <b>350p</b>	AD161 2 <b>45p</b> AU107 <b>200p</b> BC107 8 <b>11p</b>	BFX8 BFX8 BFX8	16 7 <b>30p</b> TIP3 18 <b>30p</b> TIP3	4A 115p	2N3704 '5 12p 2N3706 · 7 14p 2N3708 '9 12p	40410 100p 40411 300p 40594 120p	2 7V-33V 400mW 90
7409 7410 7411	19p 15p 24p	74LS00 74LS02	14p 16p	4031 4034	200p 200p	9334 <b>360p</b> 9368 <b>250p</b>	74S74 90p 74S85 300p 74S86 180p	74S241 <b>450</b> p 74S260 <b>70</b> p	BC109 11p BC117 20p BC147 8 9p	BFW BFY5 BFY5	0 <b>30p</b> TIP3 1 2 <b>30p</b> TIP3	5C 290p 6A 270p	2N3773 300p 2N3819 25p 2N3820 50p	40595 <b>120</b> p 40573 <b>75</b> p 40841 <b>90</b> p	TRIACS
7412 7413	20p 30p	74LS03 74LS04 74LS05	18p 16p 25p	4035 4036 4039	110p 295p 295p	1111	74S112 <b>12Op</b>	745374 <b>500p</b>	BC149 10p BC157 8 10p BC159 11p	BFY5 BFY9 BRY3	0 <b>90p</b> TIP4 19 <b>45p</b> TIP4	1A 65p 1C 78p	2N3823 <b>70</b> p 2N3866 <b>90</b> p 2N3902 <b>700</b> p	40871 2 100p	PLASTIC 3A 400V 60p 6A 400V 70p
7414 74C14 7416	40p 90p 27p	74LS08 74LS09 74LS10	22p 21p 20p	4040 4041 4042	100p 80p 80p	AY1-0212 AY1-1313 AY1-1320	600p   LM1360   MB3712   MC1310   MC1458	? 150p ⊮ 150p	BC169C 12p BC172 12p BC177 8 17p	BSX1 BU10 BU10	04 <b>225p</b> TIP4	2A <b>70p</b> 2C <b>82p</b>	2N3903 4 18p 2N3905 6 20p 2N4037 65p	BY127 12p BYX36-300 20p OA47 9p	GA SOOV PP-
7417 7420 7421	27p 17p 40p	74LS11 74LS13 74LS14	40p 40p 50p	4043 4044 4046	90թ 90թ 110թ	AY1-5050 AY3-1270 AY3-8912	140p MC1499 840p MC1496	350p 70p	BC179 18p BC182 3 10p BC184 11p	BU10 BU10 BU12	09 <b>225a</b> TIP1 26 <b>150p</b> TIP1	20 120p 22 130p 42 130p	2N4058 9 12p 2N4060 12p 2N4061 2 18p	OA81 15p OA85 15p OA90 9p	124 400V 850
7422 7423 7425	22p 34p 30p	74LS20 74LS21 74LS27	20p 40p 38p	4047 4048 4049	100p 55p 45p	AY5-1224A - AY5-1315 AY5-1317A	240p MK5039 600p ML920	98 <b>750</b> p 775p	BC187 <b>30p</b> . BC212 3 <b>11p</b> BC214 <b>12p</b>	BU1 BU20 BU20	BOA <b>120p</b> TIP1. 05 <b>200</b> p TIP2	47 <b>130p</b> 955 <b>78p</b>	2N4123 4 27p 2N4125 6 27p, 2N4401 3 27p	OA91 9p OA95 9p OA200 9p	164 500V 130s.
7426 7427 7428	40p 34p 36p	74LS30 74LS32 74LS37	20p 27p 30p	4050 4051 4052	45p 80p 80p	AY5-4007D CA3019	775p MM571 520p NE531 80p NE555	150p 20p	BC237 15p BC327 16p BC337 16p	BU40 E300 E308	06 145p TIS4: 50p TIS9:	3 45p 3 30p	2N4427 90p 2N4871 60p 2N5087 27p	0A202 10p 1N914 4p 1N916 7p	THYRISTORS
7430 7432 7433	17p 30p 40p	74LS3B 74LS42 74LS47	38p 70p 75p	4053 4054 4055	80p 150p 125p	CA3046 CA3048 CA30806	70p NE556 225p NE562B 72p NE564	70p 425p 420p	BC338 16p BC461 36p BC477 8 30p	E310 MJ2! MJ2!	50p ZTX3 501 <b>225p</b> ZTX5	00 <b>13p</b> 00 <b>15p</b>	2N5089 27p 2N5172 27p 2N5179 90p	1N4148 4p 1N4001 2 5p 1N4003 4 6p	1A 50V <b>70</b> p 1A 400V <b>90</b> p 3A 400V <b>100</b> p
7437 7438 7440	35p 35p 17p	74LS51 74LS55 7 <b>4</b> LS73	24p 30p 50p	4056 4059 4060	135p 600p 115p	CA3090AQ	48p NE565 225p NE566 375p NE567	130p 155p 140p	BC516 7 <b>40p</b> BC547B <b>16p</b>	MU30 MUE3 MUE3	001 <b>225p Z</b> TX5 340 <b>50p 2</b> N45	04 30p 7A 250p	2N5191 <b>90</b> p 2N5194 <b>90</b> p	1N4005 6p 1N4006 7 7p 1N5401 3 14p	8A 600V 140p 12A 400V 160p 16A 100V 160p
7441 7442A 7443	70p 60p 112p	74LS74 74LS75 74LS76	27p 36p 45p	4063 4066 4067	120p 5 <b>0p</b> 450p	CA3130E CA3140E CA3160E	90p NE571 50p NE5534 100p RC4136		BC549C 18p BC557B 16p	MJE3 MPF1	055 <b>70p</b> 2N69 102 <b>45p</b> 2N69	7 <b>25p</b> 8 <b>45p</b>	2N5245 <b>40p</b> 2N5296 <b>55p</b> 2N5401 <b>50p</b>	1N5404 7 <b>19p</b> iS920 - <b>9p</b>	16A 400V 180p BT106 110p C106D 45p
7444 7445 7446A	112p 100p 93p	74LS83 74LS85 74LS86	70p 80p 40p	4068 4069 4070	27p 20p 30p	CA3189E	140p S5668 450p SAD102 300p SFF963	270p 4A 12 <b>90</b> p	BC559C 18p BCY70 18p BCY71 2 22p	MPF1 MPS6	105 6 <b>40p</b> 2N70 5531 <b>50p</b> 2N91	8 <b>30p</b> 8 <b>45p</b>	2N5457 8 <b>40p</b> 2N5459 <b>40p</b> 2N5460 <b>60p</b>	HEAT SINKS For T0220 Volt	MCR101 36p TIC44 27p 2N3525 130p
7447A 7448 7450	75p 80p 17p	74LS90 74LS92 74LS93	40p 70p 60p	4071 4072 4073	25p 25p 25p	DAC1408-8	160p SL490 200p SN7647 750p SP8515	7 100p	BD131 2 <b>50p</b> BD135 6 <b>54p</b> BD139 <b>56p</b>	MPS/ MPS/	A06 30p 2N11 A12 50p 2N16	31 2 36p 13 25p	2N5485 <b>44</b> p 2N5875 <b>250</b> p 2N <b>6</b> N27 <b>48</b> p	age Regs and Transistors 22p For TO5 12p	2N4444 140p 2N5060 34p 2N5064 40p
7451 7453 7454	17p 17p 17p	74LS96 74LS107	110p 45p	4075 4076 4081	25p 107p	ICL7106	260p TA7205 850p TAA621 300p TBA641	140p 275p	BD140 <b>60p</b> BD189 <b>60p</b> BD232 <b>95p</b>	MPS/ MPS/ MPS/	120 <b>50p</b> 2N21 142 <b>50p</b> 2N21	02 <b>70p</b> 60 <b>350p</b>	2N6041 160p 2N6044 160p 2N6052 300p	BRIDGE RECTIFIERS	LOUD
7460 7470 7472	17p 36p 30p	74LS109 74LS112 74LS113 74LS114	80p 40p 90p	4081 4082 4086 4089	27p 27p 72p 150p	ICM7555	80p TBA651 310p TBA900 48p TBA810	200p	BD233 <b>75p</b> BD235 <b>85p</b> BD241 <b>70p</b>	MPS/ MPS/	A56 <b>32p</b> 2N22 A7D <b>50p</b> 2N23	22A <b>30p</b> 69A <b>25p</b>	2N6059 <b>325p</b> 2N6107 <b>65p</b> 2N6247 <b>190p</b>	1A 50V 19p 1A 100V 20p 1A 400V 25p	SPEAKERS Size 2'-" 64R 80p
7473 7474 7475	34p 30p 38p	74LS122 74LS123	45p 80p 60p	4093 4094 4095	70 <del>р</del> 250р	LF356P LM10C LM301A	95p TBA820 425p TBA950 27p TCA220	90p	8D242 70p 8DY56 200p 8E200 32p	MPSI MPSI MPSI	J07 <b>60p</b> 2N26 J <b>45 90p</b> 2N29	46 45p 04 5 30p	2N6254 130p 2N6290 65p 2N6292 65p	14 500V <b>30p</b> 24 50V <b>30p</b> 24 100V <b>35p</b>	2" 8R <b>80p</b> 2" 8R <b>90p</b> 1"3" 8R <b>100p</b>
7476 7480 7481	32p 50p 100p	74LS125 74LS126	180p 50p 50p	4096 4097 4098	95p 95p 340p	LM311 LM318 LM319	70p TCA940 200p TDA100 225p TDA100	175p 4 300p	BF244B <b>35p</b> BF256B <b>70p</b> BF257 B <b>32p</b>	MPSU 0028 0035	130p 2N29 130p 2N29	77A <b>30p</b> 26 <b>9p</b>	2SC1172 150p 3N128 120p 3N140 120p	24 400V 45p 34 200V 60p 34 600V 72p	MODULATORS
7482 7483a 7484	84p 90p 100p	74LS132 74LS133 74LS136	60р 30р 55р	4099 40100 40101	120p 200p 220p	LM324 LM339 LM348	45p TDA101 75p TDA102 95p TDA102	225p 570p	BF259 36p BFR39 25p MEMORIES	TIP29		53 <b>30</b> p 54 <b>65</b> p	3N141 110p 3N201 110p	4A 400V <b>95p</b> 4A 400V <b>100p</b>	6MHz UHF <b>375p</b> 8MHz UHF <b>450p</b> 1
7485 7486 7489	110p 34p 210p		65p 75p 120p	40102 40103 40104	132p 180p 180p	LM377 1	50p TDA103. 175p TDA1170 75p TDA200	4B <b>250p</b> ⊃ <b>300p</b>	2101.4L 4 2102.2L 1	100р 1 <b>20р</b> 500р	Z80P10 Z80AP10 Z80CTC	800p 700p 800p	8 pm 📭 18 pm		P FORCE SKT
7490A 7491 7492A	30p 80p 46p		220p 175p 80p	40105 40106 40107	99p 120p 90p	LM381AN 1	180p TDA2021 95p TE071 8 100p TE072 8	320p	2111-2 2112-2	250p 300p 300p	Z80ACTC Z80ADART Z80S10-1	700p £15 £24	14 pm <b>10p</b> 20 pm 16 pm <b>11p</b> 22 pm		HEADER
7493A 7494 7495A	36p 84p 70p	74LS154 74LS155	60p 200p 80p	40108 40109 40110	60p 470p 100p	LM709 LM710	36p TL074 50p TL084 150p TL170	130p 110p 50p	2114-2L 4027-3	500p 575p 100p		1100p 450p	WIRE WRAP SOC 8 pm 25p 18 pin	n <b>50p</b> 24 pm <b>70</b>	PLUGS 14 pin 50p 16 pin 60p
7496 7497 74100	65p 180p 130p	74LS156 74LS157 74LS158	90p 60p 60p	4011 <b>4</b> 4502	300p 250p 120p	LM733 1 LM741	00p UAA170 18p UDN611 70p UDN618	175p 8 320p	4116 4 4118-4	100p £10	AY 5-1013A IM640? CHARACTER	400p 450p	14 pin <b>35p</b> 20 pin 16 pin <b>40p</b> 22 pin	65p 40 pm 100	24 pin 100p 40 pin 275p
74107 74109 74116	34p 55p 200p		90p 75p 140p	4503 4507 4508	70p 55p 290p	LM748 LM2917 2	35p ULN2003 50p XR2206 ZN414		6514-45 6810 3	£5 125p 100o	GENERATORS 3257ADC R0-3-2513 U.C	990p	Using SOFTY you		Development tool.  r Programmes, De-
74118 74119 74120	130p 210p 110p	74LS164 74LS165	100р 90р 140р	4510 4511 4512	99p 120p 80p	LM3900 LM3909	70p ZN419C 70p ZN424E 30p ZN425E	225p 135p 400p	82516 3	125p	RO3-2513 LC SN745262AN KEYBOARD	700p £10	Also available	LT AND TESTED Expansion Board	£125 for Programming
74121 74122 74123	34p 48p 60p	74LS173 74LS174	180p 110p 100p	4514 4515 4516	250p 300p 110p	LM3914 Z LM3915 2	25p ZN427E 25p ZN1034	750p 200p	74S188 2 74S287 3	700p 225p 850p	ENCODER AY-5-2376	700p	MINI FLOPPY		CHANISM: Teac
74125 74126 74128	75p 60p	74LS181 : 74LS190	100р 320р 100р	4518 4520 4521	100p 100p 250p	VOLTAGE REGUL Fixed Plastic TO-2	ATORS	we	74S471 74S571	150p 160p 150p	74C922 CRYSTALS 32 768KHz	<b>500p</b> 250p	drives £140		e/Single Density :: FD1771 <b>£24.</b>
74132 74136 74137	75p 75p 75p	74LS192 1	100р 100р 100р	4526 4527 4528	108p 150p 100p	5V 7805 12V 7812 15V 7815	60р 60р 60р	7905 <b>65p</b> 7912 <b>65p</b>	1802CE 2	200p 750p	100kHz 200kHz 1 0MHz	300p 370p 320p	EPROM ERASI	D1691 £15, 214 ERS: Type UV140	D. Will erase up to
74141 74142	50p 50p 200p	74LS196 '	140p 120p 90p	4532 4534 4536	140p 550p 375p 120p	18V 7618 24V 7824 100mA	60p 60p	7915 <b>70p</b> 7918 <b>70p</b> 7924 <b>70p</b>	6800	£16 300p 350p	1 008MHz 1 8432MHz 2 00MHz	350p 325p 325p		and ERASE Indica	las slide in tray for ators £61.50
74145 74147 74148	90p 190p 150p'	74LS240 1		4538 4543 4553	180p / 320p	5V 78L0 12V 78L1		79[05 <b>70p</b> 79[12 <b>70p</b> 70]	6809 8080A 4	950p £16 850p	2 45760MHz 3 276MHz 3 579MHz	325p 300p 175p	NANOCOMP Mile scribed in WW, Ji	anuary 1981. A co	TRAINER. As de- implete kit of parts
74150 74151A 74153	130p 70p 70p	74LS243 1	170p 170p 150p	4556 4560 4569	72p 200p 2 <b>50</b> p	OTHER REGULAT LM309K LM317T	TORS 78HGKC 135p 78HO5KC	79(15 <b>70</b> p 600p 550p	1NSS060 10 TM59980A	00p 000p E20	1 00MHz 1 194MHz 1 43MHz	290p POA 125p	pre-programmed 27 well Price £64 inc.	716. sockets for all I	e). The kit includes Cs and PSU perts as
74154 74155 74156	120p 90p 90p	74LS247 * 74LS251 *	2 <b>50</b> p 140p 140p	4572 4583 4584	40p 110p 90p	LM323k LM723	200p 78MGT2C 500p 79HGKC 37p TE497	135p 600p 300p		100p	5 0MHz 6 0MHz 6 143MHz	325p 300p 300p	VEROBOARDS 0 1 (copper da	d) ANTEX SOLO	ERING
74157 74159 74160	70p 190p 100p		90р 90р 160р	4585 4724 40097	150p 250p 90p	OCP71 !	45p ORP60 90p ORP61	120p 120p	1702A B	00р 50р £7	7 0MHz 7 168MHz 8 00MHz	300p 300p 300p	2 5×3.75" 65 2 5×5" 75 3 75×3.75" 75	C-15W CX-17W	415p 425p
74161 74162 74163	100p 100p 100p	74LS266 1	60р  00р  70р	14411 14412 14433	1100p 1100p 1100p	ORP12 1: OPTO-ISOLATOR ILD74 130;		55p 90p	2532	£12 £12	8.867MHz 10.00MHz 10.7MHz	300p 310p 300p	3 75×5" 86 3 75×17" 340 4 75×17 9" 420	CCN-15W X25 SPARE BITS	425p 440p
74164 74165 74166	120p 130p 120p	74LS283	90р 90р 60р	14500 14599 INTERFA	700p 290p	MCT26 100g MCS2400 190g LEDS	TR 11.7	90p 90p	3242 3245	00p 50p	12 0MHz 16 00MHz 18 00MHz	350p 350p 300p	Pkt of 100 pins Spot face cutter Pin insertion tool 118	P SPARE ELEM	
74167 74170 74172	200p 240p 450p	74L5324 2 74L5348 2	100р 100р 100р	AD536A	£13 1400p 500p	0.125 TR32 / 5 TR209 Bed 1	0 2" <b>5p</b> TIL220 Re <b>3p</b> TIL222 Gr		652.7 6820 3	100p 125p 175p	18 432 19 968MHz 26 690MHz	350p 390p 350p	Vero Winng Pen	CCN	180p 200p
74173 74174 74175	120p 90p 85p	74LS367	48р 70р 00р	DM8123 DM8131 DP8304	175p 375p 450p	TIL211 G: 2 TIL212 Ye 2	Op TIL228 Red 5p Rectangula	,	6841 6850 <b>3</b>	40p £16 :00p	27 145MHz 32 6667MHz 48 0MHz	325p 350p 300p	74C925 74C928 ICM7216B	550p MC402- 600p MC404- 2000p 10116	4 325p
74176 74177 74178	90p 90p 160p	74LS374 1	50p 50p 20p	DS8835 DS8835 DS8838	250p 150p 225p		NSB5881 TIL311	570p	8155 <b>11</b> 8205 <b>3</b>	70p 00p 20p	55 5MHz 116 DMHz	400p 350p	ICM7217A ZN1040E	850p 10231 700p	350p
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74195 74196 74197	95p 80p	4007 4008 4009	20p 80p	75363 75365 75451	300p 400p 200p	TTL Data Book (700 Power Semiconducto	pages) <b>£6.80</b> or Data Book (600	pages) Understanding tems	Communications S P.0	50 Sys. D.A.	EXP300 £575p EXP350 315p EXP600 630p	DM23	5 Digital Multin	neter	£50
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74251 74259 74278	140p 250p 290p	4013 4014	50p 84p	8128 8195 8197	250p 180p 160p	Software Design for (400 pages) The Great Int I Mati	<b>£11,00</b> hs on Keys (208		£9 P&P on each book ( VAT)	.95	PB102 2295p PB103 3445p	TG105	Pulse Generate	ter or peritem + VA	£145 £81
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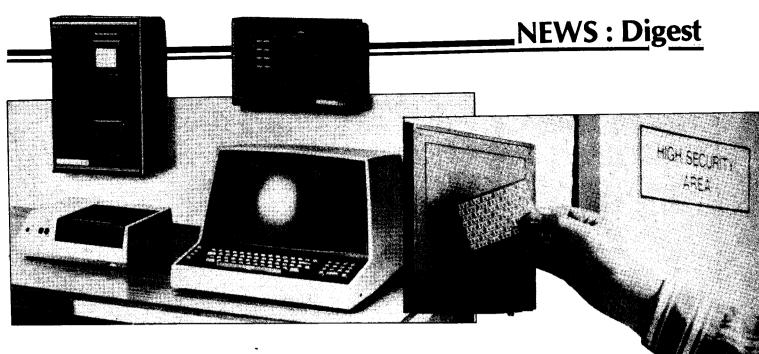
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#### **Hidden Security**

A new system from STC Electronic Security Systems (STC-ESS) protects itself while it is protecting the customer. The ITT Access Control System, now marketed by STC has no

visible mechanism to vandalise or attack at the point of entry. It operates by proximity. A hidden sensor reads a credit-card-size command key and transmits signals to a unit which controls and records access. Conventional keys, key holes or card slots

are not used. The command key can even be used while it is still inside a wallet, pocket or bag or is being used as a lapel badge.

The system is modularly expan-

The system is modularly expandable and can be integrated into existing or planned security and environmental systems requiring control of multiple access locations. More information on Access Control Systems and other STC security products is available by contacting STC-ESS, 313 Ballards Lane, London N12.

#### Wire Cutting

f you've ever had an electrical fault in your Rolls, you're only too well aware of the jungle of wires that lurk beneath your bonnet, the colour coding cleverly hidden under years of crud. Ripault of Enfield in collaboration with Liverpool University's Dept. of Electrical Engineering and Electronics have addressed themselves to the sticky problem of cutting down the wiring harness to something a little more manageable.

The prototype has already been installed in a Maxi. It uses 10 m of twin core cable instead of 100 m of 130 separate leads used in the conventional Leyland harness. The wire links a number of electronic control boxes, one core carrying power and

the other digital control signals for the black boxes. Not only does this method cut down enormously the amount and complexity of the vehicle's wiring, but it also eliminates the use of high current electromechanical relays which are subject to contact wear.

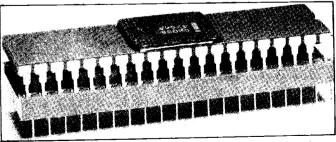
The system is designed to meet a BL specification. Amongst the requirements are that the system should operate under the hostile environment of the engine compartment. That means surviving a temperature range of 40°C to +120°C.

Benefits of the new system include low power consumption, quick and convenient fault diagnosis and easier servicing. A security system could also be built-in.

#### **IC Survival**

Winslow Component Systems has introduced a new range of IC sockets designed to be virtually indestructable. The heart of the socket is a new contact featuring an inverted leaf design. This double-sided inverted leaf allows for a certain degree of careless handling when inserting an IC, which also facilitates the use of automatic insertion equipment. It is available in two

versions — the W3200 series, which has tin plated contacts, for the lower cost consumer type applications and the W3300, aimed at the industrial and professional market incorporating tin and gold plated contacts which are totally insulated from surface tracks on double sided PCBs. The W3300 is also 100% anti-wicking. Both versions come in the complete range of contact configurations from 8-40 pins, they are only 0.15" high and are moulded in UL approved glass reinforced polyester.



#### Teach Yourself Video

Have you invested in a video recorder, but haven't yet discovered its full potential? If the sole function of your recorder is to commit 'Crossroads' to tape, a new publication from 'those awfully nice Sony people' might widen your horizons. Their 48 page full colour handbook 'How To Video' is on sale

at their 134 Regent Street showroom in London for 60p (also by post for 90p).

Video recorders are very complex electronic devices, but are nevertheless simple to operate. How To Video' uses simple, non-technical language and ample illustrations to explain what your recorder is capable of, how to make home movies, the use of sound and lighting and even the creation of professional style, special effects and titling.



#### Suck It And See

ew from OK Machine & Tool (UK) Ltd is the DSP-1 desolder pump. OK claim that it features industrial performance at an economy price. For about £6.00 you can arm your toolkit with this all-metal

device, with an easy-to-replace Teflon tip — self-cleaning on each stroke.

The DSP-1 desolder pump is supplied by OK Machine & Tool (UK) Ltd, Dutton Lane, Eastleigh, Hants SO5 4AA.

**April Fair** 

Keep April 14th to 16th of 1981 free in your diary for the gathering of the clans in the Polytechnic of North London Theatre when the Association of London Computer Clubs hold their second London Computer Fair. For only 75p you can spend a day in North London in the company of everyone who is anyone in personal computing. In addition to retail stands you can visit seminars, workshops and club stands. There's even a bring and buy sale. If you're within reach of a tube station, you're half way there. The venue, the Polytechnic of North London, is opposite Holloway Road tube station.

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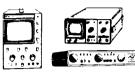
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14







#### **1024 COMPOSER**

This machine will plug into the back of your synthesiser and allow sequences of up to 1024 notes to be played automatically. This Powertran design provides complete control of the starting and finishing points of the sequence, so several shorter tunes may be stored in the memory simultaneously. Both pitch and note length are fully programmable and rests may also be entered.

#### IR REMOTE CONTROL

As promised last month, we present a five-channel infra-red remote control system which will interface with last month's Noiseless Power Switch. The unit has three latching channels (ie push-on, push-off), two non-latching channels, and a range of up to 30 feet. Full constructional details of both the transmitter and receiver will be given.

#### **SOLDERING IRON**

A DIY design for a thermostatically-controlled soldering iron that is a must for any serious constructor. If you've ever cursed your unwieldy welding device, you'll be glad to know that with our tiny version your fingers are only 1½" from the bit for precision control. The iron runs from a switched-mode power supply at only 3 V, so it's completely safe for soldering CMOS — with a continuous temperature range up to 500°C, built-in light, interchangeable tips and a price one-fifth of a commercial equivalent, you can't afford *not* to build one.

Articles described here are in an advanced state of preparation. However, circumstances may dictate changes to the final contents.

ETI APRIL 1981

#### **TOUCH DIMMER**

This project makes light work of lamp dimming. Based on the S566B IC, it provides touch control of brightness and a memory that turns the light on at a pre-determined level. The big difference with this design is that it can be used with the IR remote control and still retain all the normal functions. The remote control unit can operate two of these dimmers.

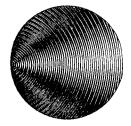
#### **POWER SWITCH**

For those of you who don't need the low noise and high current capability of the Noiseless Power Switch, we're publishing a cheap power switch that will handle a current of 5 A and interface with the IR remote control. Up to three of these switches can be controlled by the IR transmitter.

#### **SONIC HOLOGRAPHY**

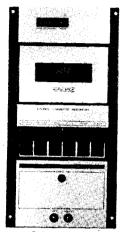
Surround-sound in your living room! No, your eyes don't deceive you — the speakers are in front of you. No, your ears don't deceive you — sounds to the left of you, to the right, behind and above you. Find out more in next month's ET!





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and connecting diagram.

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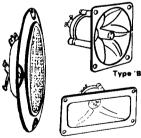


12" 100 wett. Impedance B ohm. 50 oz. magnet. 2" aluminium voice coil. Resonant Frequency 25Hz. Frequency Response to 4KHz. Sensitivity 95dB. Price £23.70 each. £2.50 Packing and Carriage each.

8" 50 west. Impedance B ohm. 20 oz. magnet. 1" aluminium voice coil. Resonant Frequency 40Hz. Frequency Response to 6KHz. Sensitivity 92dB. Price £8.90 each. £1.25 Packing and Carriage each.

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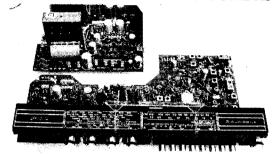
Type 'A' 3in round with removable wire mesh. Ideal for bookshelf hi-fi speakers. Price (Type 'A') £3.45 each.
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purpose speakers disco and PA systems, etc. Price £4.35 each.

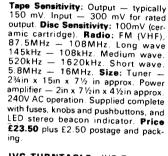
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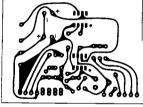
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16

There are many adverts about for build-ityourself electronic kits - everything from door chimes to hi-fi. But do they represent value for money? This new series finds,

out for you.

his is the first in a new series of articles, designed to look in detail at some of the DIY kits available on the market, particularly those which yield a useful item for the home or car when completed.

We will be paying close attention to ease of construction which includes a consideration of the clarity of the instruction leaflets provided. Anyone reading this who produces a kit which they feel might be suitable, is asked to ring the editor at our office number and we'll take if from there.

#### Taking A Dim View!

For our first month we're having a look at TK Electronic's remote controlled light dimmer, which sells for around £20. The kit comprises two separate units, a touch operated light switch and an IR (infra-red) control box. The dimmer can be constructed initially with straightforward touch operation, and the IR option added later.

The dimmer itself uses the 566 IC, which allows for a neat little circuit with 'memory' capability. Turn on the light by touching the plate and it will assume the level of brightness you last set it at. Holding a finger on the plate will cause the level to cycle between maximum and minimum brightness.

To add the IR facility an external photodiode is fitted to the mounting plate (see photo). This then produces full operation from the hand-held unit. The latter is little more than a multivibrator and two IR LEDs. A neat little black plastic box is provided, predrilled, for mounting the controls.

#### **Constructive Thinking**

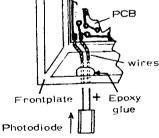
The instructions provided with the kit are well explained, but could be better presented. A separate sheet is included with details of different types of electronic components and some helpful hints on soldering.

These serve as a general construction guide, the detailed building notes for a specific project being pretty sparse. This, together with the very high component density found on the PCB, makes me think that an absolute beginner would find the dimmer a difficult task. As this is a mains circuit, best make a start in electronics elsewhere.

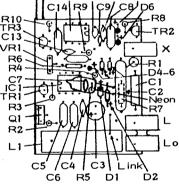
Having said that, anyone who has built a few magazine projects would find the kit relatively simple to put together,



How to connect photodiode D8 to P.C.B.



P.C.B, LAYOUT



Above left: the assembled transmitter. Note the shaky PCB fittings. Above and right: examples from the well-explained notes. Diagrams are basic, but well thought out. Instructions are generally adequate for the constructor with a little experience.

although care will still be needed in soldering up the PCB. however experienced you may be!

Assembly of the hand controller is very simple indeed, as there are only some eight components involved! The push button is PCB mounted, as are the LEDs. One point about the controller that I did not like was the fact that the LED leads are used to secure the PCB into the box. This means that every time the push button is operated, the leads are stressed unnecessarily. Also the box is a fraction too narrow to admit a PP3 with a battery clip fitted. Thus, it has to be laid along the case which means in turn that it is effectively jammed against the PCB again putting stress upon the LED leads!

#### **Built And Working**

Assembly took about two hours, including the time required to sort out the components initially. No "sillies" manifested themselves from the instructions and the kit was complete as supplied.

Once built the unit functioned first time and the notes provided on installation and use were clear and concise. Take some care with the choice of wiring box you use for mounting the kit, though, as it is fairly deep and will protrude some 35 mm behind the front plate when fitted.

In use the dimmer functioned perfectly at all times, with the photodiode having a good wide acceptance angle. Range is about 30 ft - more than most living rooms I would have thought.

#### **Conclusions**

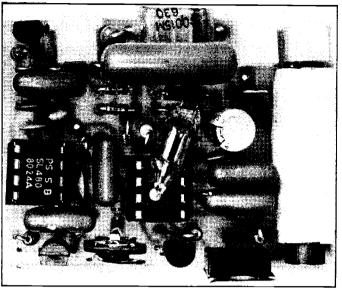
Overall a good design. The circuit is neat and well thought out and the PCB design quite a feat of miniaturisation! However, this does tend to mean that the kit is best suited to someone with some previous constructional experience.

The unit represents reasonable value for money and can be confidently recommended.

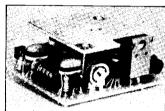
**RON HARRIS** 

#### BUYLINES

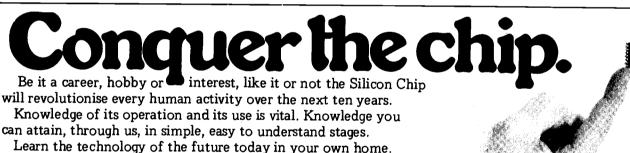
TDR300K Touch Dimmer Kit £14.30 + VAT (+ 40p P&P per order), MK6 Infra-red Transmitter £4.20 + VAT. TK Electronics, 11 Boston Road, London W7 3SJ. Tel: 01-579 9794.



Above: the main PCB assembled note the bulb fitting. This is to ensure that it lines up with the hole in the touch plate, shown fitted (right photo). The board is somewhat crowded in places and care needs to be exercised when soldering.



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# VISUAL COMPLEX SOUND ANALYSER

This unusual unit continuously analyses the amplitude/frequency content of complex audio signals and presents the results on a multi- colour 60-LED display.

Design by Ray

Marston. Development

by Steve Ramsahadeo.

his very unusual project makes an excellent multicolour visual display accessory for use with any audiooutput system. The unit continuously analyses the complex sound content of the audio signal and presents the results of the analysis, in three colours, on six 10-LED bar displays arranged as a diamond with a diagonal. Naturally, in the presence of music, etc., the displays bounce and sway in sympathy with the analysed contents of the audio signal and present an attractive moving display.

The Visual Complex Sound Analyser display unit is mains powered and receives its audio input signal from the output (speaker) of the system under test. The audio signal is actually analysed in the form of three overlapping audio bands, having nominal 3 dB points of 20 Hz — 120 Hz (red display), 250 Hz — 2 kHz (yellow display), and 2 kHz — 7 kHz (green display). The upper three 10-LED bars each move in 3 dB steps and display the instantaneous signal amplitudes of the three audio bands. The lower three 10-LED bars move in linear steps and display the instantaneous dominant frequencies of the three bands.

#### The Display

This is a project where the skilled constructor might like to experiment with alternative display-pattern layouts. Our development prototype unit was originally built up on Veroboard and had a display in which the six 10-LED bars were arranged as three parallel 20-LED lines, each representing a specific colour-coded frequency band, with the upper half of the display showing amplitude and the lower half showing instantaneous dominant frequencies. On this unit, the central 'reference' bar (four LEDs) of the display represents zero amplitude/frequency, so that each of the three display lines appears to expand and contract from its central point.

On the final PCB version of the unit we've changed the display to the form shown in the photographs. Here, the display is again in the form of three 20-LED lines, each representing a specific colour-coded frequency band, with the upper half of the display showing amplitudes and the lower half showing dominant frequencies, but in this case the two outer lines of the

display are angled to form a diamond shape. The major difference of this display is that the individual 10-LED bars are so arranged that the entire display appears to rotate left or right in sympathy with the music, rather than simply expand or contract. Thus, on the low-frequency (red) band the two 10-LED bars expand downwards with increasing amplitude/frequency, whereas on the high-frequency (green) band the two 10-LED bars expand upwards under the same condition; the central (yellow) band expands in a downwards direction. If you've got any better ideas, feel free to do your own thing.

#### Construction

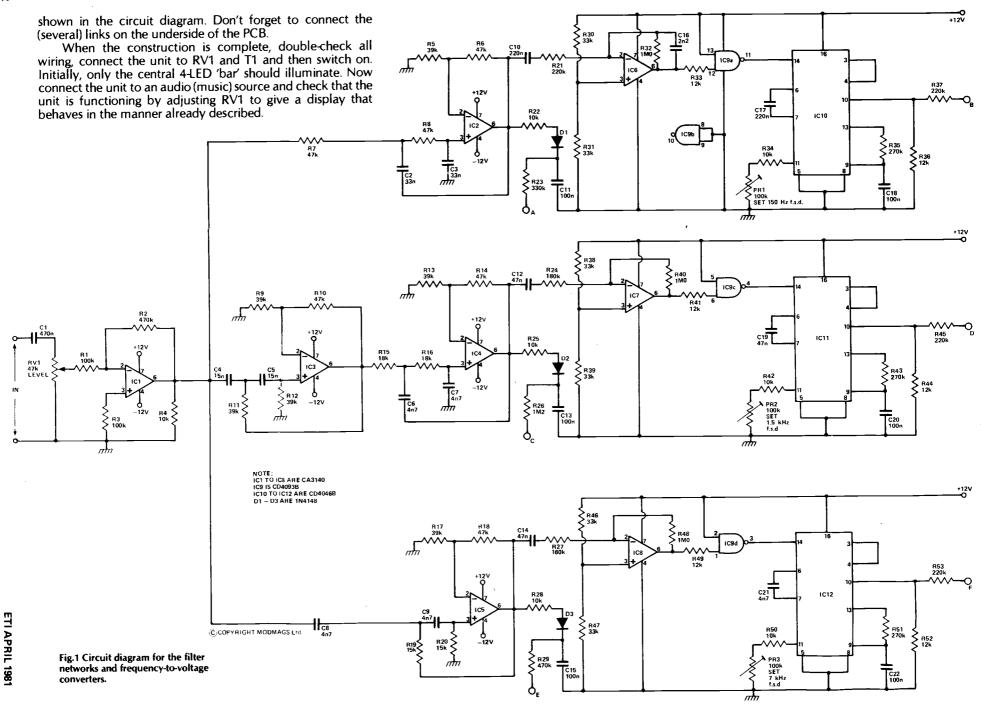
The entire circuit, with the exception of mains transformer T1 and pot RV1, is built up on a single large (12 x 8 inches) PCB. On our prototype we've coated the entire top surface of the PCB with navy-blue flock paper, to enhance the visual appeal of the unit: if you wish to do the same, proceed as follows.

(1). The PCB uses a fairly large number of bridging links on the top side of the PCB, as well as several long links on the underside; these underside links are facilitated by Veropins (marked on the overlay as A, B, C, etc) pushed through the board from the top side. The underside links are completed by joining A to A, B to B, etc. To start the construction, drill all holes to accommodate the wire links and the Veropins, then insert the links and pins from the component (upper) side of the PCB and solder into place.

(2). Now coat the entire upper surface of the PCB and the lower side of the flock paper with cow gum, allow ten minutes to set and then press the paper evenly into place and trim the outer edges.

(3). Next, drill all remaining holes in the PCB and then proceed with the construction in the normal way, taking extra care to observe the polarities of all semiconductor devices (particularly IC17 and IC18) and electrolytic capacitors. Take special care to check the functioning/polarity of all LEDs before soldering them into place and note that the LEDs must be of the colours

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#### HOW IT WORKS.

The audio input signal is fed, after a simple 'level control' (RV1-IC1), to a multiple filter network, which divides the complex input signal into three distinct (but overlapping) bands. The lowest band has an upper 3 dB cut-off frequency of 120 Hz and operates in the low-pass mode (IC2). The middle band operates in the band-pass mode (using high-pass filter IC3 and low-pass filter IC4) and has lower and upper cut-off points of 250 Hz and 2 kHz respectively. The upper band operates in the high-pass mode (IC5) and has a lower cut-off point of 2 kHz.

The output of each filter is peak-detected and filtered by a rapid-charge slow-discharge network (R22-D1-C11-R23-R56, etc) and passes to the input of a 10-LED 'amplitude indication' display. These displays are based on LM3915 dot/bar drivers and give a log display in 10 3 dB steps: they are set, via pins 6-7, to read full scale at 1.2 V. The outputs of the rectifier networks are fed to the inputs of the LM3915 drivers via fixed potential divider networks (R23-R56, R26-R60, and R29-R64), the values of which have been calculated to compensate for differences in the gains of the three sets of filters.

Note that in the LM3915 circuits the ICs are powered from a 12 V supply, but the LED chains are driven from a 24 V supply. The ICs are wired to operate in the 'dot' mode (via pins 9 and 11), but the 10 LEDs in each chain are wired in series; consequently, the LEDs produce a 'bar' display with the LEDs that are on passing a common current. Thus, the LED current consumption is constant, irrespective of whether one or 10 LEDs are turned on.

The low-frequency level indicator (IC13) uses red LEDs, the midband indicator (IC15) uses yellow LEDs and the upper indicator (IC17) uses green LEDs. To give an equal brightness to all three colours, the LED drive current of each LM3915 is weighted by the resistor connected to pins 6-7. The red LEDs pass approximately 8 mA, the yellow pass 18 mA and the green pass 25 mA.

The output of each of the three audio filters is also fed to a frequency-to-voltage converter network, and the instantaneous frequency is subsequently displayed on another line of 10 LEDs by LM3914 linear drivers. These drivers are again operated in the dot mode with a bar display and are current-weighted.

Each frequency-to-voltage converter operates as follows. The output of each audio filter is amplified (by IC6, etc) and converted to a square wave by one of the IC9 Schmitt gates. The resulting square wave signal is fed to the input of a phase-locked loop (PLL) circuit (IC10, etc) and compared with an externally set reference frequency (set by C17-R34-PR2, etc). The PLL incorporates a phase comparator and a voltage-controlled oscillator (VCO). The output of the comparator is coupled to the input of the VCO via a simple filter network (R35-C18) and the VCO input voltage is made available, via an internal buffer, at pin 10. As the PLL tries to track the rapidly-shifting input signal, it generates a signal at pin 10 that is proportional to the instantaneous frequency of the input signal (0 V at zero frequency, 12 V at the reference frequency, etc). The output signal of each PLL circuit is fed to the input of its respective LM3914 display driver via a simple potential divider network (R37-R57, etc).

The total of six 10-LED displays are arranged in three pairs, each of a different colour and each displaying the instantaneous amplitude (upper LEDs) and frequency (lower LEDs) of a specified audio band. A bar of four red LEDs is mounted horizontally across the centre of the display, to enable the amplitude and frequency areas of each band to be readily distinguished.

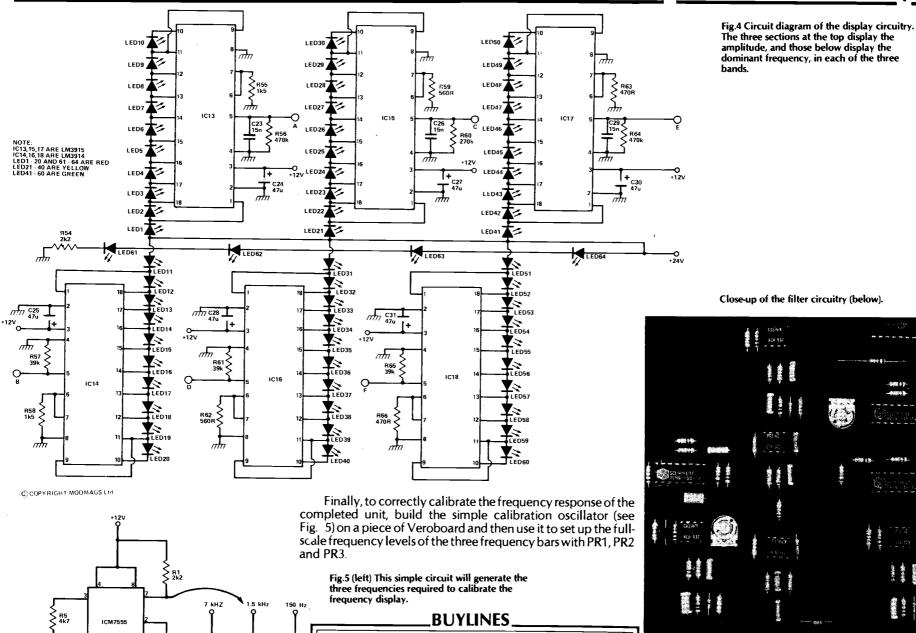
The complete unit uses +24 V, +12 V and -12 V supply rails, each regulated by an IC.

The unit incorporates only three preset controls (PR1, PR2, PR3), which are used to set the full-scale reading of each frequency display (150 Hz, 1.5 kHz and 7 kHz). Figure 5 shows a simple circuit which can be used to generate suitable reference signals when initially calibrating the unit. The circuit is a basic astable, with its frequency determined by the C1-R2-R3-R4 values; the circuit can be easily built on a spare piece of Veroboard.

ETI APRIL 1981

OUT TO VCSA INPU

R2 10k



All components used in the V.C.S.A. are easily available. In case of

difficulty the LM3914 and LM3915 can be purchased from advertisers

in this issue. Should you decide to enhance the appearance of your PCB with flock paper then Paperchase Products Ltd., 213 Tottenham Court Road, London W1P 9AF offer a selection of colours.

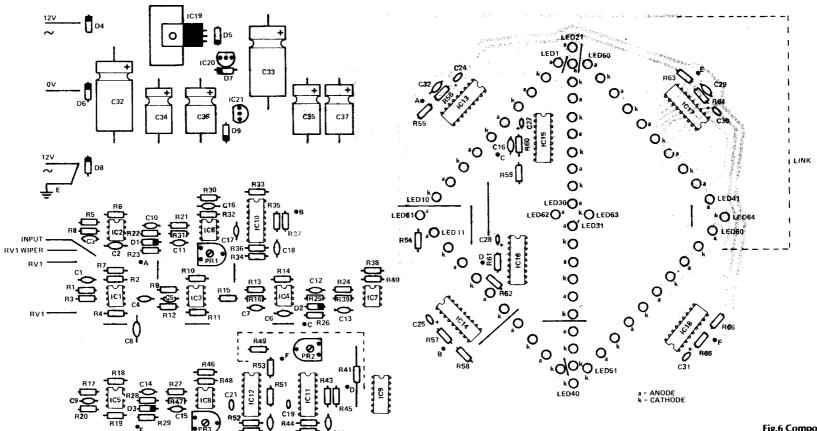


Fig.6 Component overlay of the complete VCSA.

Resistors (All 1/4W 10%	<b>)</b>	R63, 66	470R	C35, 37	470u 16 V electrolytic
R1, 3	100k	•		Semiconductors	
R2, 29, 56, 64	470k	Potentiometers		IC1-8	CA3140
R4, 22, 25, 28, 34, 42, 50	0 10k	RV1	47k linear	IC9	4093B
R5, 9, 11, 12, 13, 17, 57,		PR1, 2, 3	100k minature horizontal preset	IC10, 11, 12	4046B
61, 65	39k	• •		IC13, 15, 17	LM3915
R6, 7, 8, 10, 14, 18	47k	Capacitors		IC14, 16, 18	LM3914
R15, 16	18k	C1	470n polycarbonate	IC19	7824
R19, 20	15k	C2	33n ceramic	IC20	78L12
R21, 37, 45, 53	220k	C3	33n polycarbonate	IC21	79L12
R23	330k	C4, 5, 23, 26, 29	15n polycarbonate	D1-3	1N4148
R24, 27	180k	C6, 7, 8, 9, 21	4n7 polycarbonate	D4-9	1N4001
R26	1M2	C10, 17	220n polycarbonate	LED 1-20, 61-64	0.125" Red
R30, 31, 38, 39, 46, 47	33k	C11, 13, 15, 18, 20, 22	100n polycarbonate	LED21-40	0.125" Yellow
R32, 40, 48	1M0	C12, 14	47n polycarbonate	LED41-60	0.125" Green
R33, 36, 41, 44, 49, 52	12k	C16	2n2 ceramic		
R35, 43, 51, 60	270k	C19	47n ceramic	Miscellaneous	
R54	2k2	C24, 25, 27, 28, 30, 31	47u 16 V tantalum	T1	12-0-12, 12 VA
R55, 58	1k5	C32, 33	1000u 63 V electrolytic	SW1	DPDT miniature toggl
R59, 62	560R	C34, 36	1000u 25 V electrolytic	F1	250 mA fuse and hold

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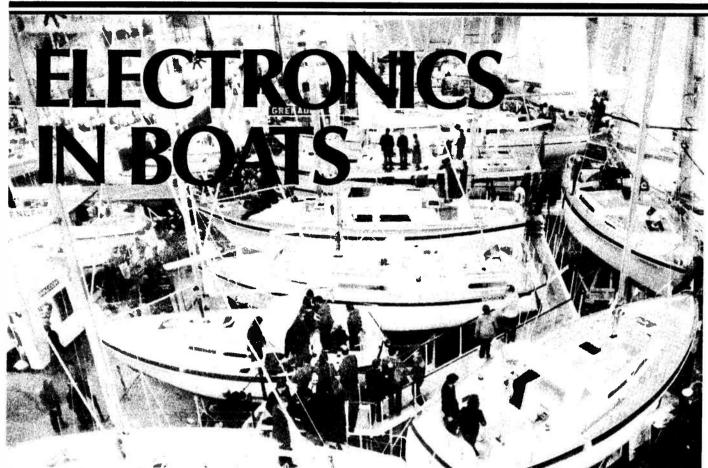
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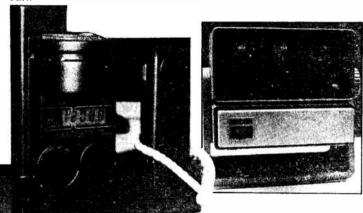
way of getting your hands on the right title.



January saw the return to Earl's Court of the International Boat Show. Tina Boylan, (ETI's very own Tiller Girl) and Peter Green went along to see what part electronics plays in boating.

he 27th London International Boat Show brought a brief glimpse of the sunny Caribbean to a frost-bitten and land-locked crowd this January at Earl's Court. It was filled to the gunwales with land-lubbers and sea-goers alike, for the show is not merely aimed at the enthusiast or those of us with money to burn. There are plenty of attractions; gadgets to puzzle over and pleasure craft of every conceivable shape and size fill the huge halls as far as the eye (no offence, Nelson) can see. The whole experience is geared towards sun-baked fantasies and the epitome of luxury.

As you leave the lower halls, however, you find stands with some of the more down-to-earth(?) elements of boating on offer. Waterproof gear, life jackets and a million different types of rope. Proving that there's a lot more to boats than basking in the sun!



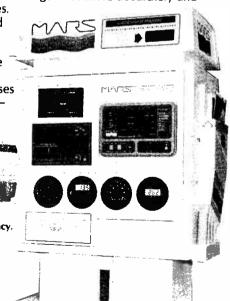
#### **Messing About In Boats**

Practically a whole floor was given to what interests ETI most — electronic devices. Electronics now plays an extremely important part in sailing the seven seas; the aid it gives to navigation and safety is immeasurable. For although men have successfully managed to sail over quite long distances for thousands of years with little more than the stars to guide them, electronics enables them to navigate far more accurately and has saved hundreds of lives.

Direction finding and measurement of speed are the most rudimentary necessities for sailing. The earliest form of navigation used charts, compasses and the first instrument — the log (literally!), which was a log tied to a rope knotted at equal intervals and dropped over the stern of the boat, the rope being paid

Far left: A small radio direction finder with digital readout of the selected frequency. Left: A satellite navigation unit.

Right: A demonstration console for various navigational aids.



out for a known length of time and the knots counted. Calculations would then be made using these three ingredients. The result was always an approximation, as time keeping was not very accurate. In order to solve this problem, during the 17th century the British Admiralty offered a prize of ten thousand pounds for the development of an accurate chronometer. This huge sum was clearly an indication of the importance of such a device. In 1762 horologist John Harrison collected the prize for his design which kept an accuracy of better than two minutes over a six week period — a considerable achievement for the time(groan)!

Today electronic time keeping and calculation are accepted as being both accurate and simple. But electronics in navigation has come a long way from this simple level. Any mechanical instrument can be used in conjunction with electronics and in the case of navigation it is used in three main ways.

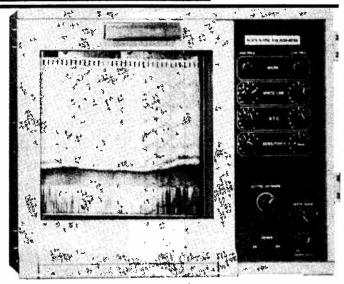
#### Which Way Now?

The first simple method is mainly an offshore aid and is called Radio Direction Finding (RDF). To use this system you must know your approximate position and from your (still indispensable) charts, you then choose three or more transmitting aircraft or marine radio beacons which are in the vicinity of your approximate position. The simplest RDF receivers are operated by manually turning a loop of ferrite antenna until the chosen beacon is heard at minimum strength. Beacon direction is then read off a calibrated scale. A separate sensing antenna must be incorporated to tell whether the beacon is in front of the boat or behind it. Some of the hand-held RDFs, of which there were many at the show, have a built-in compass. Using this it is possible to obtain a fix quickly and the skipper is able to use this on deck, therefore avoiding interference from rigging etc. Headphones are provided on many models for aural identification of very weak signals. When you have read off the bearing of each beacon you plot them on the chart and where the lines cross X marks the spot, your position has been found! The bearings taken from these fixed stations give a resultant bearing which is usually accurate to within 2°

The second method of navigation is an essential for any water-going vessel and is the aforementioned log, only somewhat changed in design! The log indicates speed and nautical mileage using a sensor. The simplest form of this is a small impellor monitoring water flow which is mounted through the hull, or over the stern of small boats. As it rotates it pulses a reed or similar switch to provide a suitable signal for subsequent analogue or digital processing and display. This type of sensor is unfortunately liable to clogging by seaweed or flotsam or may be inaccurate due to protrusions from the hull of the boat.

A way round this is to use one of two other electronic systems which have no moving parts. The first of these transmits ultrasonic pulses through the hull into the water and then listens for reflections caused by bubbles or other moving particles under the boat. The frequency of the received signal will differ from the transmitted one because of the Doppler shift and this is proportional to the speed of the water flow. The instrument displays the frequency difference as units of speed. Incorporated circuitry compensates for variations in the speed of sound in water at different temperatures and salinities.

The second and more common device is a hull-mounted electromagnet which creates a magnetic field at right-angles to the motion of the boat, with the lines of flux passing vertically through the hull. Since seawater is conductive, a voltage is induced in the water proportional to the velocity at which the water cuts through the field. There are two small metal studs which protrude through the hull and pick up the voltage — and



Above: A depth sounder with pen recorder. Bottom: Another satellite navigation console.

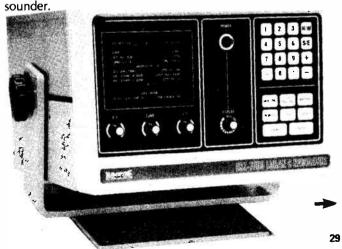
that's all there is to it! With the log to calculate speed and mileage and bearings taken from a compass, this method can be used for dead reckoning navigation out at sea.

#### **Seeing Stars**

Satellite navigation is the last and most accurate means of position finding at present. This method is used mostly in large boats and ships as it can be rather expensive to install. As each satellite orbits the earth it transmits a signal on 150 and 400 MHz every two minutes. These signals give its exact orbital parameters, which are frequently updated with information based on observations made by land-based dedicated tracking stations. The satellites can provide information 19 or 20 times in every 24 hours, and, although their passes are not evenly spaced the worst delays are not normally longer than 21/2 to 3 hours. Using the most sophisticated type of on-board dual frequency receivers, a positional accuracy of a few metres can be achieved anywhere in the world. Current satellite navigation receivers often incorporate extra features which are capable of predicting the next satellite pass, and have the ability to perform dead reckoning navigation between passes as well as ringing an alarm when the predicted destination is reached.

#### **Sounds Fishy**

So now your direction is pretty clear, but there is more information which must be found because you *really* need to know what's around you as well, and particularly what's under you. The open sea is not a swimming pool with a constant depth everywhere, and rivers are not like canals; they have sandbanks and shallows. So next on the list of electronic aids is a depth



ETI APRIL 1981

These work by transmitting an impulse and measuring how long it takes to return. Ultrasonic energy is used for this; all types of depth sounder use this principle and only vary in the type of display, output power and frequency.

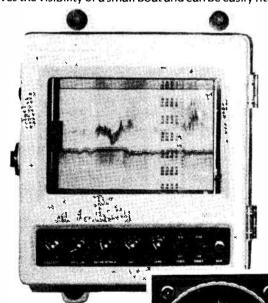
The display is usually an LED type, and when the acoustic pulse is sent out an LED flashes at the zero mark. When the echo returns another LED flashes on the dial at an angle proportional to the time since the transmit pulse was sent, thus indicating the depth of water below the hull. Apart from indicating the distance of the sea bed, the depth sounder will also pick up the position of shoals of fish, making it a useful aid for fishermen. Many depth sounders incorporate a pen recorder which enables them to return to a particularly good area where shoals have been found before. The depth sounder also makes landing less hazardous in bad weather conditions.

So now you know exactly where you're going. Great. But with the waterways of the world crowded with many different types of vessel, it's rather important that you know where they're going to, otherwise — oops! A collision, and that happens all too frequently!

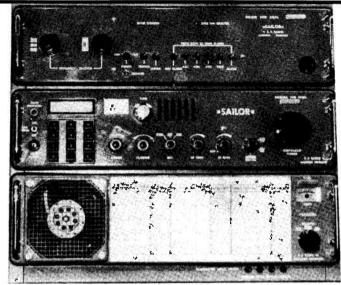
#### On The Rebound

As far as hitting other vessels at sea goes, radar is the most effective safeguard available, even for the smallest craft. Radar not only enables you to see other vessels, but can also be used as a navigational aid because coastlines are also visible on it. Most radar sets consist of two main units — a console containing the display circuitry and controls, and a transceiver/scanner unit containing the RF electronics and the rotary antenna. Efficient radar does depend largely upon the height of elevation of the antenna since radar waves are transmitted on a line-of-sight principle. In bad weather this can mean that high waves will deflect the radar signal from a small boat making readings inaccurate. A small boat can also be easily mistaken for a wave by a radar operator on a large vessel, and this point brings us neatly to an associated safety device which is used with radar.

A small boat, particularly if it is built of fibreglass or wood, does not reflect radar waves as well as a large vessel or one made of steel or aluminium, which leaves it little hope of being spotted on radar. Luckily there is a device which greatly improves the visibility of a small boat and can be easily fitted.



Above: another depth recorder.
Right: small radar screen.



Above and left: Two reasons for choosing a small VHF radio telephone. These HF units are fairly bulky and would only suit large craft travelling far out to sea.

The metal radar reflector is masthead mounted and its shape and material make it an effective reflector of radar beams, giving a clear indication of the presence of a small boat on a radar monitor. These do have to be carefully fitted or they can be practically useless.

## Steering A Straight Course Electronics can also be used for steering your course once

Electronics can also be used for steering your course once it is chosen. An 'autopilot' can be used for either power boats or sailing boats. Basically an autopilot is a straightforward servomechanism; the actual heading is compared to the desired course and the error signal is used to drive a servomotor, thus correcting the rudder. A disadvantage with this system is that the swell of waves can affect the autopilot and cause it to continually try to correct the movements of the rudder, however insignificant they may be, so many autopilots have a built-in override mechanism which can be adjusted to compensate for varying sea conditions.

On a sailing boat, steering is far more dependent on wind direction, so an autopilot of the type used in power boats would be next to useless; it would keep a heading regardless of wind change leaving the sails set wrongly, which, at best, would cause the boat to lose speed and at worst could put it into a dangerous situation. So most sailboat autopilots keep the boat on the right heading relative to the wind; these units offer a choice of compass or wind vane to generate the control signal.

#### Come In Number 44

Even boats equipped with all of the safety features so far mentioned can find themselves running into trouble and in need of communication with rescue services. Or maybe you want to contact someone you wish to speak to (you're half-way across the North Sea when you realise that it's Aunt Maud's birthday and you forgot to send a card...).

British Telecom International, the new telecommunications branch of the Post Office, now operates 12 coastal radio stations in Britain; 11 of these are for medium/short range use, one is for long range. In addition, there is a continually growing network of remotely controlled VHF stations. The coastal stations will deal with any type of message, from ship-to-shore social calls to distress signals — the latter naturally receiving priority at all times — and also broadcast routine weather reports, gale warnings and details of navigational hazards.

## **FEATURE: Electronics In Boats**

handset and a small helical aerial. In an emergency the set can be removed from its installation and used as a walkie-talkie; an obvious advantage if your cockpit is on fire, you've lost your mast and the main aerial with it, or you're sitting in a small rubber dinghy about 20 fathoms above the remains of your yacht! However, in this mode your range will be reduced still further, especially at sea level.



Left: This VHF radio telephone features more facilities than the basic models but is still quite compact.

#### The Art of RT

The VHF radio telephone solves many of the problems that prevent small boat owners from fitting HF equipment and as such is an invaluable aid to safety for pleasure boats. HF radios are generally large and draw a lot of power, sometimes necessitating extra batteries. They are more complex, more prone to interference, more expensive and more difficult to install (aerials are generally loaded whips which require a ground plane). A typical VHF unit, though, is only slightly bigger than a car radio/cassette player and is just as easy to install. Mounting brackets for vertical or horizontal fitting are usually provided, and some types have a mounting flange that allows flush installation in a bulkhead, car dashboard style. After that you simply fit a mast-top aerial, plug into the boat's 12 V supply and you're ready to go.

Models generally offer similar facilities and these are limited to the essentials — on/off switch, volume, squelch and channel selector switch. The VHF frequencies allocated are from 156 MHz to 162 MHz and generally the transceivers will have a selection of a dozen channels in this range. Some models use a frequency synthesiser, so you can only transmit on the frequencies pre-selected by the manufacturer. Others have individual crystals fitted for each channel, and by changing crystals you can pick any set of frequencies that are convenient. All radio telephones should be capable of transmitting on channel 16 — this is the VHF international distress frequency.

Output power ranges from about 10 W to 25 W and often a control is provided to reduce the power output when speaking to a station at close quarters. This may either be in the form of a high/low switch or a continuously variable pot, and prevents unnecessary interference to more distant users.

#### Simply Simplex

Although there are some duplex channels in the VHF band (ie you may transmit and receive simultaneously, as with a telephone), only simplex transceivers were in evidence at the Show. These require the use of a press-to-talk button on the microphone, a feature well-known to those "good buddies" who have the other sort of radio fitted in their cars!

The qualification "in-shore and coastal" is due to the one disadvantage of VHF compared to HF: lack of range. VHF frequencies are not subject to 'skip' via the ionosphere and while this provides immunity from unwanted signals, it does mean that only line-of-sight communication is possible. Even with a mast-top aerial, range is limited to about 20 nautical miles.

A few VHF radio telephones have an optional version which allows completely portable use: the set has a battery pack (rechargeable from the ship's 12 V supply), a telephone

## Hand-Held Help

For absolute assurance that an accident at sea will not be compounded by your inability to summon help, a portable distress radio telephone is essential. These units are complete, self-contained HF radio telephones, pre-tuned to one frequency only, the international maritime distress frequency (2182 kHz). Unlike the VHF band, this frequency is not subject to line-of-sight restrictions and is insensitive to aerial height. Typical 'worst-case' transmitting ranges exceed 40 miles; under favourable conditions this can be greatly extended.

A typical distress radio telephone is shock-resistant, water-proof and self-buoyant (radio overboard?!). The controls are kept to an absolute minimum and are designed to be easy to operate even with numbed fingers. Instructions are clearly and concisely printed on the case for the benefit of untrained people. To use the unit, the earth-wire with its lead sinker is thrown into the sea, the telescopic aerial extended fully, and the alarm button pressed for abut 20-30 S. This causes a two-tone signal to be transmitted which overrides all other traffic on the 2182 kHz frequency and automatically activates the watch-keeping receivers used by coastguards, rescue services, merchant ships and trawlers. Once you've attracted everyone's attention you can make speech contact with your rescuers.

These units may also be used for 'urgency' calls (without using the alarm button), for direct contact with coastguards and commercial ships in order to obtain medical, meteorological or navigational advice, or to report any less serious damage to your vessel such as engine failure.

It should be pointed out that, especially in the case of VHF sets, there is little point in fitting a radio telephone unless everyone who is aboard the boat has been told where the set is and how to use it. Help is going to be a long time coming if the only man who can use the radio is the one who has just suffered a heart attack, or food poisoning, or been washed irretrievably overboard. For similar reasons, try to get a VHF set with duplex operation. Then anyone unfamiliar with radio procedure is unable to cause, at least, confusion and at worst, fatal delay, by forgetting to press the push-to-talk button.

#### **Be Prepared**

So that more or less sums up the wide range of electronic gadgets you will need for your boat, whatever size it may be. Of course, there are still many developments being made in nautical electronics because, unfortunately accidents do still happen. One thing visiting the Boat Show can teach you is how important having the right equipment is, and, if you visit next year's Show you too may become hooked on boats for life! **FT** 

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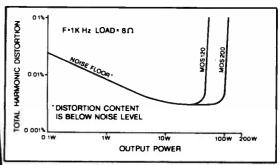
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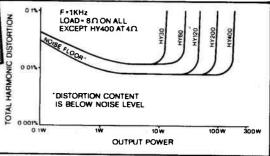
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HY200	120W into 4-8Ω	0.01%	15 <b>V</b> /μ <b>s</b>	5µs	100dB	£21.21 +£3,18
HY400	240W into $4\Omega$	0.01%	15V/μs	5µs	100dB	£31.83 + £4.77



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Load impedance both models Input impedance both models 100KΩ Frequency response both models
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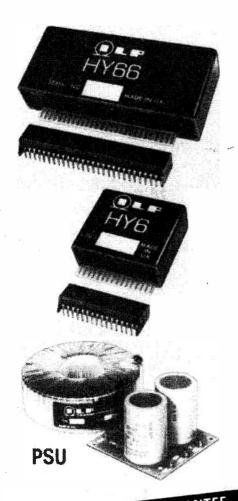
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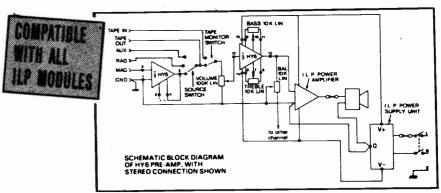
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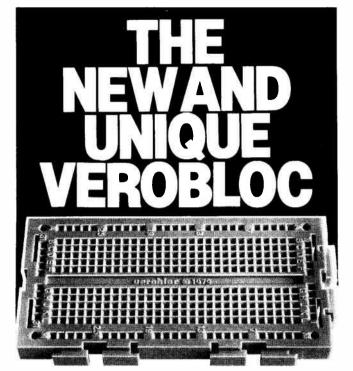
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2N914 17p	0.BA/100V	37p		. 1	[	1	270B	610p
2N221B/9 23p	1.6A/400V	39p		,	1	, ,	2716	840p
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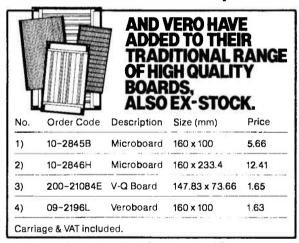


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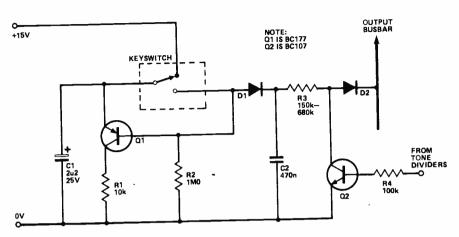


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## **TECH TIPS**



### Touch-Sensitive Piano Keying

J. Cozens, York

The circuit is operated by a single-pole change-over key switch. When the key is in the fully released position C1 is held charged from the 15 V rail. Q1 is turned

on by the bias current supplied by R2. When the key is depressed C1 is disconnected from the 15 V rail and starts to discharge through Q1 and R1. When the

key is fully depressed Q1 is turned off and the remaining voltage on C1 then charges up C2 via D1. Both capacitors then discharge via R3. The envelope produced by this decaying voltage is chopped by Q2, driven directly from the tone dividers. Upon the release of the key, C1 is disconnected from the chopper circuit and C2 discharges rapidly via R3, simulating the action of the dampers. D1 is included to prevent C2 discharging through R2 when the key is released and D2 prevents interaction with other keying circuits.

As the voltage remaining on C1 at the completion of a keystroke depends on the key velocity, a degree of touchsensitivity is obtained with this circuit.

## Tuning Fork Mods.

M.L. Duncan, Greenford.

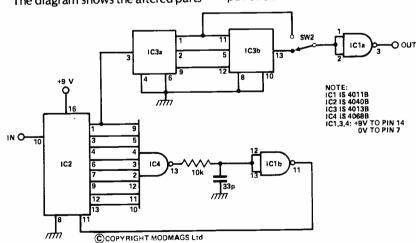
With a few slight modifications to the ETI Tuning Fork it is possible to use the very cheap and plentiful TV colour crystal tuned to 4.43361875 MHz.

The oscillator circuit output is divided by 2519 giving a frequency of 1760 accurate to one part in 250,000. The division is done by a 4040 in place of the 4020 and the switching giving an alternate 'A' at 445 Hz is eliminated.

A 4013 dual flip-flop is added before the output buffer to give further division by two and four. These outputs are switched before the buffer to give a choice of 'A's at 880 and 440 Hz respectively. The extra cost of the 4013 is offset by eliminating one of the 4011s.

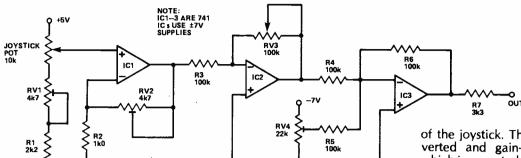
The diagram shows the altered parts

of the circuit. The oscillator is retained, using the changed crystal, as is the output circuit from R4 onwards.



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

ETI is prepared to consider circuits or ideas submitted by readers for this page. All items used will be paid for. Drawings should be as clear as possible and the text should preferably be typed. Circuits must not be subject to copyright. Items for consideration should be sent to ETI TECH-TIPS, Electronics Today International, 145 Charing Cross Road, London WC2H OEE.



#### **Joystick Control**

M. Swale, Cardiff

having recently built the ETI 4600 synthesiser, I found, to my dismay, that most joystick pots only vary by about 30° at maximum deflection. Consequently, the original circuit for the joystick control, which assumes complete rotation of the joystick pot, will not give the required

5 V swing. The circuit attached will convert a small DC voltage change provided by the joystick into 0-5 V at the output.

Circuit function and setting up is as follows:- RV1 is adjusted so that there is 0 V at the joystick pot wiper. (Note that RV1 and R1 may need to be on the + 5 V side of the joystick pot, depending on the actual pots used in the joystick).

RV2 is then adjusted to give  $\pm 2V5$  swing at IC1 output with full deflection

of the joystick. This voltage is then inverted and gain-controlled by RV3, which is mounted on the joystick plate. IC3 re-inverts IC2's output and RV4 is adjusted to add 2V5 to the output of IC3. The output then becomes a 0-5 V swing, with 2V5 at the centre point.

This control voltage swing is ideal for use in the 4600 synthesiser since 2V5 into the keyboard modulation input gives no variation in pitch, ie the keyboard pitch can be shifted up and down by an amount dependent on RV3. The power for the circuit can be taken directly from the 4600 PSU.

#### Improved Speaker Overload Indicator

J. Harrold, Bristol

This circuit is based on a design by J. P. Macaulay, which appeared in Electronics Digest Vol. 1. This one offers an improvement in performance, which is low cost and does not introduce an external DC power supply.

Peaks in music can be very short and may be too fast (or dim) to be seen clearly on a LED if held for their duration only. This circuit uses a monostable to hold a LED on for a set time after triggering by a peak in music.

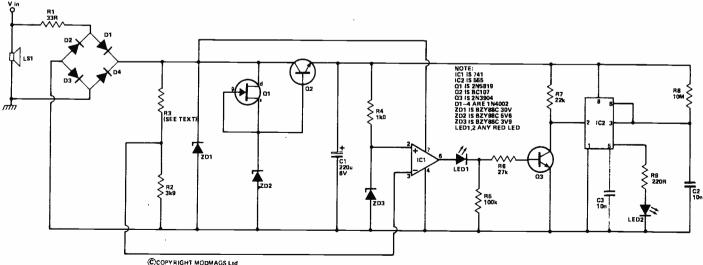
The voltage at the speaker output terminals is rectified and then passed to

potential divider R2, R3, ZD1 provides 'last ditch' protection for Q1 and IC1 (this method is not suitable if indication of overloads of greater than 50 W is required). Q1 is used as a voltage variable resistor and with ZD2, series pass transistor Q2 and C1, provides a regulated supply. This supply improves the stability of the 3V9 reference potential at the inverting input of IC1 and also provides a stable supply for IC2 and its timing components R8, C2. C1 cannot be placed between 0 V and the collector of Q2 as this would have an adverse filtering effect on high frequency signals. When the voltage across R2 is less than 3V9, the output from comparator IC1 is low (~1V5) and this voltage is dropped across forward biased red LED 1 (or alternatively any three silicon diodes in

series). Q3 is off and the trigger (pin 2) of IC2 is high. When the voltage across R2 exceeds 3V9, IC1 output goes high and Q3 is turned on, lowering the voltage at IC2 pin 2, triggering the monostable and lighting LED 2 for a period dependent on R8, C2 (about 100 mS with given values). C2 must be a low leakage type (not ceramic). Decoupling of the control voltage (pin 5) by C3 was not necessary in the prototype. R1 protects the amplifier from possible bridge failure. Q1 may be replaced by a fixed resistor appropriate to the input voltage with slight degradation of performance. The value of R3 is given by:

$$R3 = (\sqrt{2PR} - 3.9)$$
 kilohms,

where P is the power output and R is the speaker impedance.



## 'Zener-less' Battery Eliminator

P.J. Hunt, Wimborne

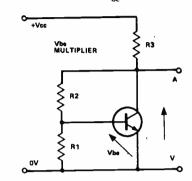
Designed as a variable-voltage battery eliminator, this circuit provides a stabilised output without Zener diodes as the reference source. Instead, a V<sub>be</sub>-multiplier is employed, so that the output voltage may be continuously varied by PR1 over the range 6-10 V.

The V<sub>be</sub>-multiplier is shown schematically in the inset. Provided that V<sub>cc</sub> is high enough, the potential across R1 will be about 600 mV for a silicon transistor. The current through R1 can thus be adjusted so that the base current of the transistor may be ignored for practical-purposes. In this case, the current through R1 will equal the current

through R2. The potential at point A is thus given by:

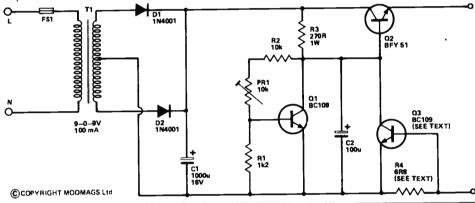
$$V = V_{be} x (R1 + R2)$$
R1

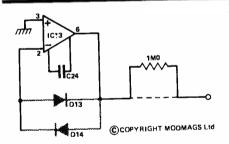
— hence the name  $V_{be}$ -multiplier.



R3 limits the current through the parallel combination of the transistor and R1/R2. Suppose as an example that  $V_{cc}$  tries to rise. The potential divider formed by the three resistors will try to raise the voltage across R1. This will tend to increase the collector current and thus increase the potential drop across R3, leading to a stabilising effect at point A. This is a case of voltage-derived series feedback.

In the practical circuit, R3 also provides base current for the series transistor Q2. Q3 and R4 form a current limiter. If the output current exceeds approximately 100 mA, Q3 starts to turn on, reducing the output voltage. If desired, Q3 and R4 may be omitted, in which case R3 may be de-rated to ½ W. The whole unit fits easily inside a PP9 battery case.



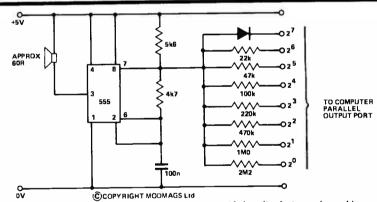


# Transcendent Pulse Wave Improvement

J.F. Jordan, Cambridge

The pulse wave on the original Transcendent 2000 suffers from a slow falling edge, making LFO modulation of pulse width less effective for chorus sounds and removing the characteristic hollow tone of the square wave.

This problem can be solved by removing D13 and D14 and inserting a 1M0 resistor across a break in the track from the output of IC13 to SW4. The comparator then operates in open loop mode giving much improved waveform edges.



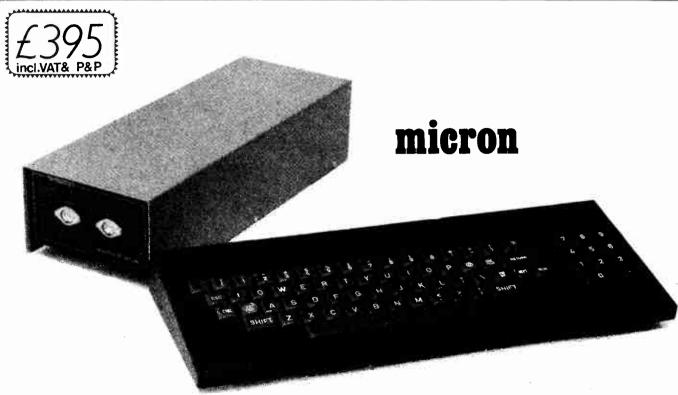
## **Cheap Micro Music Box**

T.M. Tobin, Birmingham

This circuit may be connected to the output port of any micro to generate musical notes over a range of about 1½ octaves. On/off control is provided by the most significant bit and the resistors provide seven bit resolution. Alternative on/off control methods can be used to give eight bit resolution, eg by using the handshake lines, if available.

If the diode is replaced by a resistor, say 10k, it will be found that below a certain output value the voltage at pin 7 is insufficient to charge the capacitor. Thus the sound can be switched off.

The resolution is sufficient to enable values to be found corresponding to tones and semitones throughout the frequency range. Current consumption depends largely on the loudspeaker impedance and is generally low enough for power to be taken directly from the computer. Most constructors will have all the parts required which in any case will cost less than £1.



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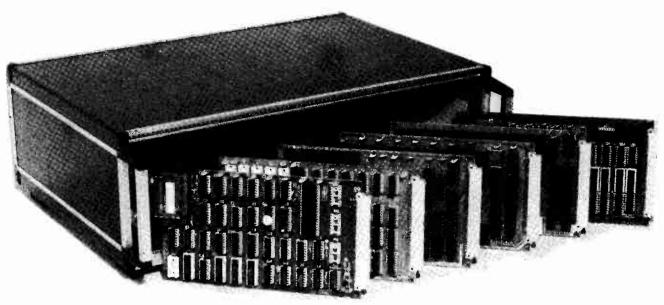
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- BASIC CAN CALL MACHINE CODE SUB-ROUTINE.
- USER MACHINE CODE INTERRUPT HAND-LER INTERFACES WITH BASIC.
- XBUG.
- DATA CASSETTE FILE HANDLING IN BASIC

## microtan 65



The Microtan system is rapidly becoming accepted as the ultimate approach to personal computing. Start with Microtan 65, a 6502 based single board computer, and expand to a powerful system in simple and in-expensive stages. The Microtan system is a concept and not an afterthought, this means expansion is easy and very efficient! Unlike many other systems, you'll find it difficult to outgrow Microtan, and you won't be wasting your money on a product that will only last you a few months! When you are ready to expand, Tanex is waiting. The features offered by Tanex are tremendous, and you can start into them for just £49.45! Cassette interface, 16 I/O lines, two 16 bit counter timers, data bus buffering, memory mapping and a further 1K of RAM are standard. From thereon expansion is simple, just plug in extra integrated circuits to get yourself 8K of RAM, a further 16 I/O lines and two more counter timers a serial I/O line with RS232/20mA loop and full modem control, XBUG - a firmware package containing cassette file handling routines, plus a line-by-line assembler (translator) and dis-assembler, PLUS 10K EXTENDED MICROSOFT BASIC, a suped-up version of the Basic as used by major manufacturers such as Apple, Tandy and Nascom, NO OTHER LOW COST MICROCOMPUTER OFFERS YOU THIS SUPERB PACKAGE. O.K. so you want more memory, try Tanram for size! Upto 40K bytes on one board starting for as little as £50.60. RAM freaks will be pleased to hear that our system mother board offers page memory logic which will support 277K Bytes, satisfied? To house these beautiful modules you can choose between our mini-rack (as used on Micron), which accepts Microtan and Tanex, or our system rack pictured above. The system rack will support 12 modules. What are these extra modules? Well for starters there's a couple of I/O modules, parallel and serial offering upto 128 I/O lines organised as 16 8 bit ports and 8 serial I/O ports respectively. Shortly we'll be introducing high definition (256x256) colour graphics, A to D and D to A modules, IEEE 488 Bus interface, a PROM programmer, disc controller and TANDOS - a 6502 CPM system. So there's plenty to keep you busy. Send for more details, and find out how you can get started ALL PRICES QUOTED INCLUDE V.A.T. for just £79.35!

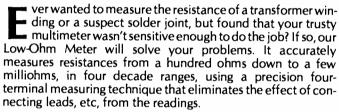
## AIM 65, KIM 1, SIM 1 USERS- READ ON!

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D1		44.	:	noguinad
Please	underline	tne	information	requirea.
AIM T.	V. INTERFA	CE.	MICROTAN	I SYSTEM.
NAME:				
ADDRESS	S:			
PLEASE	ENCLOSE 1	2p S	TAMP. THANK	YOU.

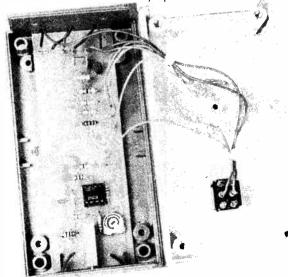
# LOW-OHM METER

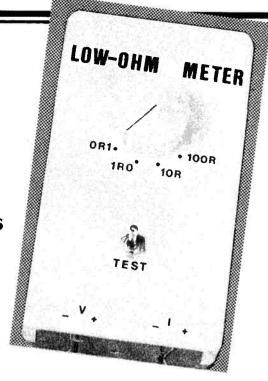
Measure resistances from a hundred ohms down to a few milliohms with this accurate four-range meter. It can be built as a self-contained unit or as an adaptor for use with an existing multimeter. Design and development by Ray Marston.



Our Low-Ohm Meter contains two fully independent (and independently powered) circuits, these being a multi-range constant-current generator and a DC millivoltmeter with a full-scale sensitivity of 10 mV. The generator is used to apply a fixed test current to the resistor that is being measured, and the voltmeter is used to measure the resultant voltage that is developed directly across the resistor, indicating the true value of the resistor and ignoring the effects of the test leads. This four terminal measurement technique is widely used in precision calibration laboratories.

The Low-Ohm Meter indicates 100 milliohms (0R1) on its most sensitive range, using a test current of 100 mA. Supply battery B1 must be capable of supplying this current without excessive voltage drop; a PP9 type is recommended. The unit consumes power only when TEST switch SW1 is closed. SW1 is a biased switch and is normally open.





## Construction

The Low-Ohm Meter can be built as either a self-contained unit, with built-in supply batteries and moving coil meter, or as an adaptor unit for use with an existing multimeter. In this latter instance, use a meter set to its 1 V DC range.

Start the construction by assembling the components on the PCB, as shown on the overlay. If your meter or multimeter has a sensitivity of 100 uA (10k/V) or better, give R9 a value of 10k. If the sensitivity is 1 mA (1k0/V) or better, reduce the R9 value to twice the ohms-per-volt value of the meter.

When assembling the components, note that PR2 is a multi-turn 3/4 inch cermet trimmer and that its adjuster spindle overhangs the edge of the PCB; we'll refer to this end of the PCB as the 'front'. Solder four flexible leads to the indicated points at the front of the PCB. Solder Veropins to the other terminal points. Now test-fit the PCB in your chosen case. Drill a small hole in the front of the case, in line with PR2, to accept PR2's spindle and facilitate external 'set zero' adjustments. Drill two additional holes in the case front, to allow passage of the two pairs of 'I' and 'V' leads. You might consider taking the 'I' leads to a pair of quick-connection terminals (push-button loudspeaker type), for easy insertion of the resistor under test. Now drill the top of the case to accept SW1 and SW2 and fit these components into place. Finally, fix the PCB into the case and complete the interwiring to the switches.

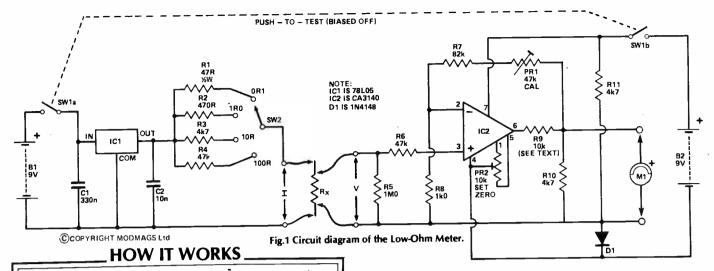
## **Test And Use**

When construction is complete, connect the two 9 V batteries to the unit, noting that B1 must be capable of supplying 100 mA, and connect the 'M' terminals to a 1 V DC meter or multimeter. Now short the two 'V' terminals together, close the test switch, and adjust PR2 to obtain a zero reading on the meter.

Next, turn SW1 to the 100R range and connect a 100R resistor (5% or better) accross the '1' terminals. Now connect the 'V' terminals across the test resistor (on the resistor side of the '1' leads), with like polarities to like (+ to +, etc), close the test switch, and adjust PR1 to obtain a full scale reading on the meter. The unit is now calibrated and ready for use.

The PCB is mounted so that the cermet preset can be adjusted through a hole in the case.

đΩ



The constant generator circuit is very simple. IC1 is a 5 V regulator and the output test current (I) is determined by resistor R1 to R4. On each range, the value of the test resistor (Rx) is very low relative to the current-limiting resistor, and the full scale test voltage (10 mV) is very small relative to the 5 volts of the regulator. Consequently, on each range, the test current is virtually independent of the effects of lead resistances, etc: on the most sensitive (100 milliohms) range (I = 100 mA), one ohm of lead resistance will introduce a maximum full-scale error of 2%. A similar lead resistance will introduce an error of only 002% on the 100R (I = 100 uA) range. In practice, therefore, the reading errors are primarily determined by the accuracies of R1 to R4.

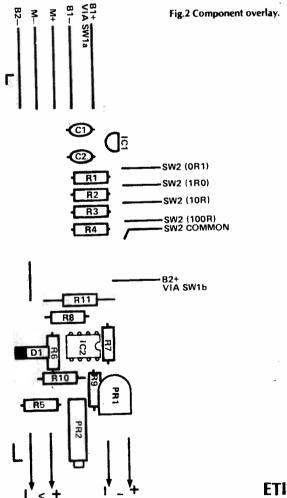
reading errors are primarily determined by the accuracies of R1 to R4. The DC millivoltmeter (designed around IC2) is a fairly conventional design. It is based on a CA3140 op-amp, which can respond to DC inputs down to zero volts. To enable the output to go slightly negative (for zero-setting purposes), a -600 mV supply rail is generated by R11 and D1. Resistor R9 is used to limit the maximum voltage to the meter to about 2 V, to eliminate the possibility of meter damage if the unit is incorrectly ranged. The sensitivity of the meter is variable over a limited range by PR1, for calibration purposes (to compensate for test-current errors).

When using the unit, note that the 'l' terminals supply a test current to the resistor being measured, and that the 'V' terminals indicate the voltage developed directly across the resistor. The 'V' terminals must therefore always be connected to the resistor 'inside' the 'l' leads, as indicated by the circuit diagram. When using the meter on its most sensitive (0R1) range, the 'l' leads should be kept as short as possible: on this range, 1R0 of lead resistance will introduce a maximum reading error of 2% on a 100 milliohm test resistance.

	PARTS LIST
Resistors (1/4 W 5%.	unless otherwise stated)
R1	47R 1/2 W
R2	470R
R3, 10, 11	4k7
R4.6	47k
R5	1M0
R7	82k
R8	1k0
R9	10k
Potentiometers	
PR1	47k miniature horizontal preset
PR2	10k ¼ inch cermet multiturn preset
Capacitors	
Capacitors C1	330n polycarbonate .
C2	10n polycarbonate
	ion por cursonate
Semiconductors	701.05
IC1	78L05 CA3140
IC2	1N4148
D1	1144140
Miscellaneous	At 1 A 2 - A blaced to cal- (normally
SW1	Miniature 2-pole biased toggle (normally
	off)
SW2	1-pole 4-way rotary switch
M1	Moving coil meter, 1 V FSD, sensitivity
6	
Case, quick-connec	tion terminals.

BUYLINES

Absolutely no problems here: all components are readily available



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TRANSIST BC107	TORS 100	BC237	12p	BF194	12p	BF595	30p	2N3055	45p
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BC109	10p	BC547	100	BF197	140	BFY90	50p	2N3702	10p
BC1258	80	BD238	40p	BF245	30p	8UW81A	200p	2N3705	10p
BC149	100	80239	40p	BF256A	40p	MJE340AT	50p	2N371D	10p
BC154	12p	BD371A	30p	BF324	30p	MPF131	25p	2N4061	15p
BC159	9p	BDX94	65p	BF469	65p	MPF132	25p	2N4123	10p
8C171	10p	B0Y92	120p	BF495	20p	MPU131	25p	2N4125	12p
LIMEAR IC	s								
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CA3080	50p	MC1350	90p	TBA120S	60p	TOATOTO	150p	SPECIAL C	HFER
LM324	60a	MC1558	100p	TBA651	100p	TDA1170	750	AY-5-350	
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MC1307	75p	SAS580	100p	T8A920	150p	TDA2560	150p	' "	
WC1310	100p	SAS590	100p	TCA270S	90p	TDA2581	175p		
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It's a long time since one of our adverts was presented in 'list' form - but simply because we do not try to squeeze this lot in every time doesn't mean that it's not available. Our new style price list (now some 40 pages long) includes all this and more, including quantity prices and a brief description. The kits, modules and specialized RF components - such as TOKO coils, filters etc. are covered in the general price list so send now for a free copy (with an SAE please). Part 4 of the catalogue is due out now (incorporating a revised version of pt.1). TRANSISTORS CAPACITORS VARICAP

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U257B 1.28	KB4423 2.30	74LS01 0.20	7448N 0-56	7412IN 0.42	74LS175 1.10 74176N 0.75	BB204B 0.36 BB105B 0.36	BC308 0.08	22P,27P,33P,47P 56P,68P,82P,100P.0.05
U267B 1.28	KB4424 1.65	7402N 0.14 74LS02 0.20	74LS48 0.99 74LS49 0.99	74122N 0.46 74123N 0.73	74177N 0.78	BB109 0.27	BC309 0.0B	150P,226P,270P
LM301H 0.67 LM301N 0.30	KB4431 1.95 KB4432 1.95	74LS02 0.20 7403N 0.14	7451N 0.17	74LS124 1.75	74181N 1.65	MVM125 1.05	BC413 0.10 BC414 0.11	330P,390P,470P0.055
LM301N 0.30	KB4432 1.95 KB4433 1.52	74LS03 0.20	74LS51 0.24	74125N 0.38	74LS181 3.50	BB212 1.95 KV1210 2.45	BC415 0.07	1NU, 2N2, 3N3, 4N70.06
IM308N 0.65	KB4436 2.53	7404N 0.14	7453N 0-17 7454N 0-17	74LS125 0.44 74126N 0.57	74LS183 2.10 74184N 1.35	KV1210 2.43 KV1211 1.75	BC416 0.08	10N (0.01uF)0.05 22N,47N0.06
LM339N 0.66	KB4437 1.75	74LS04 0.24 7405N 0.18	7454N 0.17 74LS54 0.24	74LS126 0.44	74185N 1.34	KV1226 1.95	BC546 0.12	100N,220N0.09
LM348N 1.86 LF351N 0.38	KB4438 2.22 KB4441 1.35	74LS05 0.26	74LS55' 0.24	74128N 0.74	74LS190 0.92	KV1225 2.75	BC556 0.12 BC550 0.12	MONOLITHIC CERAMIC
LF353N 0.76	KB4445 1.29	7406N 0.28	7460N 0.17	74132N 0.73 74LS132 0.78	74192N 1.05 74LS192 1.80	KV1215 2.55 KV1225 2.75	BC560 0.12	10N,100N0.16
LM374N 3.75	KB4446 2.75	7407N 0.38	74LS63 1.24 7470N 0.28	74LS132 0.76	74193N 1.05	SWITCHING AND	BC639 0.22	FEEDTHRU
IM380N-14 1.00	KB4448 1.65	7408N 0.17 74LS08 0.24	7472N U-28	74LS138 0.60	74LS193 1.80	PIN DIODES	BC640 0.23	INU SOLDER IN0.09
LM380N-8 1.00 LM381N 1.81	NE5044N 2.26 NE5532N 1.85	7409N 0-17	7473N 0.32	74141N 0.56	74194N 1.05	SHOTTKY DIODES	2SC1775 0.18 2SA872A 0.14	POLYESTER (SIEMENS)
ZN419CE 1.95	SD6000 3.75	74LS09 0.24	74LS73 0.38 7474N 0.27	74142N 2.65 74143N 3.12	74196N 0.99 74LS196 1.10	1N6263 0.62	2SD666A 0.30	10mm LEAD SPACING 10N,22N,33N0.17
NE544N 1.80	SL6270 2.03	7410N 0.15 74LS10 0.24	74LS74 0.28	74144N 3.12	74LS197 1.10	BA182 0.19 BA244 0.17	2SB646A 0.30	47N,68N,100N0.19
NE555N 0.30 NE556N 0.50	SL6310 2.03 SL6600 3.75	7411N 0.20	7475N 0.38	74LS145 0.97	74198N 1.50	BA379 0.35	2SD668A 0.40	220N,470N0.22
NE560N 3.50	SL6640 2.75	74LS11 0.24	7476N 0.37	74147N 1.75	74199N 1.60 74LS247 0.93	TDA1061 0.95	2SB648A 0.40 2SD760 0.45	luF0.29
NE562N 4.05	SL6690 3.20	7412N 0.17 7413N 0.30	74LS76 0.38 74LS78 0.38	74148N 1.09 74LS148 1.19	74LS257 1.08	SIGNAL DIODES	2SB720 0.45	POLYESTER (GENERAL)
NE564N 4.29	SL6700 2.35	7414N 0.51	7480N 0.48	7415146 1.19 74150N 0.99	74LS260 1.53	& RECTIFIERS	2SC2546 0.19	10mm LEAD SPACING
NE565N 1.00 NE566N 1.60	ICL8038CC 4.50 MSL9362 1.75	74LS15- 0.24	7481N 0.86	74151N 0.55	74LS279 0.52	1N4148 0.06 1N4001 0.06	2SA1084 0.20 2SC2547 0.19	10N,15N,22N,33N0.06 47N,68N,100N0.08
NE570N 3.85	MSL9363 1.75	7416N 0-30	7482N 0.69	74LS151 0.84	74LS283 1.20 74LS293 0.95	1N4001 0.06 1N4002 0.07	2SC2547 0.19 2SA1085 0.20	220N0.11
SL624 3-28	HA11211 1.95	7417N 0.30 7420N 0.16	7485N 1.04 74LS85 0.99	74153N 0.64 74LS153 0.54	74LS365 0.49	IN5402 0.15	AUDIO POWER	20mm LEAD SPACING
TBA651 1.81 UA709HC 0.64	HA11223 2.15 HA11225 1.45	74LS20 0.24	74LS86 0.40	74154N 0.96	74LS366 0.49	OA91 0.07	DEVICES	220N,330N,470N0.18
uA709PC 0.36	HA11225 1.45 HA12002 1.45	7421N 0.29	7489N 2.05	74155N 0.54	741.5367 0.43	AA112 0.25 BRIDGES:	2SB753 2.34	MYLAR Seen LEAD SDACING
uA710HC 0.65	HA12017 0.80	74LS21 0.24 7423N 0.27	7490N 0.33 74LS90 0.90	74LS155 1.10	74LS368 0.49 74LS374 1.80	1A/50V 0.35	2SB723 2.34	5mm LEAD SPACING 1NO,10N,22N,33N0.08
uA710PC 0.59 uA741CH 0.66	HA12402 1.95	7423N 0.27 7425N 0.27	7491N 0.76	74156N 0.80 74157N 0.67	74LS377 1.95	6A/200V 0.75	25K133 3.00 2SJ 48 3.00	100N
uA741CH 0.66 uA741CN 0.27	HA12411 1.20 HA12412 1.55	7427N 0.27	74LS91 1.10	74LS157 0.55	74LS379 1.30		2SK134 3.10	20mm LEAD SPACING
uA747CN 0₊70	LF13741 0.33	74LS27 0.44	7492N 0.38	74LS158 0.60	74LS393 1.40		2SK135 3.75	220N, 470N 0.17
uA748CN 0.36	SN76660N 0.80	7428N 0.35 74L528 0.32	74LS92 0.78 7493N 0.32	74159N 2.10 74160N 0.82	1 7000 0000 0	AND ELL TERE I	2SJ 50 3.75 BD535 0.52	POLYSTYRENE
uA753 2•44 uA758 2•35	FREQUENCY DISPLA		74LS93 0.99	74LS160 1.30	TOKO COILS A	INSIVE SECTION	BD536 0.52	10P,15P,18P,22P, 27P,47P,56P,68P0.08
TBA810AS 1.09	& SYNTHESISER ICS	74LS30 0.24	7494N 0.78	74161N 0.92	IN OUR NEW P	RICE LISTS AND	BD377 0.33	100P,180P,220P,
TBA820M 0.75		7432N 0.25	7495N 0.65 74LS95 1.14	74LS161 0.78	CATALOGUE	- 14/01/07/07/0	BD378 0.33 BD165 0.30	270P,330P,390P0.09
TCA940E 1.80	SAA1056 3.75 SAA1058 3.35	74LS32 0.24 7437N 0.40	741595 1.14 7496N 0.58	74LS162 1.30 74163N 0.92		DINDUCTORS	BD165 0.30 BD166 0.31	470P,680P,820P0-10
TDA1028 2.11 TDA1029 2.11	SAA1058 3.35 SAA1059 3.35	7438N 0.33	74LS96 1.20	74LS163 0.78	-FULL E12	NANGE luH-lmH 0.16	SMALL SIGNAL	1N0,1N2,1N5,1N80.11 2N2,2N7,3N3,3N90.12
TDA1054 1.45	11C90DC 14.00	74LS38 0.24	7497N 1.85	74164N 1.04	8RB series	201 2001 0020	RF DEVICES	4N7,5N6,6N8,10N0.13
TDA1062 1.95	LN1232 19.00	7440N 0-17	74LS107 0-38	74LS164 1.30		0.19		
TDA1072 2.69			74109N U-63	74165N 1 05	100uH-33mH		BF194 0.18	TANTALUM BEAD CAPS
		74LS40 0.24 7441N 0.74	74109N 0.63 74LS109 0.70	74165N 1.05 74LS165 1.04	10RB series	à	BF195 0.18	16v: 0.22,0.33,
TDA1074A 5.04 TDA1083 1.95	MSL2318 3.84 MSM5523 11.30	7441N 0.74 7442N 0.70	74LS109 0.70 74110N 0.54		10RB series 33mH-120mH	0.33	BF195 0.18 BF224 0.22	16v: 0.22,0.33, 0.68,1.00.18
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30	7441N 0.74	74LS109 0.70	74LS165 1.04	10RB series	0.33	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100.19
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85	7441N 0.74 7442N 0.70 74LS42 0.99	74LS109 0.70 74110N 0.54	74LS165 1.04 74167N 2.50	10RB series 33mH-120mH 10RBH series 120mH-1.5H	0.33 es 0.55	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21	16v: 0.22,0.33, 0.68,1.00.18
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30	7441N 0.74 7442N 0.70 74LS42 0.99	74LS109 0.70 74110N 0.54 74111N 0.68	74LS165 1.04 74167N 2.50	10RB series 33mH-120mH 10RBH series 120mH-1.5H	0.33 es 0.55	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF441 0.21	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0.19 6v3: 22,470.30 10v: 22,1000.35
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75	7441N 0.74 7442N 0.70 74LS42 0.99 4043 0.85 4044 0.80	74LS109 0.70 74110N 0.54	74LS165 1.04 74167N 2.50	10RB series 33mH-120mH 10RBH series 120mH-1.5H PIEZO SOUN	0.33 es 0.55 DER	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0-19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HAL137 1.20 HAL196 2.00 HAL197 1.00 TDA1220 1.40 LM1303 0.99	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM55271 9.75 ICM7106CP 9.55	7441N 0.74 7442N 0.70 74LS42 0.99 4343 0.85 4044 0.80 4046 1.30 4047 0.99	74LS109 0.70 74110N 0.54 74111N 0.68 VOLTAGE REGUL	74LS165 1.04 74167N 2.50 ATORS	10RB series 33mH-120mH 10RBH series 120mH-1.5H PIEZO SOUNI PB2720	0.33 es 0.55 DER 0.44	BF195 0.18 BF224 0.22 BF241 0.18 BE274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0.19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/voltage)
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HAL137 1.20 HAL197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55	7441N 0.74 7442N 0.70 74LS42 0.99 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4049 0.52	74LS109 0.70 74110N 0.54 74111N 0.68 VOLTAGE REGUL 78series 0.95 79series 1.00	74LS165 1.04 74167N 2.50 ATORS	10RB series 33mH-120mH 10RBH series 120mH-1.5H PIEZO SOUNI PB2720	0.33 DER 0.55 DER 0.44 LEDs 5MM RED 0.12	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF679S 0.55	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0-19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (uF/voltage) 1/63,2.2/50,4.7/35
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM55271 9.75 ICM7106CP 9.55	7441N 0.74 7442N 0.70 74LS42 0.99 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4049 0.52 4050 0.55	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65	74IS165 1.04 74167N 2.50 ATORS  CRYSTAL FI 10.7MH2 2	10RB series 33mH-120mH 10RBH series 120mH-1.5H PIEZO SOUNI PB2720	0.33  DER 0.55  DER 0.44  LEDs  5MM RED 0.12 3MM RED 0.12	BF195 0.18 BF224 0.22 BF241 0.18 BE274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0.19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/voltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10
TDA1074A 5.04 TDA1083 1.05 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 MSM55271 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85	7441N 0.77 7442N 0.70 741542 0.99 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4049 0.52 4050 0.55 4051 0.65	74LS109 0.70 74110N 0.54 74111N 0.68 VOLTAGE REGUL 78series 0.95 79series 1.00	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL FI 10.7847 2 10M15A 11 10.7847 8	10RB series 33mi-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LITER PRODUCTS FOLE TYPES: SKHZ BW 2.49 FOLE TYPES:	0.33  DER 0.55  DER 0.44  LEDs  5MM RED 0.12 3MM RED 0.15 3MM RED 0.15	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BFT95 0.99	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0.19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/voltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 HA1370 1.90	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM71216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00	744LN 0.77 7442N 0.70 74LS42 0.99 4043 0.80 4044 0.80 4046 1.30 4047 0.99 4049 0.55 4051 0.65 4052 0.65 4053 0.65	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.45 78Lseries 0.35 79L05 0.85 78KGT2C 1.75	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL FI 10.7MHz 2 10M15A 19 10.7MHz 8 10M81 151	10RB series 33mi-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  LITER PRODUCTS POLE TYPES: 56HZ BW 2.49 POLE TYPES: 6HZ BW 14.50	0.33 2S 0.55 DER 0.44  LEDs 5MM RED 0.12 3MM RED CLEAR 0.15 3MM RED 0.15 3MM RED 0.17	BF195 0.18 BF224 0.22 BF224 0.18 BF274 0.18 BF440 0.21 BF341 0.21 BF395 0.18 BF479 0.66 BF679S 0.55 BF891 1.33 BFW92 0.60 BFT95 0.99 BFY99 0.99	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100.19 6v3: 22,470.30 10v: 22,1000.35  ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (uF/voltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 2Z/16,33/10, 47/100.09
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HA1370 1.20 HA1370 1.20	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM72168 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 958190PC 6.00	744IN 0.774 7442N 0.70 74LS42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL 78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KGT2C 1.75 79KGT2C 1.75	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL F1 10.7MH12 6 10M45A 11 10,7MH2 6 10M451 15) H4402 7.1	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LITER PRODUCTS POLE TYPES: 612 BW 14.50 SKHZ BW 14.50 SKHZ BW 15.50	0.33  DES 0.55  DER 0.44  LEDs  5MM RED 0.12  3MM RED 0.15  3MM RED 0.15  2.5 X 5MM RED 0.17  5MM GREEN 0.15  3MM GREEN 0.15	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF341 0.21 BF395 0.18 BF479 0.66 BF6798 0.55 BF891 1.33 BFW92 0.60 BFT95 0.99 BFY90 0.90 40238 0.85 EPPOWER	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HA1388 2.75 TDA1490 1.25	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM55271 9.75 ICM7106CP 9.55 ICM7106CP 9.55 ICM7106CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD44015 4.45	744LN 0.774 7442N 0.70 74LS42 0.99 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4049 0.52 4050 0.55 4051 0.65 4053 0.65 4063 1.09 4066 0.56	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LO5 0.85 78KGT2C 1.75 79KGT2C 1.75 723CN 0.65	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL FI 10.7MHZ 2 10M15A 1: 10.7MHZ 6 10M481 15: H4402 7.: 10M2ZD 2.: HF EFIEST H	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  ILTER PRODUCTS FOLE TYPES: 64RZ BW 2.49 FOLE TYPES: 64RZ BW 14.50 SKHZ BW 15.50 KHZ BW 15.50 KHZ SB 17.20 FILTER:	0.33 ES 0.55 DER 0.44  LEDs 5MM RED 0.12 3MM RED 0.15 3MM RED 0.15 2.5 X 5MM RED 0.15 5MM GREEN 0.15 3MM GREEN 0.16 3MM GREEN 0.16	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF440 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF679S 0.55 BFW91 1.33 BFW92 0.60 BFT95 0.99 BFY90 0.90 BFY90 0.90 BFY90 0.90 BFY90 0.90 BFY90 0.90 BFY90 0.90 BFY90 0.90	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HA1370 1.20 HA1378 2.75 TDA1490 1.86 MC1496P 1.66	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 HDI0551 2.45 HD44015 4.45 HD12009 6.00	744IN 0.774 7442N 0.70 74LS42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL 78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79KGT2C 1.75 79KGT2C 1.75 723CN 0.65 L200 1.95 TDN1412 0.75	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHz 2 10M15A 11 10.7MHz 8 10M4B1 15 10M22D 2.4 H F FIRST 1 B34F8A 34	10RB series 33mi-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  ILTER PRODUCTS FOLE TYPES: SRHZ BW 2.49 PDLE TYPES: cHz BW 14.50 SKHZ BW 15.50 KKHZ SSB 17.20	0.33  DES 0.55  DER 0.44  LEDs 0.12  3MM RED 0.15  3MM RED 0.17  3MM CR CLEAR 0.16  3MM GREEN 0.16  3MM GREEN 0.16	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF340 0.21 BF395 0.18 BF479 0.66 BF6795 0.55 BFF91 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100.19 6v3: 22,470.30 10v: 22,1000.35 ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (uF/woltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 2Z/16,33/10, 47/100.09 10/63,22/50,33/50, 47/16,100/160.10 47/63,100/160.10 47/63,00/25,220/16
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1303 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1350 1.20 HA1370 1.90 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1611P 1.60	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM55271 9.75 ICM7106CP 9.55 ICM7106CP 9.55 ICM7106CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD44015 4.45	744IN 0.774 7442N 0.70 74LS42 0.99  4043 0.85 4044 0.80 4046 1.30 4047 0.99 4050 0.55 4051 0.65 4053 0.65 4053 0.65 4063 1.09 4066 0.56 4068 0.25 4069 0.25 4070 0.20	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KTT2C 1.75 79KTT2C 1.75 723CN 0.65 L200 1.95 TNA1412 0.75 NESS53N 1.25	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7941z 2 10M15A 1: 10.7941z 8 10M41z 8 10M41z 15 H4402 7: 10M2ZD 2.4 HF FIRST 1 B34F8A 34	10RB series 33m4-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  LITER PRODUCTS FOLE TYPES: SKHZ BW 2.49 FOLE TYPES: CHZ BW 14.50 SKHZ BW 14.50 SKHZ BW 15.50 SKHZ BW 15.50 FOLETTER: .5MHZ HA 500	0.33  DER 0.55  DER 0.44  LEDs  5MM RED 0.12  3MM RED 0.15  3MM RED 0.15  5MM RED 0.15  5MM RED 0.15  3MM RED 0.15  3MM RED 0.15  5MM RED 0.16  3MM CREEN 0.16  3MM CREEN 0.16  2.5 X 5MM RN 0.20  5MM YELLOW 0.12	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF440 0.21 BF440 0.21 BF395 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BFK91 1.33 BFW92 0.60 BF795 0.99 40238 0.85 RF POWER DEVICES VN66AF 0.95	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 HA1370 1.90 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1611P 1.60 SL1611P 1.60 SL1612P 1.60	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95190PC 6.00 HDJ4551 2.45 HDJ2009 6.00 HDJ4752 8.00	7441N 0.774 7442N 0.70 74LS42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LD5 0.85 78MST2C 1.75 723CN 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48	74LS165 1.04 74167N 2.50  ATORS  CRYSTAL F! 10.7MH2 2 10M15A 19 10.7MH2 8 10M8H1 15 H4402 7.1 10M22D 2.4 HF FIRST 1 B34F8A 34	10RB series 33m4-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  ILTER PRODUCTS FOLE TYPES: SKHZ BW 2.49 FOLE TYPES: KHZ BW 14.50 SKHZ BW 15.50 SKHZ BW 15.	0.33  DES 0.55  DER 0.44  LED5  SMM RED 0.15  SMM GREEN 0.15  SMM GREEN 0.16  SMM GREEN 0.16  SMM GREEN 0.16  SMM SELLON 0.16  SMM YELLON 0.16	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF341 0.21 BF395 0.18 BF479 0.66 BF6798 0.55 BF691 1.33 BF992 0.60 BF795 0.99 BF790 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2\38666 0.85 SMALL SIGNAL	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.90 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1350 1.20 SDA10490 1.25 SD	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 HDI0551 2.45 HD44015 4.45 HD12009 6.00	744IN 0.774 7442N 0.70 74LS42 0.99  4043 0.85 4044 0.80 4046 1.30 4047 0.99 4050 0.55 4051 0.65 4053 0.65 4053 0.65 4063 1.09 4066 0.56 4068 0.25 4069 0.25 4070 0.20	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78MST2C 1.75	74LS165 1.04 74167N 2.50  ATORS  CRYSTAL F1 10.7MH12 6 10M15A 11 10.7MH2 6 10M481 15) H4402 7.1 10M2ZD 2.4 HF FIRST 1 B34F8A 34  RADIO CONT	10RB series 33m4-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  LITER PRODUCTS FOLE TYPES: SKHZ BW 2.49 FOLE TYPES: CHZ BW 14.50 SKHZ BW 14.50 SKHZ BW 15.50 SKHZ BW 15.50 FOLETTER: .5MHZ HA 500	0.33 ES 0.55 DER 0.44  LEDs 0.42  SMM RED 0.15 SMM RED 0.16 SMM RED 0.10 SMM RED 0.15	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF679S 0.55 BFM91 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100.19 6v3: 22,470.30 10v: 22,1000.35  ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/Woltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 2/7/6,33/10, 47/100.09 10/63,22/50,33/50, 47/16,100/160.10 47/63,100/25,220/16 470/630.12 100/63,470/16, 1000/100.18 7 1000/16,470/630.23
TDA1074A 5.04 TDA1083 1.95 TDA1083 1.95 TDA1090 3.05 HAL117 1.20 HAL197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.90 MC1330 1.20 MC1350 1.20 MC1350 1.20 HAL388 2.75 TDA1490 1.86 MC1496P 1.25 SLI610P 1.60 SLI612P 1.60 SLI612P 1.69 SLI612P 1.89 SLI620P 2.17 SLI622P 2.17	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7106CP 9.55 ICM7107CP 9.55 ICM71216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD14015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17	7441N 0.774 7442N 0.707 74LS42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LD5 0.85 78MST2C 1.75 723CN 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48	74LS165 1.04 74167N 2.50  ATORS  CRYSTAL FI 10.7WHz 2 10M15A 1: 10.7WHZ 8 10M4B1 65 14402 7: 10M2D 2.4 HF FIRST 1 B34F8A 34  RADIO CONT (No splite AM TX:-	10RB series 33m4-120mH 10RRH serie 120mH-1.5H PIEZO SOUNI PB2720  LITER PRODUCTS FOLE TYPES: SRHZ BW 2.49 POLE TYPES: CHZ BW 14.50 SKHZ BW 14.50 SKHZ BW 15.50 KKHZ SSB 17.20 FILTER: 5.5MHZ HR 32.00  ROL CRYSTALS 5 available)	0.33  DES 0.55  DER 0.44  LEDs 0.12  3MM RED 0.15  3MM RED 0.15  3MM RED 0.15  3MM RED 0.15  3MM RED 0.17  3MM GR CLEAR 0.15  3MM GR CLEAR 0.16  2.5 X SMM GN 0.20  5MM YELLOW 0.15  3MM YELLOW 0.15  3MM YELLOW 0.16  3MM YELLOW 0.16  3MM YELLOW 0.16  3MM YELLOW 0.18	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF461 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE: BF256 0.38	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1350 1.20 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1611P 1.60 SL1611P 1.60 SL1612P 1.89 SL1620P 2.17 SL1621P 2.17 SL1621P 2.17 SL1623P 2.24 SL624C 3.28	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5525 7.85 MSH5526 7.85 MSH5527 9.75 ICM7107CP 9.55 ICM7107CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDI0551 2.45 HD4015 4.45 HD1209 6.00 HD44752 8.00  CMOS 4000 SERIES	7441N 0.74 7442N 0.70 74LS42 0.70 74LS42 0.99	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KST2C 1.75 79WST2C 1.75 79WST2C 1.75 72SCN 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48 LM337MP 1.48 MICROMARKET	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL F1 10.7MHz 8 10M15A 11 10.7MHz 8 10M451 15) 14402 7.1 10M22D 2.4 HF FIRST II B34F8A 34  RADIO CONT (No splits AM TX:- 3rd OT 30 AM/FM KX:	10RB series 33mi-120mH 10RRH serie 120mi-1.5H plezo SOUN pB2720  LITER PRODUCTS FOLE TYPES: 5KHZ BW 2.49 FOLE TYPES: 5KHZ BW 14.50 SKHZ BW 14.50 SKHZ BW 15.50 KHZ SBB 17.20 FILTER: 55Miz HT 32.00  FROL CRYSTALS 5 available) pF HC25U 1.65	0.33  ES 0.55  DER 0.44  LEDS  MM RED 0.15  3MM RED 0.16  2.5 X 5MM R. 0.20  5MM VELLOW 0.18  3MM VELLOW 0.18  2.5 X 5MM VE 0.20  5MM ORANGERED 0.20  5MM ORANGERED 0.20  5MM ORANGERED 0.20	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6795 0.55 BF191 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2N3866 0.85 SMALL SIGNAL F FET MOSFE BF256 0.38 2SK168 0.35	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100.19 6v3: 22,470.30 10v: 22,1000.35  ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/Voltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 2Z/16,33/10, 47/100.09 10/63,22/50,33/50, 47/16,100/160.10 47/63,100/25,220/16 470/630.12 100/63,470/16, 1000/100.18 1 1000/16,470/630.23 1 1000/63,2200/160.30 3 300/250.69 1000/1000.88
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1350 1.20 MC1350 1.20 MC1350 1.20 MC1350 1.20 S11610P 1.60 S11611P 1.60 S11612P 1.60 S11612P 1.60 S11612P 2.17 S11620P 2.17 S11620P 2.17 S11620P 2.17 S11621P 2.17 S11621P 2.14 S11621P 2.17 S11622P 2.24 S1624C 3.28 S11625P 2.17	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD44752 8.00 CMOS 4000 SERIES  4001 0.17 4000 0.17 4000 0.23	7441N 0.774 7442N 0.70 741542 0.79 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4050 0.55 4051 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.20 4070 0.20 4070 0.20 4070 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4077 0.20	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.35 78LSeries 0.35 78LSERIES 0.35 78KTT2C 1.75 79KTT2C 1.75 79KTT2C 1.75 723CN 0.65 L200 1.95 TLN1412 0.75 NES553N 1.25 LM317MP 1.48 LM337MP 1.48 MICROMARKET  8080A/2 7.50 8212 2.30	74LS165 1.04 74167N 2.50  CRYSTAL FI 10.7941z 2 10M15A 1: 10.7941z 8 10M481 15: H4402 7: 10M22D 2.4 HF FIRST 1 B34F8A 34:  RADIO CONT (No splits AM TX: 3rd OT 30) AM/FM RX: 3rd OT 30;	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES: FOLE TYPES: SCHIZ BW 14.50 SKHIZ BW 14.50 SKHIZ BW 15.50 KHIZ SSB 17.20 FILTER: SMHIZ HF 32.00  FROL CRYSTALS 5 available) pF HC25U 1.65	0.33  DER 0.44  LED5  M RED 0.15  SMM GREEN 0.15  SMM GREEN 0.15  SMM GREEN 0.16  SMM GREEN 0.16  SMM YELLGN 0.16  SMM YELLGN 0.16  SMM YELLGN 0.16  SMM YELLGN 0.15  SMM ORANCERED 0.20  SMM ORANCERED 0.20  SMM ORANCERED 0.19  SMM ORANCERED 0.19  SMM ORANCERED 0.19  SMM ORANCERED 0.19	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF461 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF91 1.33 BF992 0.60 BF795 0.99 BF790 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE BF256 0.38 2SK55 0.28 2SK168 0.35 J310 0.69	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1350 1.20	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5525 7.85 MSH5526 7.85 MSH5527 9.75 ICM7107CP 9.55 ICM7107CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDI0551 2.45 HD4015 4.45 HD1209 6.00 HD44752 8.00  CMOS 4000 SERIES	7441N 0.74 7442N 0.70 74LS42 0.70 74LS42 0.99	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 79LS 0.65 78LSeries 0.35 79LO5 0.85 78MST2C 1.75 79MST2C 1.75 723CN 0.65 L200 1.95 TDN1412 0.75 NE5553N 1.25 LM117MP 1.48 LM337MP 1.48  MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50	74LS165 1.04 74167N 2.50  CRYSTAL F1 10.7MHZ 2 10M15A 11 10.7MHZ 6 10M4B1 153 H4402 7.1 10M2ZD 2.4 HF FIRST I B34F8A 34  RADIO CONT (No splits AM TX:- 3rd OT 30) AM/FM RX:- 3rd OT 30; FM TX:-	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES	S 0.33 ES 0.55 DER 0.44  LEDS 5MM RED 0.15 3MM GREEN 0.16 2.5 X 5MM RED 0.15 3MM GREEN 0.16 2.5 X 5MM CN 0.20 5MM GREEN 0.16 3MM YELLON 0.10 3MM ORANGERED 0.20 5MM ORANGERED 0.20 5MM ORANGERED 0.20 5MM ORANGERED 0.20 5MM ORANGERED 0.19 2.5 X 5MM ORA 0.24 5MM ORANGERED 0.19	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF365 0.49 BF395 0.18 BF395 0.18 BF479 0.66 BF679S 0.55 BF191 1.33 BF1992 0.60 BF795 0.99 BF1990 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE BF256 0.38 2SK56 0.28 2SK168 0.35 J310 0.69 J176 0.65	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 IM1307 1.55 MC1310P 1.90 MC1330 1.20 HA1370 1.90 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 S11610P 1.60 S11611P 1.60 S11611P 1.60 S11612P 2.17 S11622P 2.17 S11622P 2.17 S11625P 2.24 SL624C 3.28 S12625P 2.41 S12630P 1.62	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7106CP 9.55 ICM7106CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4010B 0.58	7441N 0.774 7442N 0.707 741S42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 78LOTO 0.85 78MST2C 1.75 723CN 0.65 L200 1.95 TD1412 0.75 NES553N 1.25 LM317MP 1.48  MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95	74IS165 1.04 74167N 2.50  ATORS  CRYSTAL FI 10.7841Z 2 10M15A 1: 10.7841Z 8 10M4B1 15 H4402 7: 10M22D 2.4 HF FIRST I B34F8A 34  RADIO CONT (No spills AM TX: 3rd OT 30) FM TX: 1rd OT 30 FM TX: 1	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES	0.33  DES 0.55  DER 0.44  LEDs 0.12  3MM RED 0.15  3MM RED 0.17  3MM GR CLEAR 0.16  3MM GREEN 0.16  2.5 X SMM GN 0.20  5MM YELLOW 0.15  3MM YELLOW 0.16  3MM ORA CL 0.29  3MM ORA CL 0.29  3MM ORANCERED 0.20  5MM ORANCERED 0.20	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF195 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2N3866 0.85 SMALL SIGNAL RF FET MOSFE BF256 0.38 2SK168 0.35 J310 0.69 J176 0.65	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1083 1.95 TDA1090 3.05 HAL117 1.20 HAL197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.90 MC1330 1.20 MC1350 1.20 MC1350 1.20 HAL370 1.86 MC1496P 1.25 SLI610P 1.60 SLI611P 1.60 SLI612P 1.60 SLI612P 2.17 SLI622P 2.24 SLE24C 3.28 SLI626P 2.17 SLI625P 2.17 SLI625P 2.47 SLI626P 2.44 SLE31630P 1.62 SLI64DP 1.89 SLI640P 1.89	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5524 7.85 MSH5527 7.85 MSH5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDJ0551 2.45 HD4015 4.45 HD4015 4.45 HD4000 0.17 4000 0.17 4000 0.17 4000 0.23 4008 0.80 4010B 0.58 4010B 0.58 4010B 0.58 4010B 0.58 4010B 0.58	7441N 0.774 7442N 0.70 741542 0.79  4043 0.85 4044 0.80 4046 1.30 4047 0.99 4052 0.65 4052 0.65 4052 0.65 4053 0.65 4063 1.09 4066 0.56 4068 0.25 4069 0.20 4070 0.20 4071 0.20 4072 0.20 4073 0.20 4074 0.20 4075 0.20 4076 0.90 4077 0.20 4077 0.20 4078 0.20 4079 0.20 4079 0.20 4070 0.20 4071 0.20 4073 0.20 4073 0.20 4073 0.20 4074 0.20 4075 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.20 4093 0.78 4175 0.95	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KXT2C 1.75 79WXT2C 1.75 79WXT2C 1.75 723CN 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48 LM37MP 1.48 L	74LS165 1.04 74167N 2.50  CRYSTAL F1 10.7MHZ 2 10M15A 11 10.7MHZ 6 10M4B1 153 H4402 7.1 10M2ZD 2.4 HF FIRST I B34F8A 34  RADIO CONT (No splits AM TX:- 3rd OT 30) AM/FM RX:- 3rd OT 30; FM TX:-	10RB series 33mi-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LITER PRODUCTS FOLE TYPES: SKHZ EW 14.50 SKHZ EW 14.50 SKHZ EW 15.50 4KHZ SSB 17.20 FILTER: SMYZ LFF 32.00  FROL CRYSTALS 5 available) of HC25U 1.65 pF HC25U 1.65 HC25U 1.65 HC25U 1.65	0.33  DES 0.55  DER 0.44  LEDs 0.12  3MM RED 0.15  3MM RED 0.17  3MM GR CLEAR 0.16  3MM GREEN 0.16  2.5 X SMM GN 0.20  5MM YELLOW 0.15  3MM YELLOW 0.16  3MM ORA CL 0.29  3MM ORA CL 0.29  3MM ORANCERED 0.20  5MM ORANCERED 0.20	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.60 BF6795 0.55 BF191 1.33 BF992 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2N3866 0.85 SMALL SIGNAL RF FET/MOSFE BP256 0.38 2SK168 0.35 J3110 0.69 J176 0.65 40673 33K31 0.65 40673 33K31 0.67	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1350 1.20	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 7.85 MSM5526 7.85 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4000 0.23 4008 0.80 4009 0.58 4011AE 0.20 4011B 0.20	7441N 0.774 7442N 0.79 741S42 0.79 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4050 0.55 4051 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4059 0.20 4070 0.20 4070 0.20 4072 0.20 4072 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4070 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4079 0.20	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 78LOTO 0.85 78MST2C 1.75 723CN 0.65 L200 1.95 TD1412 0.75 NES553N 1.25 LM317MP 1.48  MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95	74LS165 1.04 74167N 2.50  CRYSTAL F! 10.7MHz 2 10M15A 1! 10.7MHz 2 10M2D 2.4 HF F!RST   B34F8A 34.  RADIO CONT (No splits AM TX: 3rd OT 30; AM/FM XX: 3rd OT 30; FM TX : Fund 20pF Pairs FM	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  ILTER PRODUCTS FOLE TYPES: 64RZ BW 2.49 FOLE TYPES: 64RZ BW 15.50 SKHZ BW 15.	0.33  DES 0.55  DER 0.44  LEDs 0.12  3MM RED 0.15  3MM RED 0.17  3MM RED 0.17  3MM RED 0.17  3MM RED 0.16  2.5 X SMM RD 0.17  3MM RED 0.16  2.5 X SMM RD 0.17  3MM RED 0.16  2.5 X SMM RD 0.16  3MM YELLOW 0.16  3MM YELLOW 0.16  3MM YELLOW 0.18  2.5 X SMM RED 0.20  5MM RA CL 0.29  3MM ORA CL 0.29  3MM ORANCERED 0.20  5MM RANCERED 0.19  2.5 X SMM RED 0.56  5MM RED 0.17  1.44  5MM RED 0.56	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF247 0.21 BF441 0.21 BF462 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF195 0.99 BF190 0.90 40238 0.85 BF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSE BF256 0.38 2SK55 0.28 2SK168 0.35 J310 0.69 J176 0.65 40823 0.65 40823 0.65 40823 0.65 40823 0.65 40823 0.65 3SK51 0.49 3SK51 0.54	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 HA1197 1.00 TDA1220 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1340 1.20 MC1350 1.20 MC1360 1.20 MC1370 1.20	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5524 7.85 MSH5527 7.85 MSH5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDJ0551 2.45 HD4015 4.45 HD4015 4.45 HD4000 0.17 4000 0.17 4000 0.17 4000 0.23 4008 0.80 4010B 0.58 4010B 0.58 4010B 0.58 4010B 0.58 4010B 0.58	7441N 0.774 7442N 0.70 741542 0.70 741542 0.70 741542 0.99 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4059 0.55 4052 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.20 4070 0.20 4071 0.20 4072 0.20 4072 0.20 4073 0.20 4075 0.20 4076 0.90 4076 0.90 4077 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4071 0.20 4075 0.20 4071 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.90 4079 0.20 4099 0.78 4175 0.95 4503 0.69 4506 0.51	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 79series 1.00 78Mseries 0.65 78LSeries 0.35 79LO5 0.85 78MST2C 1.75 8210 1.95 MS17MP 1.48 LM337MP 1.48 LM337MP 1.48 MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8251 6.25 8255 5.40	74IS165 1.04 74167N 2.50  CRYSTAL F! 10.7MHZ 2 10M15A 1: 10.7MHZ 2 10M2D 2.: HF FIRST II B34F8A 34.  RADIO CONT (No splits AM TX: 3rd OT 30; AM/FM KX: 3rd OT 30; FM TX : Fund 20pF Pairs FM Pairs AM	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  ILTER PRODUCTS FOLE TYPES: 64RZ BW 2.49 FOLE TYPES: 64RZ BW 15.50 SKHZ BW 15.	LEDS 0.33  DER 0.44  LEDS 0.44  SMM RED 0.15  SMM RED 0.16   BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF365 0.49 BF395 0.18 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BF1992 0.60 BF195 0.99 BF199 0.99 BF199 0.90 A0238 0.85 BF4 POWER DEVICES VN66AF 0.95 ZN1866 0.38 SMALL SIGNAL BF FET MOSFE BF256 0.38 2SK56 0.28 2SK56 0.28 2SK56 0.35 J310 0.69 J176 0.65 40823 0.65 40823 0.65 40873 3SK51 JSK45 0.49 JSK51 0.54	16v: 0.22,0.33, 0.68,1.0	
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1330 1.20 SCHORLES 1.50 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1310P 1.90 MC1330 1.20 MC1310P 1.90 MC1310P 1.90 MC1310P 1.90 MC1310 1.20 MC1310P 1.90 MC1310P 1.90 MC1496P 1.25 SLI610P 1.60 SLI611P 1.60 SLI611P 1.60 SLI611P 1.60 SLI612P 2.77 SLI622P 2.77 SLI622P 2.77 SLI622P 2.77 SLI624P 2.78 SLI625P 2.77 SLI624P 1.89 SLI640P 1.89 SLI640P 1.89 SLI641P 1.89 SLI641P 1.89 TDA2020 1.25 TDA2020 3.00 ULW2242A 3.05 ULW2243A 3.05	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7107CP 9.55 ICM7107CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95490PC 6.00 HD10551 2.45 HD44015 4.45 HD12009 6.00 HD10551 2.45 HD44015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4011AE 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011 0.55 4013 0.55	7441N 0.774 7442N 0.707 741S42 0.99	74LS109 0.70 74110N 0.58 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LO5 78LSERIES 0.79 79KTZC 1.75 723CN 0.65 L200 1.95 TAN1412 0.75 723CN 1.75 8212 0.75 8212 0.75 8212 0.75 8214 0.75 8214 0.75 8216 0.75 8216 0.75 8251 6.25 8251 6.25 8255 5.40	74LS165 1.04 74167N 2.50  CRYSTAL FI 10.7WHz 2 10M15A 1: 10.7WHz 8 10M4B1 15 H4402 7. 10M22D 2.4 HF FIRST 1 B34F8A 34 RADIO CONTI (No splits AM TX:- 3rd OT 30) FM TX :- 1rd 20pF Pairs FM Pairs AM CRYSTALS	10RB series 33mi-120mH 10RRH serie 120mi-1.5H plezo SOUN pB2720  LLTER PRODUCTS FOLE TYPES: 5KHZ BW 2.49 FOLE TYPES: 6KHZ BW 14.50 KHZ SBB 17.20 FILTER: 5MHZ H7 12.00  FROL CRYSTALS 5 available) pF HC25U 1.65 HC25U 1.65 HC25U 1.65 3.25 3.10	0.33  ES 0.55  DER 0.44  LEDs 0.44  LEDs 0.15  SMM RED 0.16  SMM YELLON 0.15  SMM YELLON 0.15  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM ORANGERED 0.29  SMM ORANGERED 0.29  SMM ORANGERED 0.20  SMM ORANGERED 0.20  SMM ORANGERED 0.19  LE SMM IN RED 0.56  BEWAIT IR DET 1.51  IR OPT CPLR 1.44  SMM IN PL CDS  SMM CLIP 0.45  SMM CLIP 0.45  4 digit 9.45  4 digit 8.95	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF247 0.21 BF441 0.21 BF462 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF195 0.99 BF190 0.90 40238 0.85 BF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSE BF256 0.38 2SK55 0.28 2SK168 0.35 J310 0.69 J176 0.65 40823 0.65 40823 0.65 40823 0.65 40823 0.65 40823 0.65 3SK51 0.49 3SK51 0.54	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 IM1303 0.99 LM1307 1.95 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1612P 1.60 SL1612P 1.60 SL1612P 1.89 SL1622P 2.17 SL1623P 2.24 SL624C 3.28 SL1625P 2.17 SL1625P 2.17 SL1625P 2.17 SL1625P 2.17 SL16262P 2.17	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5524 11.30 MSH5525 7.85 MSH5527 9.75 MSH5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDJ0551 2.45 HD4015 4.45 HD4015 4.45 HD4000 0.17 4002 0.23 4008 0.80 4010B 0.58 4010B 0.58 4010B 0.58 4011B 0.20 4011 0.55 4013 0.55 4013 0.55 4013 0.55 4015 0.95	7441N 0.74 7442N 0.70 74LS42 0.70 74LS42 0.99	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78MST2C 1.75 72SON 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48 LM337MP 1.48 MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8224 3.50 8255 5.40 6800P 7.50 6810 5.95 6820 7.45	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHZ 2 10M15A 1: 10.7MHZ 6 10M4B1 15: H4402 7.: 10M2ZD 2.: HF ETRET I B34F8A 34  RADIO CONT (No splits AM TX:- 3rd OT 30; AM/FM RX: 3rd OT 30; FM TX :- Fund 20pF Pairs FM Pairs FM Pairs AM  CRYSTALS 32.768 M1	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES	LEDS 0.33  DER 0.44  LEDS 0.44  SMM RED 0.15  SMM RED 0.16   BF195 0.18 BF224 0.22 BF241 0.28 BF274 0.18 BF274 0.21 BF440 0.21 BF467 0.69 BF395 0.18 BF479 0.60 BF795 0.55 BF191 1.33 BF992 0.60 BF795 0.99 BF790 0.90 BF790 0.90 BF795 0.99 BF790 0.90 BF795 0.38 BF85 0.85 SMALL SIGNAL BF EFT/MOSFE BF256 0.38 2SK168 0.35 J310 0.69 J176 0.65 40673 3SK51 0.54 JSK60 0.58 MEM680 0.75 BF961 0.70 BF960 0.70	16v: 0.22,0.33, 0.68,1.0	
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1303 1.20 MC1330 1.20 MC1330 1.20 MC1350 1.20 MC1350 1.20 MC1350 1.20 MC1350 1.20 S11610P 1.60 S11611P 1.60 S11611P 1.60 S11612P 1.60 S11612P 2.17 S11623P 2.24 S1624C 3.28 S11624C 3.28 S11624C 3.28 S11624C 3.28 S11625P 2.17 S11625P 2.44 S11630P 1.62 S11641P 1.89 S11641P 1.89 S11641P 1.89 S11641P 1.89 S11641P 1.89 S116420 2.24 S116420 1.25 TDA2020 3.00 ULW2283B 1.00 CA3080E .70	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7107CP 9.55 ICM7107CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95490PC 6.00 HD10551 2.45 HD44015 4.45 HD12009 6.00 HD10551 2.45 HD44015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4011AE 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011 0.55 4013 0.55	7441N 0.774 7442N 0.707 741S42 0.99	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KST2C 1.75 79KST2C 1.75 79KST2C 1.75 723CN 0.65 L200 1.95 L201 1.95 L203 1.95 L204 1.95 L205 1.95 L205 1.95 L206 1.95 L207	74LS165 1.04 74167N 2.50  CRYSTAL FI 10.78Hz 2 10M15A 1: 10.78Hz 2 10M481 15: H4402 7: 10M22D 2.4 HF FIRST 1 B34F8A 34:  RADIO CONT (No splits AM TX: 3rd OT 30] FM TX:	10RB series 33mi-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LITER PRODUCTS POLE TYPES: ROLE TYPES: RHZ EW 14.50 SKHZ EW 14.50 KHZ EW 14.50 KHZ SSB 17.20 FILTER: Swiz HF 32.00  FROL CRYSTALS S available) PF HC25U 1.65 PF HC25U 1.65 HC25U 1.65 3.25 3.10  Z 2.70 3.85 5.00	0.33  ES 0.55  DER 0.44  LEDs 0.44  LEDs 0.15  SMM RED 0.16  SMM YELLON 0.15  SMM YELLON 0.15  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM ORANGERED 0.29  SMM ORANGERED 0.29  SMM ORANGERED 0.20  SMM ORANGERED 0.20  SMM ORANGERED 0.19  LE SMM IN RED 0.56  BEWAIT IR DET 1.51  IR OPT CPLR 1.44  SMM IN PL CDS  SMM CLIP 0.45  SMM CLIP 0.45  4 digit 9.45  4 digit 8.95	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF440 0.21 BF395 0.49 BF395 0.18 BF479 0.66 BF979 0.66 BF979 0.60 BF995 0.99 BFY90 0.90 40238 0.85 BF POWER DEVICES VN66AF 0.95 ZN1866 0.85 SMALL SIGNAL BF FET MOSFE BF256 0.38 SMALL SIGNAL BF FET MOSFE BF256 0.38 2SK55 0.28 2SK168 0.35 J310 0.69 J176 0.65 40823 0.65 40823 0.65 40823 0.69 J3K51 0.54 3SK45 0.49 3SK51 0.54 3SK60 0.55 BF961 0.75	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1350 1.20 MC1350 2.75 LM1370 1.90 HA1378 2.75 LM161P 1.60 SL161P 1.60	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5526 7.85 MSM5527 9.75 ICM72166CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD4752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4010B 0.58 4011B 0.20 4012 0.55 4013 0.55 4013 0.55 4013 0.55 4016 0.52 4017 0.80 4019 0.60 4020 0.93	7441N 0.774 7442N 0.70 741S42 0.70 741S42 0.70 741S42 0.99 4044 0.80 4046 1.30 4047 0.99 4059 0.55 4051 0.65 4052 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.20 4070 0.20 4071 0.20 4072 0.20 4072 0.20 4073 0.20 4076 0.20 4077 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4079 0.20 4071 0.20 4071 0.20 4075 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4071 0.20 4071 0.20 4075 0.20 4076 0.90 4077 0.95 4510 0.99 4511 0.99 4511 0.99 4511 0.99 4512 0.98	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78MST2C 1.75 72SON 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48 LM337MP 1.48 MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8224 3.50 8255 5.40 6800P 7.50 6810 5.95 6820 7.45	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHZ 2 10M15A 1: 10.7MHZ 2 10M2D 2.:	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PEZO SOUN PBZ720  LLTER PRODUCTS FOLE TYPES: 642 BW 14.50 SKHZ BW 2.49 FOLE TYPES: 642 BW 14.50 SKHZ BW 15.50 KRHZ SSB 17-20 FILLTER: 55MHZ BH 15.50 KRHZ SSB 17-20 FILLTER: 55MHZ BH 15.50 FROL CRYSTALS 5 available) 65 HC25U 1.65 66 HC25U 1.65 67 HC25U 1.65 68 3.25 3.10  z 2.70 3.85 5.00 3.00	DER 0.33  DER 0.44  LEDS 0.55  DER 0.44  LEDS 0.42  SMM RED 0.15  SMM RED 0.15  SMM RED 0.15  SMM GRED 0.15  SMM GREEN 0.16  2.5 X SMM CN 0.20  SMM YELLGN 0.15  SMM YELLGN 0.15  SMM YELLGN 0.16  SMM YELLGN 0.18  SMM YELLGN 0.19  SMM YELLGN 0.18  SMM YELLGN 0.19  SMM YELLGN 0.20  SMM YELLGN 0.19   BF195 0.18 BF224 0.22 BF241 0.28 BF274 0.18 BF274 0.21 BF440 0.21 BF467 0.69 BF395 0.18 BF479 0.60 BF795 0.55 BF191 1.33 BF992 0.60 BF795 0.99 BF790 0.90 BF790 0.90 BF795 0.99 BF790 0.90 BF795 0.38 BF85 0.85 SMALL SIGNAL BF EFT/MOSFE BF256 0.38 2SK168 0.35 J310 0.69 J176 0.65 40673 3SK51 0.54 JSK60 0.58 MEM680 0.75 BF961 0.70 BF960 0.70	16v: 0.22,0.33, 0.68,1.0	
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.55 MC1310P 1.90 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1330 1.20 MC1330 1.20 STA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1611P 1.60 SL1611P 1.60 SL1612P 1.60 SL1612P 1.60 SL1612P 1.60 SL1612P 1.60 SL1614P 1.89 SL1624C 2.17 SL1624C 2.24 SL624C 3.28 SL1625P 2.17 SL1624P 1.89 SL1640P 1.89 SL	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7106CP 9.55 ICM7107CP 9.55 ICM7106B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95490PC 6.00 HD10551 2.45 HD12009 6.00 HD10551 2.45 HD44015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4011AE 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.55 4013 0.55 4013 0.55 4015 0.95 4016 0.52 4017 0.80 4019 0.60 40206 0.93 4021 0.82	7441N 0.774 7442N 0.70 741S42 0.79	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KST2C 1.75 79KST2C 1.75 79KST2C 1.75 723CN 0.65 L200 1.95 L201 1.95 L203 1.95 L204 1.95 L205 1.95 L205 1.95 L206 1.95 L207	74LS165 1.04 74167N 2.50  CRYSTAL F! 10.7MHz 2 10M15A 1! 10.7MHz 2 10M15A 1! 10.7MHz 8 10M2D 2.4 HF FIRST I B34F8A 34  RADIO CONT (No splits AM TX:- 3rd OT 30 AM/FM XX:- 17	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  ILTER PRODUCTS FOLE TYPES: 64RH SW 2.49 FOLE TYPES: 64RH SW 15.50 SKHZ BW 15.	0.33  ES 0.55  DER 0.44  LEDs 0.44  LEDs 0.15  SMM RED 0.16  SMM YELLON 0.15  SMM YELLON 0.15  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM YELLON 0.18  SMM ORANGERED 0.29  SMM ORANGERED 0.29  SMM ORANGERED 0.20  SMM ORANGERED 0.20  SMM ORANGERED 0.19  SMM INFRA RED 0.56  BIWAIL IR DET 1.51  IR OPT CPLR 1.44  SMM CLIP 0.45  SMM CLIP 0.45  LCDs 3.5 digit 9.45  4 digit 8.95	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF440 0.21 BF365 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BF1992 0.60 BF795 0.99 BF1990 0.90 40238 0.85 RF POWER DEVICES VN666AF 0.95 2N1866 0.85 SMALL SIGNAL RF FETTMOSFE BF256 0.38 2SK55 0.28 2SK56 0.38 2SK56 0.35 J310 0.69 40623 0.65 40623 0.65 40623 0.65 40673 3SK51 0.54 3SK51 0.59 BF960 0.58 BMM680 0.75 BF960 1.70 BF960 1.24 3SK48 1.64	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,10.0.19 6v3: 22,470.30 10v: 22,1000.35  ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (LF/Voltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 2/16,33/10, 47/100.09 10/63,22/50,33/50, 47/16,100/160.10 47/63,100/25,220/16 470/6.30.12 100/63,470/16, 1000/100.18 1000/16,470/630.23 1000/63,2200/16.0.30 3300/250.69 1000/1000.88 10000/1000.88 10000/1000.88 10000/1000.80 4.7/63,22/10,22/16 33/160.09 4.7/63,22/10,22/16
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 IM1307 1.95 MC1310P 1.90 MC1330 1.20 MC1350 1.20 MC1350 1.20 HA1388 2.75 TDA1490 1.86 MC1496P 1.55 SL1610P 1.60 SL1611P 1.60 SL1612P 2.17 SL1621P 2.17 SL1622P 2.17 SL1622P 2.17 SL1623P 2.24 SL242C 3.28 SL1625P 2.17 SL1624P 1.60 SL1644P 1.89 SL1644P 1.89 TDA2020 1.25 TDA2020 3.00 ULM2242A 3.05 ULM2242A 3.05 ULM2242A 3.05 ULM2242A 3.05 ULM2242A 3.05 ULM2242B 1.00 CA3080P 1.84 CA3090AQ 3.35 CA3123E 1.40 CA3130E 0.80 CA3130E 0.80	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5524 11.30 MSH5525 7.85 MSH5526 7.85 MSH5527 9.75 ICM7106CP 9.55 ICM7107CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDJ0551 2.45 HD4015 4.45 HD4015 4.45 HD4000 0.17 4002 0.23 4008 0.80 4009 0.58 4010B 0.58 4010B 0.58 4010B 0.58 4011B 0.20 4012 0.55 4013 0.55 4016 0.52 4017 0.80 4019 0.60 4020B 0.93 4021 0.82 4022 0.90	7441N 0.774 7442N 0.770 741S42 0.790	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78MST2C 1.75 72SON 0.65 L200 1.95 TDN1412 0.75 NE553N 1.25 LM337MP 1.48 LM337MP 1.48 LM337MP 1.48  MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8224 3.50 6800 7.45 6800 7.45 6850 6.95 6820 7.45 6850 4.90 6852 4.85  MC2708 7.50	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHZ 2 10M15A 1: 10.7MHZ 2 10M15A 1: 10.7MHZ 6 10M8H1 15: H4402 7.: 10M2D 2.: HF FIRST II B34F8A 34.  RADIO CONT (No splits AM TX: 3rd 07 30; AM/FM RX: 3rd 07 30; FM TX : Fund 20pF Pairs FM Pairs AM  CRYSTALS 32.768 KH 100kHZ 4.58kH2 1.0MHZ 3.2768MsL 4.000MHZ 4.19439MH	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES	0.33  ES 0.55  DER 0.44  LEDs 0.44  LEDs 0.44  LEDs 0.44  LEDs 0.44  LEDs 0.46  SMM RED 0.15  SMM RED 0.15  SMM RED 0.15  SMM RED 0.15  SMM CREEN 0.15  SMM CREEN 0.16  2.5 X 5MM CN 0.20  SMM YELLON 0.15  SMM YELLON 0.15  SMM YELLON 0.18  3MM YELLON 0.10  SMM YELLON 0.10  SMM YELLON 0.10  SMM ORANCERED 0.20  SMM ORANCERED 0.20  SMM ORANCERED 0.20  SMM ORANCERED 0.19  LEDS 1.44  SMM INFRA RED 0.56  BIWAIL IR DET 1.51  IR OPT CPLR 1.44  SMM INFRA RED 0.56  SMM INFRA RED 0.56  SMM INFRA RED 0.56  SMM INFRA RED 0.59  SMM ORANCERED 0.49  SMM INFRA RED 0.56  SMM INFR	BF195 0.18 BF224 0.22 BF241 0.28 BF274 0.18 BF274 0.21 BF440 0.21 BF440 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6795 0.55 BF191 1.33 BF992 0.60 BFT95 0.99 BF790 0.90 M0238 0.85 RF POWER DEVICES WN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE* BF256 0.38 ZSK168 0.35 J3110 0.69 J176 0.65 40823 0.65 408673 3SK51 0.54 JSK45 0.49 JSK51 0.54 JSK45 0.49 JSK51 0.59 MEM680 0.75 BF961 0.70 BF960 0.75 BF961 0.75	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1083 1.95 TDA1090 3.05 HAL117 1.20 HAL197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.95 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HAL388 2.75 TDA1490 1.86 MC1496P 1.25 SLI6610P 1.60 SLI612P 1.60 SLI612P 1.60 SLI613P 1.89 SLI622P 2.17 SLI623P 2.17 SLI623P 2.24 SLE24C 3.28 SLI625P 2.17 SLI625P 2.17 SLI625P 2.17 SLI625P 2.17 SLI626P 1.89 SLI640P 2.17 SLI623P 1.89 SLI641P 1.89 TDA2020 3.00 ULN2242A 3.05 ULN2242A 3.05 ULN2242A 3.05 ULN2242A 3.05 ULN2243A 3.05 ULN2343A	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5524 11.30 MSH5525 7.85 MSH5526 7.85 MSH5527 9.75 ICM7107CP 9.55 ICM7107CP 9.55 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HDI0551 2.45 HD4015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4009 0.58 4010B 0.58 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.25 4013 0.55 4013 0.55 4013 0.55 4015 0.95 4016 0.52 4017 0.80 4019 0.60 4020 0.93 4021 0.82 4022 0.90 4023 0.17 4024 0.76	7441N 0.774 7442N 0.70 741542 0.70 741542 0.99 4044 0.80 4046 1.30 4047 0.99 4051 0.65 4052 0.65 4052 0.65 4053 0.65 4063 1.09 4066 0.56 4068 0.25 4069 0.20 4070 0.20 4071 0.20 4072 0.20 4073 0.20 4076 0.20 4077 0.20 4078 0.20 4079 1.020 4071 0.20 4071 0.20 4071 0.20 4072 0.20 4073 0.20 4073 0.20 4074 0.20 4075 1.09 4076 0.90 4077 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4071 0.20 4071 0.20 4073 0.20 4073 0.20 4074 0.20 4075 1.09 4076 0.90 4077 0.20 4078 0.20 4079 0.20 4079 0.20 4079 0.20 4079 0.20 4079 0.20 4071 0.20 4071 0.20 4072 0.20 4073 0.20 4073 0.20 4074 0.20 4075 1.09 4076 1.09 4076 1.09 4076 1.09 4076 1.09 4076 1.09 4076 1.09 4076 1.09	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78KXT2C 1.75 79KXT2C 1.75 79KXT2C 1.75 79KXT2C 1.75 723CN 0.65 L200 1.95 TDA1412 0.75 NE5553N 1.25 LM317MP 1.48 LM337MP 1.48 LM337MP 1.48 MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8255 5.40 6800P 7.50 6810 5.95 6820 7.45 6850 4.90 6852 4.85 MC.2708 7.50 2114 6.50 2114 6.50	74IS165 1.04 74167N 2.50  CRYSTAL FIF 10.79Hz 2 10M15a 1: 10.79Hz 2 10M481 15: H4402 7.: 10M2D 2.: HF FIRST I B34F8A 34:  RADIO CONT (No splits AM TX: 3rd OT 30; AM/FM KX: 3rd OT 30; FM TX :- Fund 20pF Pairs FM Pairs AM  CRYSTALS 32.768 kH 100cHZ 458kH2 1.0MHz 3.2768M1z 4.194399H 6.5536M1z 4.194399H 6.5536M1z 6.5536M1z	10RB series   33mi-1-20mH   10RR   series   120mi-1.5H   PIEZO SOUN   PB2720   120mi-1.5H   PIEZO SOUN   PB2720   120mi-1.5H   PIEZO SOUN   PB2720   120mi-1.5H   PIEZO SOUN   PB2720   120mi-1.5H   15.50   MRHZ SSB 17.20   FILTER:   15.50   MRHZ SSB 17.20   MIXE   15.50   MIXE	0.33  DES 0.55  DER 0.44  LEDs 0.15  SMM RED 0.16  SMM RED 0.20  SMM RED 0.16  SMM RED 0.20  SMM RED 0.16  SMM RED 0.16  SMM RED 0.20  SMM RED 0.16  SMM RED	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET MOSFE BF256 0.38 2SK55 0.28 2SK168 0.35 J310 0.69 J176 0.65 40623 0.65	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.95 MC1310P 1.90 MC1330 1.20 MC1350 1.20 HA1370 1.90 MC1350 1.20 S1610P 1.60 S1161P 1.60 S1161P 1.60 S1161P 1.60 S1161P 1.60 S1161P 2.17 S1162P 2.17 S1162P 2.17 S1162P 2.17 S1162P 2.17 S1162P 2.17 S1162P 2.44 S162C 2.17 S1162P 2.45 S1164P 1.89 S1164P 2.44	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD40752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4019 0.58 4011AE 0.20 4011B 0.20 4012 0.55 4013 0.55 4016 0.55 4011 0.95 4016 0.52 4017 0.80 4019 0.60 4020 0.93 4021 0.82 4022 0.90 4023 0.17 4024 0.76 4025 0.17	7441N 0.774 7442N 0.770 741S42 0.790	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LO5 0.85 78MST2C 1.75 8210 1.75 8211 0.55 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8255 5.40 6800P 7.50 6810 5.95 6820 7.45 6850 4.90 6852 4.85 MC.2708 7.50 2114 6.50 4027 5.78 2102 1.70	74IS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHZ 2 10M15A 1: 10.7MHZ 2 10M15A 1: 10.7MHZ 6 10M8H1 15: H4402 7.: 10M2D 2.: HF FIRST II B34F8A 34.  RADIO CONT (No splits AM TX: 3rd 07 30; AM/FM RX: 3rd 07 30; FM TX : Fund 20pF Pairs FM Pairs AM  CRYSTALS 32.768 KH 100kHZ 4.58kH2 1.0MHZ 3.2768MsL 4.000MHZ 4.19439MH	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PEZO SOUN PBZ720  LLTER PRODUCTS FOLE TYPES: 47 EW 14.50 SKHZ EW 2.49 FOLE TYPES: 47 EW 14.50 SKHZ EW 15.50 KRHZ SSB 17-20 FILLTER: 5.5MHZ HF 32.00  FROL CRYSTALS 5 available) 6F HC25U 1.65 6F HC25U 1.65 6F HC25U 1.65 7 HC25U 1.65 7 HC25U 1.65 8 3.25 3.10  Z 2.70 3.85 5.00 3.85 5.00 2.70 Z 2.30 SBL1 2.10 SBL1	0.33	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF274 0.18 BF440 0.21 BF441 0.21 BF362 0.49 BF395 0.18 BF479 0.66 BF6798 0.55 BF191 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2N3866 0.85 SMALL SIGNAL BF FET/MOSFE BF256 0.38 2SK168 0.35 3310 0.69 40673 33K51 0.54 3SK60 0.58 BMM680 0.75 BF961 0.70 BF960 0.75 BF961 0.70 BF960 1.24 3SK48 1.64	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1196 2.00 HA1197 1.00 HA1197 1.00 HA1197 1.55 MC1310P 1.90 MC1330 1.20 MC1330 0.20 MC13357P 2.35 MC3330 0.40 MC13130 0.80 MC13137P 2.35 MC13130 0.80 MC13130 0.80 MC13137P 2.35 MC13130 0.80 MC13137P 2.35 MC13130 0.80 MC13137P 2.35 MC13130 0.80 M	MSL2318 3.84 MSH5523 11.30 MSH5524 11.30 MSH5525 7.85 MSH5526 7.85 MSH5527 9.75 ICM7107CP 9.55 ICM7107CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD4015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4000 0.17 4000 0.17 4000 0.58 4010B 0.80 4009 0.58 4011AE 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.55 4015 0.95 4016 0.52 4017 0.80 4020 0.95 4016 0.52 4017 0.80 4020 0.90 4021 0.82 4022 0.90 4022 0.90 4023 0.17 4026 1.80	7441N 0.774 7442N 0.774 7442N 0.79	74LS109 0.70 74110N 0.54 74111N 0.68  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 79series 1.00 78Mseries 0.65 78Lseries 0.35 79LO5 0.85 78KST2C 1.75 79KCT2C 1.75 72SCN 0.65 L200 1.95 TDN1412 0.75 NE5553N 1.25 LM317MP 1.48 LM337MP 1.48 LM337MP 1.48 LM337MP 1.48 LM337MP 1.50 8212 2.30 8214 3.50 8214 3.50 8216 1.95 8251 6.25 8255 5.40 6800P 7.50 6810 5.95 6820 7.45 6850 4.90 6852 4.85  MC2708 7.50 2114 6.50 4027 5.78 2102 1.70 2112 3.40 2513 7.54	74LS165 1.04 74167N 2.50  CRYSTAL FIF 10.7MHZ 2 10M15A 19 10.7MHZ 2 10M15A 19 10.7MHZ 8 10M2D 2.4 HF FIRST 1 B34FBA 34  RADIO CONT (No splits AM TX:— 3rd OT 30 AM/FM KK:— 3rd OT 30 FM TX:— Pund 20pF Pairs FM Pairs AM  CRYSTALS 32.76B kH 100kHZ 45kHZ 1.0MHZ 4.19439kH 4.19439kH 6.5536MHZ 10.0MHZ	10RB series   33mH-120mH   10RR   series   120mH-1.5H   prizzo SCUN	S 0.33  DER 0.44  LEDs 0.55  DER 0.44  LEDs 0.15  SMM RED 0.15  SMM CREEN 0.16  SMM CREEN 0.16  SMM YELLGU 0.15  SMM YELLGU 0.16  SMM ORANGERED 0.20  SMM ORANGERE	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF440 0.21 BF362 0.49 BF395 0.18 BF395 0.18 BF479 0.66 BF6798 0.55 BF891 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 ZN3866 0.85 SMALL SIGNAL RF FET/MOSFE BF256 0.38 ZSK16 0.38 ZSK16 0.39 J176 0.65 40623 0.65 40623 0.65 40623 0.65 40673 3SK51 0.54 3SK60 0.59 BF960 0.70 BF960 1.24 JSK48 1.64  LCD Module CM161 Miniature clock, 12/24 hr., alarm, day, dater.	16v: 0.22,0.33, 0.68,1.0
TDA1074A 5.04 TDA1083 1.95 TDA1090 3.05 HA1137 1.20 HA1197 1.00 TDA1220 1.40 LM1303 0.99 LM1307 1.90 MC1310P 1.90 MC1330 1.20 MC1350 1.20 MC1350 1.20 HA1388 2.75 TDA1490 1.86 MC1496P 1.25 SL1610P 1.60 SL1611P 1.60 SL1612P 2.17 SL1621P 2.17 SL1622P 2.17 SL1622P 2.17 SL1623P 2.24 SL242C 3.28 SL1625P 2.17 SL1624P 1.60 SL1641P 1.89 SL1641P 1.89 SL1641P 1.89 SL1641P 1.89 SL1642P 2.17 SL1623P 2.24 SL242C 3.28 SL1625P 2.17 SL1623P 2.17 SL1623P 2.24 SL242C 3.28 SL1625P 1.62 SL1640P 1.89 SL1641P 1.89 TDA2002 1.25 TDA2020 1.25 TDA2020 1.25 TDA2030 1.84 CA3030P 1.84 CA3030P 1.84 CA3130F 0.80 CA3130F 0.80 CA3130F 0.80 CA3140F 0.46 CA3130F 0.80 CA3140F 0.46 CA314990P 0.46 CA314990P 0.46 CA3157P 2.35 LM3900P 0.60	MSL2318 3.84 MSM5523 11.30 MSM5524 11.30 MSM5524 11.30 MSM5525 7.85 MSM5527 9.75 MSM5527 9.75 MSM5527 9.75 ICM7106CP 9.55 ICM7216B 19.25 ICM7217A 9.50 SP8629 3.85 SP8647 6.00 95H90PC 6.00 HD10551 2.45 HD4015 4.45 HD12009 6.00 HD44752 8.00  CMOS 4000 SERIES  4001 0.17 4002 0.23 4008 0.80 4019 0.58 4011AE 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.20 4011B 0.55 4011 0.55 4011 0.55 4011 0.55 4011 0.55 4012 0.55 4013 0.55 4014 0.95 4016 0.52 4017 0.80 4029 0.90 4023 0.17 4024 0.76 4025 0.17 4026 1.80 4028 0.72 4029 1.00	7441N 0.774 7442N 0.79 741S42 0.79 4043 0.85 4044 0.80 4046 1.30 4047 0.99 4052 0.65 4051 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4053 0.65 4058 0.20 4070 0.20 4077 0.20 4078 0.20 4077 0.20 4078 0.20 4078 0.20 4078 0.20 4078 0.20 4079 0.20 4071 0.20 4072 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.20 4078 0.20 4079 0.20 4079 0.20 4071 0.20 4072 0.20 4073 0.20 4075 0.20 4076 0.90 4077 0.20 4078 0.20 4079 0.20 4070 0.20 4071 0.20 4072 0.20 4073 0.20 4073 0.20 4073 0.20 4075 0.20 4	74LS109 0.70 74110N 0.70 74110N 0.58  VOLTAGE REGUL  78series 0.95 79series 1.00 78Mseries 0.65 78Lseries 0.35 79L05 0.85 78MST2C 1.75 72SON 0.65 L200 1.95 TDN1412 0.75 NE5531 1.25 LM337MP 1.48  MICROMARKET  8080A/2 7.50 8212 2.30 8214 3.50 8214 3.50 8212 2.30 8214 3.50 8216 1.95 8224 3.50 8216 1.95 8224 3.50 8255 5.40  6800P 7.50 6810 5.95 6820 7.45 6850 4.90 6852 4.85  MC2708 7.50 2114 6.50 4027 5.78 2102 1.70 2112 3.40 2513 7.54 MM4716 4.551	74LS165 1.04 74167N 2.50  CRYSTAL FI 10.7MHz 2 10M15A 1:1 10.7MHz 8 10M4B1 15 H4402 7.1 10M2D 2.4 HF FIRST I B34F8A 34  RADIO CONTI (No splits AM TX:- 3rd OT 30) FM TX:- 3rd OT 30, FM TX:- 3rd OT 30, FM TX:- 10M2D 2.6 Pairs FM Pairs AM  CRYSTALS 32.768 kH 100MHz 1.00MHz 1.00MHz 1.00MHz 1.0.6985MH 1.0.70159MHz 1.0.6985MH	10RB series 33mH-120mH 10RRH serie 120mH-1.5H PIEZO SOUN PB2720  LLTER PRODUCTS FOLE TYPES: FOLE TYPES	0.33  ES 0.55  DER 0.44  LEDS  5MM RED 0.15  3MM RED 0.15  3MM RED 0.15  2.5 X 5MM RED 0.15  3MM GEN 0.15  3MM GEN 0.15  3MM GEN 0.15  3MM GEN 0.16  2.5 X 5MM CN 0.20  3MM YELLON 0.15  3MM YELLON 0.15  3MM YELLON 0.10  3MM YELLON 0.10  3MM YELLON 0.10  3MM YELLON 0.10  3MM YELLON 0.11  3MM ORANCERED 0.20  5MM ORANCERED 0.20  5MM ORANCERED 0.20  5MM ORANCERED 0.10  1.5 S 5MM ORA 0.24  5MM INFRA RED 0.56  BIWAI IR DET 1.51  1.6 CDs  3.5 digit 9.45  5 conder 4.25  8.15  -8 1.2000Hz 4.25  -8 1.2000Hz 4.55  -8 1.1-5000Hz 9.25  5.5-500MHz 8.45  -1 1.1-5000Hz 9.25  5.5-500MHz 9.25	BF195 0.18 BF224 0.22 BF241 0.18 BF274 0.18 BF274 0.18 BF274 0.21 BF440 0.21 BF460 0.21 BF479 0.60 BF6795 0.18 BF479 0.60 BF6795 0.55 BF191 1.33 BFW92 0.60 BF795 0.99 BFY90 0.90 40238 0.85 RF POWER DEVICES VN66AF 0.95 2N3866 0.85 SMALL SIGNAL BF FET/MOSFE BF256 0.38 2SK168 0.35 J310 0.69 J176 0.65 40673 33K51 0.54 J35K45 0.49 J35K51 0.54 J35K40 0.75 BF961 0.70 BF960 0.75 BF961 0.70 BF960 1.24 J35K48 1.64	16v: 0.22,0.33, 0.68,1.00.18 16v: 2.2,4.7,100-19 6v3: 22,470.30 10v: 22,1000.35  ALUMIN ELECTROLYTICS RADIAL (VERT. MOUNT) (UF/Woltage) 1/63,2.2/50,4.7/35 10/16,15/16,22/10 33/6.30.08 22/16,33/10, 47/100.09 10/63,22/50,33/50, 47/16,100/160.10 47/63,100/25,220/16 470/6.30-12 100/63,470/16, 1000/100.18 1 0000/100.18 1 0000/100.18 1 0000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 10000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 1000/100.99 10.95,47.0/160.90 10.95,47.0/160.90 10.95,47.0/160.90 10.95,47.0/160.95 10.00/500.58 RESISTORS 0.25w, 5% E12 CARHON 10xim=10M0.05 HORTZ CARBON PRESETS
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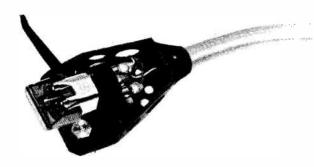
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# PICKUP PRINCIPLES



There have been many features on hi-fi in ETI. We have pondered preamplifiers. We have looked at loudspeakers. We have tested turntables. And now — Ron Harris gives you the needle!

he pickup cartridge is the smallest and most oft overlooked component in the hi-fi chain. Much debate has taken place of late as to the what, which and how of turntables and amplifiers. Speakers have also had their day in the centre of the stage, but cartridges — apart from the resurgence of the moving coil a few years back — have simply and quietly gone from strength to strength. Companies such as Goldring, Shure, Ortofon and Empire have continued to add more art to the science of music reproduction without always receiving due attention or accolade.

There have been many variations on the pickup theme. Such divergences as the electret/capacitive cartridge and the almost universal (cheap and cheerful!) piezo-electric are still for sale in most emporiums, but are of little importance to the main hi-fi market. Two main systems dominate; moving magnet and moving coil.

Both are based upon Faraday's laws of electromagnetic induction, which can be briefly, if a little impolitely, summed up as stating that if you move a magnet around anywhere near a coil of wire, you will cause a voltage to appear across that coil. The voltage will bear a direct relationship to the movement.

## **Elements Of Generation**

Before moving on to a consideration of the important parameters and how they affect performance, let's take a look at how each of the systems work:-

1/ Moving Magnet And Induced Magnet

Figure 1 shows a very generalised view of a moving magnet cartridge. Figure 1a shows the relationship of magnet to record groove and the position of the pole pieces. Axis A allows the two drawings to be related.

As the stylus follows the groove wall the magnet transcribes a similar path, parallel to PR and at varying distance from PL. A voltage is thus generated in the coil which is directly related to the groove information.

All cartridges must be well shielded from external fields generated by such as mains transformers, as the flux changes are minute and such a field can induce an output comparable to the wanted signal. (Hence that all-too-familiar mains hum.)

The most oft employed variation upon this theme replaces the moving magnets with a single high permeability armature (usually iron). The magnets are fixed within the body, with a resulting drop in mass attached to stylus. A voltage is induced into the coils by the movement of the iron armature within the magnetic field. For this reason the technique is called 'induced magnet' or 'moving iron' and excellent examples are marketed by Ortofon and Empire amongst others.

Output levels are generally around 2-3 mV.

#### 2/ Moving Coil

It may come as a surprise to some of the newer converts to the black arts of hi-fi to know that moving coil cartridges have a longer history than the ubiquitous moving magnet. Originally

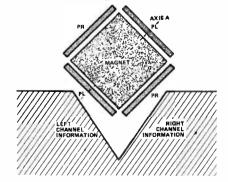


Fig. 1a The mechanical relationship between the pole pieces (which are fixed to the cartridge body), the magnet (which is attached to the stylus), and the record groove wall.

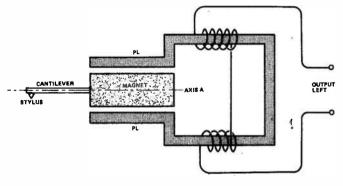


Fig. 1b Axis A can be referred to Fig. 1a to show the positioning of the generator within a moving magnet cartridge.

ETI APRIL 1981



Strange looking things, but every home should have one. This particular point is a close-up Van der Hul stylus as employed in the Goldring G900IGC.

developed by Ortofon, their tracking-ability weaknesses and requirement for a step-up device led to their practical extinction a few years ago. However, the birth of the 'esoteric' hi-fi market and the subsequent interest of the Japanese audiophiles, has led to their virtues being prized over their vices once more.

The principle is extremely simple, and is illustrated in very general terms in Fig.2. The magnets are held in a fixed position within the cartridge body and the coils are mechanically linked to the stylus assembly. As the stylus follows the groove modulations the coils move relative to the magnets, thus generating the required signal voltages.

Output is generally lower, of the order of 0.2 mV and an extra amplification stage (step-up device) is required. However, a new generation of cartridges has arisen which utilise a far greater number of windings on the coils and more powerful magnets to generate a higher voltage level, comparable to moving magnet designs. The need for a step-up device is thus eliminated.

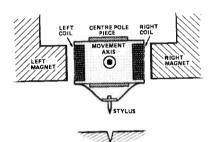


Fig. 2 Moving coil cartridge basics. As the stylus moves the coils, a current is generated within them by the magnetic field from the fixed magnets.

## **Two By Two**

Considering the cartridge to be composed of two separate systems allows the different parameters of each to be evaluated correctly. The two systems are (i) dynamic components:- i.e. stylus, cantilever, pivot and moving generator (ii) static components:- i.e. body, fixed generator elements, electrical connections. If we define the task of the pickup as that of translating the mechanical movements produced at the stylus, by the LP, into an electrical signal for transmission to an amplifier, then we can consider the design requirements for each stage of that translation in turn.

Before proceeding, it should be noted that the pickup cartridge is an integral part of the record playing system as a whole. Many of the design parameters for the cartridge are correctly chosen to optimise the complete system under dynamic condition. In this article we cannot fully explore these interactions, but merely highlight them where they impinge upon the cartridge design directly.

## **Putting On The Stylus**

In order to correctly interpret the record groove, a stylus must remain in contact with the groove wall, and be able to follow each and every modulation. The earliest stylus shape employed was a spherical one, simply because it was easiest to make and required least alignment. This suffered from the disadvantage of an inability to follow the highest frequencies recorded on a disc, because it will get "squeezed out" of the groove once the modulations become shorter than the length of the stylus, measured along the groove.

Elliptical stylii were introduced to overcome this by reducing that length and yet maintaining as large an area of contact with the groove wall as possible. Tracking weights had to be lower to prevent record wear increasing significantly, but the modulation tracing (tracking) deficiency of the spherical tip was overcome. Many companies have since attempted to refine this stylus configuration, with varying degrees of success. Only the Shure hyper-elliptical appears to offer any real advantage over the basic design, having an increased tracking ability and better high frequency definition.

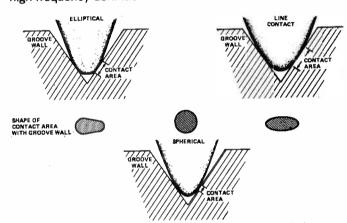
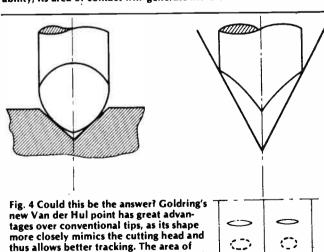


Fig. 3 The three most common stylus profiles and their relative parameters. Note that whilst the elliptical offers a greater tracking ability, its area of contact will generate increased record wear.



contact is also larger than for an elliptical

(see small drawing).

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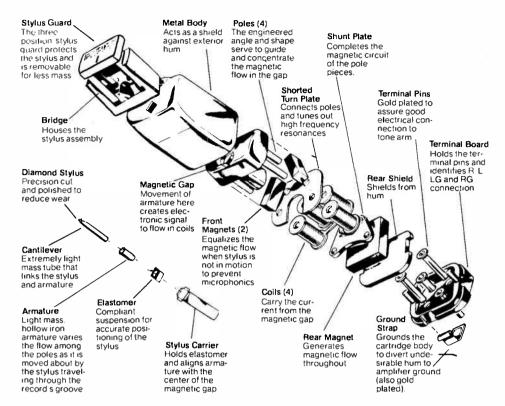
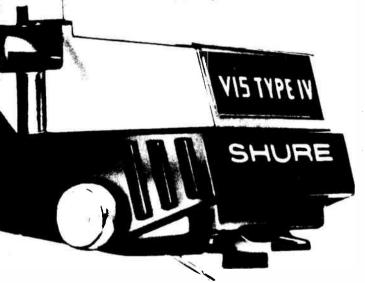


Fig. 5 This exploded view of an Empire induced magnet design gives an indication of the lengths that top manufacturers will go to in order to beat reasonances and colourations.

A still later development has been the line-contact stylus, (Shibata) which has attempted to get closer to the shape of the cutter head used in the initial production of the disc - this would obviously allow it to follow the groove more closely than anything else. Contact area would also be increased, with a resultant reduction in record wear. This type has reached its zenith with the introduction of the Goldring G900IGC cartridge and its Van der Hul stylus. It dramatically improved the performance of the G900 series and would seem, at the moment, to be closer to The Answer than anything else.



This V15IV attempts to optimise its own working conditions by using a damped, static-conducting 'rider' brush, operating ahead of the stylus. Warp effects are drastically reduced.

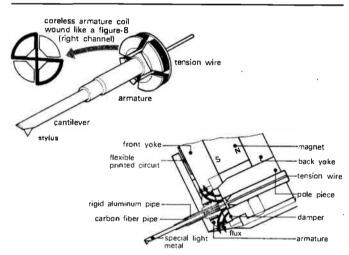


Fig. 6. A cross-section of a Sony moving coil pickup, showing how the coils are miniaturised to decrease the mass of the moving element, thus improving transient behaviour.

## **Cantilever Leavings**

The stylus is joined to the generating element, be it coils or magnetic material, by the cantilever. It should be so attached that it tracks the disc at 20° to the vertical, (vertical tracking angle), since this is the cutting head angle and any deviation from this will be yet another source of distortion. (20° is, in fact, not yet a totally standard figure, but is the most used and best compromise figure we have).

If the cantilever were a totally rigid coupling then the pickup would be just as totally unable to produce a signal from the record, since the stylus would be prevented from moving with the groove. If it were too compliant, then the slightest warp or variation in surface would destroy the unit, with the arm mass

inertia bending the cantilever out of shape.

Compliance is thus an important compromise parameter. The higher the compliance the lower must be the arm mass for the correct operation. This is because, like any mechanical system, the two working together will possess a resonant frequency — i.e. they will move easier at one frequency than any other, producing a non-linear response. Since the usable audio band extends approximately from 20 Hz-20 kHz and disc warps generally produce a signal somewhere around 6 Hz the ideal compromise is to place the system resonance between the two.

Combinations of compliance and arm mass are chosen to achieve this aim. Low mass pickup arms score a few points here as mass is easily added to these to 'tune' the resonance to an ideal frequency. If an arm is too heavy for a particular cartridge then there is little that can help — short of a hacksaw! For that reason alone, I tend to favour the SME Series III for all but a couple of cartridges — and those are low compliance, low output, moving coil designs, for which there exist specially designed carriers

Compliance is normally measured in Compliance Units or CU where 1 CU =  $1 \times 10^{-6}$  cm/dyne.

**Damping For All** 

All cartridge cantilevers are 'damped' to some extent, to control the resonances of the system. Some companies eg Ortofon (in the MC30) employ a complex mechanical linkage to overcome both the low frequency resonance and that at around 18 kHz — way at the other end of the spectrum — excited by the interaction between the record itself and the stylus. It is this resonace, and how successfully it is controlled which, more than any other single factor, determines how well a cartridge will audition.

A large number of factors are involved here; the mass of the stylus tip itself, the length of cantilever, compliance, damping of the pivot and the mass seen by the stylus reflected back from the arm through the cantilever, ie the effective mass of the system. It is an unfortunate fact that the better solutions to the problem are all expensive, which is why cartridges continue to cost a comparable amount of money, per ounce, to precious metals.

## **Generators**

In the case of moving magnet designs the requirement for the fixed coils is fairly straightforward. The vast majority of amplifiers carry a 47k input, which is designed to accept these units. This makes electrical matching a fairly simple affair. The greatest source of contention will be the level of capacitance that the cartridge will be subjected to as a load. Too high a value will act as an HF filter and 'dull' the cartridge sound significantly. Too little will subjectively boost the treble, giving increased noise and a harsh brittle sound. Manufacturers always specify a capacitance value at which their unit performs best and this should be rigidly adhered to. Add about 150pF, for arm leads, to the input value of the amplifier and adjust by adding capacitors if necessary — ±15% will generally be close enough.

Some units, such as Grado are uncritical to a great extent, whilst others, eg Goldring, will have their subjective performance jeopardised if the value is not adjusted properly.

Moving coils present a more involved problem. The output here is too low to be connected directly to a conventional pickup, and so too is the impedance, so the step-up device must act as a buffer stage as well as providing the gain needed to allow normal usage. Impedance levels are of the order of 10-40R and as the device is essentially a current generator, noise will be a problem if matching is not precise. Again the easiest way around this is to stick with the manufacturer's recommendations as to which unit performs best with his cartridge.

**High-Outputs** 

The latest generation of moving coil cartridges employ a generator technique which obtains outputs of around 2 mV, allowing their direct connection to a standard input. The coils in these models are generally wound with many more turns of wire to produce a higher voltage from the same magnetic field strength. The impedance is also 'padded' by this technique to improve matching. However, the resultant unit 'gain' has led some companies into problems with hum induction and electrical matching difficulties, despite their precautions.

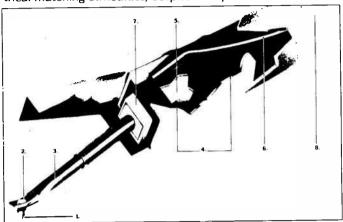


Fig. 7. So you thought cantilevers were simple? Take a look as this Shure version:- 1. Full diamond stone, meticulously shaped and polished, then assembled into an accurately machined mounting. Hyperelliptical in the V15 Type IV; hyperbolic in the M24H; biradial (elliptical) in the V15 Type III, and spherical in the V15 IV-G. 2. Doubly secure mounting — aligned, the diamond is first fitted into its socket, then high-temperature cemented to ensure permanent geometric orientation. 3. Ultra-thin-wall stylus shank — telescoped structure in V15 Type IV for low mass. Beryllium interior control lever in V15 Type III, M24H, M95 Series, M75 Type 2, and M91 Series for rigidity where needed to prevent tracking errors. 4. Viscoelastic suspension block — the efficient "heart" of the bearing which defines the pivot point of the stylus. In the V15 Type IV and M24H, a two-function bearing system separately optimized for high frequencies and for low frequencies. 5. High-energy magnet with electromachined aperture for exact positioning of stylus shank. Pivot location ensures minimal contribution to effective mass of moving system. 6. Precisely adjusted, resonance-free support wire. 7. Pivot control — correct location and function of bearing and support wire ensured. 8. Stylus assembly carrier — placement of stylus assembly relative to pickup coils within cartridge body is optimised. Not so straightforward really, is it?

Ultimo produce perhaps the best known examples of highoutput moving coils and they are also renowned for requiring very high capacitive loading, well in excess of the levels normally found in amplifier circuits. Correctly loaded, though they possess a very high sound quality and avoid the need (and expense) of a step-up device altogether.

## **Conclusions**

Summarising briefly then, a cartridge has to extract the mechanical information from the record groove without passing on any appreciable vibration to the pickup arm if possible, and translate this into as faithful an electrical signal as possible; it must not be affected by warps or distortions in the vinyl surface; it must be impervious to electrical fields produced by motors, transformers etc and, ideally should be totally insensitive as to which pickup arm it is used in.

Any cartridge which met those requirements could be safely described as perfect, and whilst we are unlikely ever to have such a unit offered for sale, some of the approximations we do have are really incredible engineering achievements when you consider the difficulties involved, — whether you happen to like the sound of them, or not!

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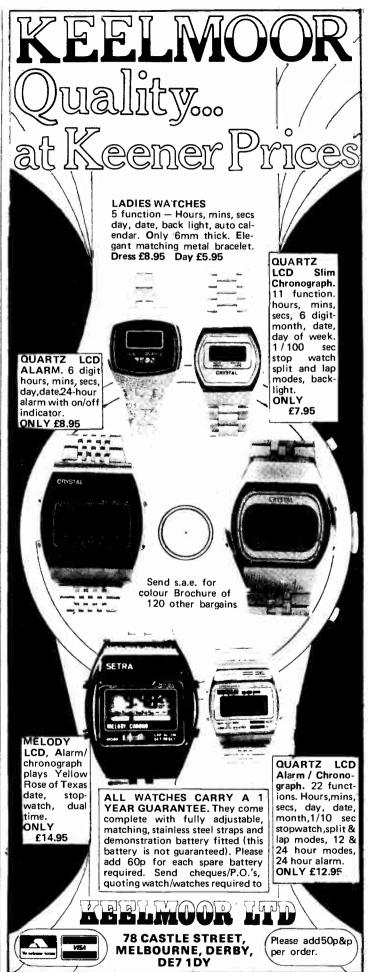
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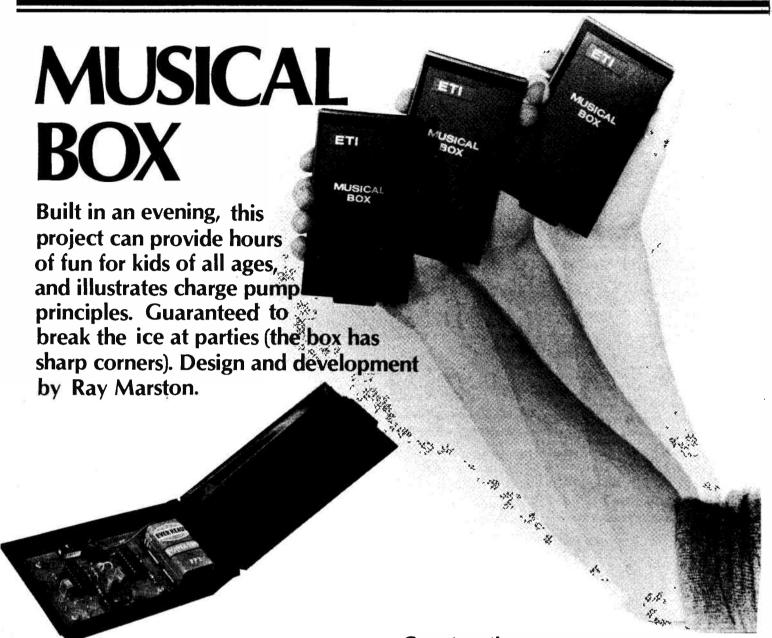
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his neat little novelty project contains a variable-frequency master tone generator and a variable-rate gate oscillator, both activated by a single built-in mercury tilt switch. The output of the tone generator is fed directly to a miniature acoustic transducer (sound generator); the frequency of this generator slowly rises when the tilt switch is open or slowly falls when it is closed. The gate oscillator is used to pulse the master tone generator on and off. Its operating rate is proportional to the switching rate of the tilt switch; the rate decays slowly towards zero when the tilt switch takes up a stable state.

Thus, if the unit is gently tilted downwards, a rising tone is generated; tilt the unit upwards, and a falling tone is produced. Give the unit a gentle shake and the tone will be pulsed on and off at a slow rate. Shake the unit vigorously and the pulse rate will rise to a high value. In all cases, the tone can be increased or decreased by suitably tilting the unit. A whole range of sounds can be produced by shaking and/or tilting the unit.

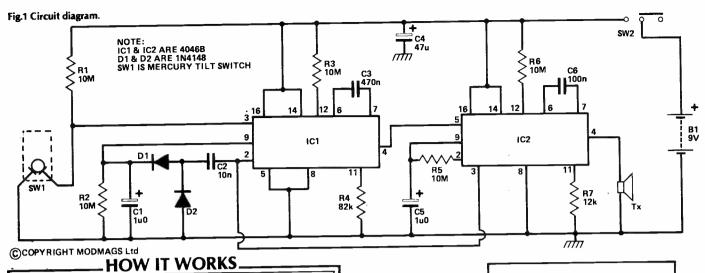
The unit is housed in a pocket-sized 'flip-top' black case. The unit's on/off switch is mounted directly on the PCB, access to the switch being gained by flipping open the case top. The unit is powered by a single PP3 battery.

## Construction

This is a very easy project to build, since all of the circuit's components (including the battery and the acoustic transducer) are mounted directly on a single PCB. The PCB is designed to fit into the Verobox mentioned in the list of components.

When building the unit, note that the two CMOS ICs should be mounted in suitable sockets. Other points to note are that two bridging links are used on the board and that the mercury tilt switch is fixed by soldering it to Veropins (see photograph). On/off switch SW2 is a sub-miniature PCB-mounting type, soldered directly to the board. Don't solder the transducer leads yet.

When construction is complete, fix the acoustic transducer (Tx) to the underside of the PCB (below the large unetched copper area) with double-sided sticky pads. Now pass the transducer leads through the hole near the centre of the board and solder them in place. Fix the PP3 battery in place on the PCB, again using sticky pads. Now fix the completed PCB into the specified case, after first drilling a large hole in the case below the position of the acoustic transducer. Finally, switch the unit on, snap the lid shut, give it a shake, and sit back and enjoy the sounds.



The circuit contains two wide-range voltage-controlled oscillators (VCOs), each built around a 4046B IC, together with a mercury tilt switch and some switch-conditioning circuitry. The two oscillators are basically similar, their frequencies being determined by the input voltage on pin 9 (of the 4046B ICs) and by the values of the capacitors/

resistors connected to pins 6, 7, 11 and 12.

The 4046B ICs contain a variety of elements in addition to the VCOs. In our circuit, the most important of these is an EX-OR gate which, in our application, is wired as a simple pulse inverter with its input at pin 3 and its output at pin 2. We use these inverters as part of the

witch-conditioning circuitry.

The mercury tilt switch is wired to the input of the built-in inverter (pin 3) of IC1: the output of this inverter (pin 2) is connected to the input of the inverter of IC2. If the tilt switch is opened, these two inverters cause the pin 2 voltage of IC2 to switch to a high value, so C5 starts to charge up via R5, thereby causing the VCO in IC2 to generate a rising tone signal in the acoustic transducer. When the tilt switch closes, pin 2 of IC2 switches low, causing C5 to discharge via R5 and so generating a falling tone.

The inverted switch output of IC1 (pin 2) is also fed to a charge pump circuit (designed around C2-D1-D2-C1-R2), which causes a small amount of charge to be fed to C1 each time that the tilt switch activates. This charge leaks away slowly via R2, so that the mean voltage of C1 is proportional to the rate at which the tilt switch is operated or shaken. The C1 voltage is used to control the VCO frequency of IC1, and the output (pin 4) of this IC is used to gate the VCO of IC2 on and off via pin 5.

Thus, the operating frequency of IC2 is controlled by tilting the mercury tilt switch and the pulse rate is controlled by shaking the

switch.

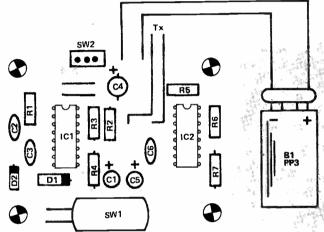
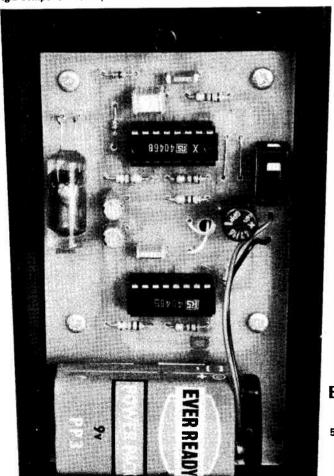


Fig.2 Component overlay for the Musical Box.

#### PARTS LIST. Resistors (all 1/4 W 5%) R1,2,3,5,6 10M R1,2,3,5,6 82k R4 **R7 Capacitors** 1u0, 16 V electrolytic (PCB-mounting) C1,5 10n polyester C2 C3 470n polyester 47u, 16 V electrolytic (PCB-mounting) 100n polyester Semiconductors 4046B IC1,2 1N4148 D1,2 Miscellaneous mercury tilt switch SW<sub>1</sub> sub-miniature PCB-mounting slide switch SW2 PB-2720 transducer Verocase, order no. 202-21317 BUYLINES

The only unusual components here are the mercury tilt switch and the acoustic transducer. The transducer is available from Ambit International.

The tilt switch used in our prototype is available, to order, from Watford Electronics.



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Vs	± 20V
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Cost	11 (01.00 01 1 2000)
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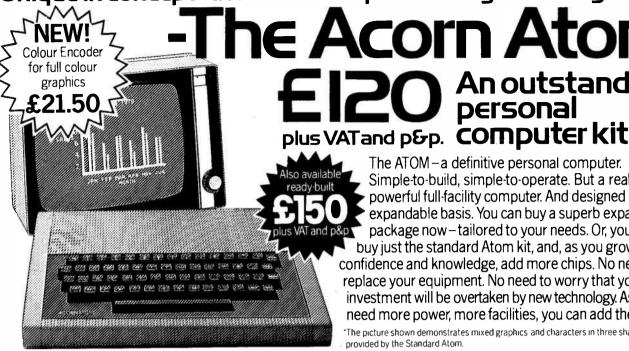
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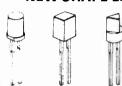
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404	0.47uF 16v	0.11	417 2	2uF 35v	0.12
405	0 68uF 16v	0.11	418 .3	3uF 35v	0.12
406	1 OuF 16v	0.11	419 4	7uF 35v	0.12
407	2.2uF 16v	0.12	420 6	8uF 35v	0.12
408	3.3uF 16v	0.13	421 1.	DuF 35v	0.12
409	4.7uF 16v	0.14	422 2	2uF 35v	0.13
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# **MICROBASICS**

Having dealt with the hardware, Microbasics now takes a look at its use. Programmers aren't born, they're... programmed? A.P. Stephenson explains how.

rogramming entails far more than the mechanical mastery of the BASIC language. However cunning you are with the IF/THENs, however nifty with the FOR loops, however subtle with ON GOTOs and however flashy your attack on the keyboard, you can remain in a time-wasting rut unless all this brilliance is tempered with self-discipline.

The media in general and the American TV slush programs in particular would have us believe that programmers have an IQ of three figures and walk about with glazed eyes and swollen brains. This is absolute codswallop. The primary attribute required of a programmer is patience. The secondary attribute is a

strong sense of method.

A programmer must also have compassion. Consideration for the poor wretch who must use the program afterwards is not always taken as seriously as it should be. Rather paradoxically, this compassion should also be directed inward. A month or so can elapse between the start and finishing date of even moderately sized programs, at the end of which the details of the structure seem to be indelibly printed in the mind... dangerous and often entirely false assumption. A year after writing it, scrutiny of the listing may fail not only in recalling to mind how the thing works but in many cases may not even be recognised as one's own work! Superficially, this would appear to be unimportant. It worked when I wrote it so why the hell does it matter if I can't understand it now? This is a comforting philosophy if the program was perfect, complete, covered all possible variations and was immune to constructive criticism. The probability of this is about as remote as finding a farmer who confesses to making a profit. In truth, any program will eventually reveal annoying deficiencies or omissions with the result that modifications are reluctantly forced upon the original masterpiece. It is at this time that the programmer may wish a little more care had been taken in the original version. A few more REMarks, perhaps, or a few less purposeless GOTOs all over the place... in short, a little more compassion.

A programmer must also be willing to learn from others. To put it more bluntly, you must not be afraid to cheat a little by indulging in controlled plagiarism. Programs in magazines should be studied for novel twists, clever little short cuts or elegant new solutions to old problems. Most 'inventions' are ninety-nine percent other peoples' ideas, plus perhaps a few additions or rearrangements. The same applies to programs.

For example, the well known trick used in the PRESS ANY KEY TO CONTINUE situation:

200 GET K\$: IF K\$ = "" THEN 200

must have been invented by somebody and yet we all use it at times. But this is obvious you might say. So is the safety pin now, but the 'inventor' is alleged to have made a fortune. There is of course a respectable middle of the road approach between blatent stealing of an entire program (perhaps with a few pathetic attempts at disguise by changing the names of a few variables) and complete avoidance of all previous ideas.

A programmer should be familiar with the programming language. This should be self-evident but surprisingly is not always the case. It is easy to become hooked on a small subset of the language and neglect some of the keywords because they

are difficult to understand. The string handling keywords LEFT\$, RIGHT\$, MID\$ AND STR\$ are particularly neglected in BASIC and even subscripted variables are sometimes shunned. Before embarking on any ambitious project, any weaknesses in this area should be patched up by re-reading the manual and practising at the keyboard. Learning to program is like learning to play the piano. You practice difficult exercises even if they sound boring.

Last but certainly not least, a programmer must be dedicated. Once a program has been started, whatever difficulties arise, it must be finished. Shelving a program because it becomes difficult is disgraceful, pretending it was due to the usual 'lack of time' is worse. Unfortunately, it takes some time before you acquire an instinct for assessing the 'complexity potential' of a given programming project. However dedicated, it is no good carrying on if the project turns out to be beyond your capabilities. There is a balanced midway approach between dedication and pigheadedness which can only come with experience.

## **Before Sitting At The Keyboard**

Serious works on programming have traditionally sneered at the thought of 'writing' a program at the keyboard. The correct approach, we are told, is to first draw the flowchart and then the coding on paper... only then should we sit at the keyboard. Whilst agreeing with the general principle, it is a little hard to stick rigidly to such idealistic advice. In the days when the main (or usually the only) peripheral was the printer and the keyboard was operated under time-sharing disciplines it was too expensive on paper and computer time to monopolise the keyboard for trial-and-error programming techniques. In the modern era of the personal computer the situation is easier and the advice can be taken less literally. However, it is advisable to scribble out a rough flowchart outlining the strategy to be employed before the bout of keyboard bashing.

Regarding flowcharts in general, there appears to be a growing doubt as to their usefulness in some quarters. It has even been suggested that most programmers write the program first and the flowchart afterwards just to please the academic Establishment. In other words the flowchart is used to explain how the program was designed rather than as a prelude to the actual design. The structure of a flowchart is beginning to show basic changes. A new idea entirely is superseding the old scheme. Thus, the flow in the new flowchart is from left to right with progressively more detailed levels of 'explanation' beneath. If you are experienced, the first left — right level is sufficient without assistance from lower levels. An idea of the difference between the old and the new can be gained by examining Fig.1 and Fig.2.

Deeper levels of even greater detail can be shown if desired. This leads on to the idea of structured programming which is a set of rules and regulations which advanced programmers are now expected to use when they are part of a team. Anyone interested should buy a book on the subject if they want to get with it!

ETI APRIL 1981

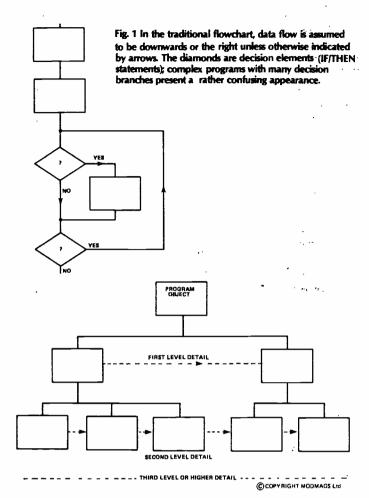


Fig. 2 In the modern flowchart, flow is only from left to right (the arrows shown are normally omitted). The different levels of detail simply 'explain' how the level above is programmed. If you are clever, the crude first level is sufficient to understand the program structure; the second level merely explains more fully how the first level works.

Back to earth again. Get hold of a folder, preferably a loose leaf ring binder, and collect vital pieces of information such as POKE numbers and codes, hex to decimal conversion tables, an abridged BASIC keyword list, the memory map (and in particular, the screen memory map), cuttings from magazine articles etc. etc. But watch the Parkinson syndrome. The binder can get fatter and fatter and particular information more and more difficult to locate as the collection grows. Be ruthless and periodically spit out the muck which, in this sense, means anything you now KNOW.

One final piece of advice... have some scrap paper and a pencil by the side of you. Once you get locked-on to a computer keyboard, it becomes an effort of will to get up and search for a pencil. Consequently you will try to memorise GOTO line numbers and almost certainly forget them once the listing scrolls back.

## **Starting At The Keyboard**

Rule 1. Always have a blank (or rubbish) tape in the cassette, fully rewound, and another by the side. As soon as a reasonable segment of the program has been entered and roughly proved, get it onto tape and rewind it again. Then place the other tape in the cassette and continue with another segment and then tape it. The reason for this advice is based on the following possible hazards:

a. another member of the household or workshop, unac-

quainted with the volatile properties of RAM may suddenly decide to unplug the PET in order to use the iron!

b. the current segment you are working on has been the subject of an improvement. . . but a bug shows up and you get lost. Frantic efforts to remember the pre-modified version to get back to safety often fail miserably.

Under these conditions the advantage of a "fall-back" tape is obvious. By continually swopping the tapes as the program progresses, each one being a proven update of the last, much frustration can be avoided without the expensive assistance of the psychiatrist.

**Rule 2.** Risking the charge of advertising, PET owners should save up and get the PROGRAMMER'S TOOLKIT. This is without doubt the most useful aid to programming the PET you are ever likely to meet. Once you have used it, it appears to be indispensable. No more ragged line number sequences. No more endless searches to discover which variables have been used and which haven't. The ability to append subroutines to programs on tape is a joy to behold and operate. All this at seemingly lightening speed and idiot-proof in operation. (This should bring me a crate of whisky at Christmas).

One word of advice regarding the RENUMBERING facility. Avoid renumbering too many times during program development. This is not due to any technical reason but to the erasure of previously memorised GOTO line numbers. The TOOLKIT changes all the GOTO and THENs accordingly but it doesn't change your memory with it! As far as possible, renumber after the last bug has been hurled out of the system.

## **Developing The Program**

There are no rules... just keep pegging away until you have 'finished'. To finish a program is perhaps the most elusive of all the arts. The elusive nature is seldom due to unexpected difficulties in the actual programming. It is a self-inflicted elusiveness resulting from, on the one hand a growing confidence, and on the other a dissatisfaction with the original terms of reference. The original moderate aim gathers momentum and the 'end' is pushed further and further away, the number of lines grow and grow, the number of variables increase, the facilities offered are increased until the bomb bursts with a polite but spine chilling message... "OUT OF MEMORY ERROR IN LINE 2.597E25".

The moral from all this can be summed up in one sentence: Decide the aim, stick to it, write it, debug it, test it, save it and switch off.

## **Testing The Program**

After the crude bugs have been cleared and the programmer is satisfied with it, the real testing should now begin. It is necessary to enlist the aid of an independent guinea pig with no prior knowledge of computer keyboards. The luckless individual should be persuaded (or forced) to sit down and operate the program. Signs of consternation should be noted and the offending message from the screen should be earmarked for amendment. It is an astounding law of nature that if the message . . . "PRESS ANY KEY TO CONTINUE" meets the eye of certain guinea pigs, their diabolical little finger will jab at the STOP or the SHIFT LOCK keys; this in spite of there being about seventy other keys to assault. If you subsequently change this to PRESS SPACE BAR, the very size of the thing seems to make it transparent to the gaze and the eyes will be seen to oscillate wildly as they search for a key marked "SPACE BAR". The air usually becomes charged with emotion, sarcasm is freely interchanged between programmer and guinea pig, at times even escalating to full scale military activity. It is all very disappointing and sad for anyone trying to become a programmer. But don't let that discourage you.

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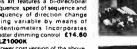
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MK5 MAINS TIME 8

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## MINI

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10 R 22 R	5p 5p	1N5401 3A/50V	8p
33 R	5p	1N54Q43A/400V	10p
47 R	6р	1A 50V Bridge	19p
100 R	8p	1A 400V Bridge	22p
220 R	11p	3A 50V Bridge 3A 400V Bridge	48p
470 R	14p	(Bridge rectifiers are miniature PCB mounting to	58p
1000 R 47 A	20p 8p	(bridge rectifiers are miniatale r cb modifiling	(ypes)
100 A	8p		
220 A	12p	VMOS POWER FETS	

1N4004 1A/400V	6p
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1N5404 3A/400V	10p
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# NOISE GENERATOR

Despite what the average audiophile will tell you, noise can be useful. This noise generator with sample and hold facility is the basic building

block for Project 80 sound effects. Design and development by Charles Blakey.

oise sources are essential for the synthesis of many sounds. These range from musical instruments, such as pipe organ and percussive devices, to natural sounds like wind, rain and surf, and to man-made sounds such as steam engines, explosions and gunfire. The 80-12 module provides white noise, which has the characteristic hissing sound, pink noise, which is deeper in intensity, and a low frequency noise (sometimes referred to as red noise). The low frequency noise may also be used as a random modulating source.

A sample and hold circuit, also incorporated, allows external sound sources to be sampled and converted into control voltages for, say operating a VCO. The sample and hold unit, therefore, provides a means by which the synthesiser can play itself.

**Noisy Networks** 

In this design white noise is produced by reverse biasing an NPN transistor, since this method produces a wide bandwidth. The main problem with this technique is the low amplitude of the noise and often the need to try several transistors to attain the desired amplitude. This has been largely overcome by using a two stage amplifier, IC1a and IC1b, which allows the overall gain to be varied between about 100 to 5700 times. As an additional safeguard the transistor is mounted in a socket to facilitate trying other devices, should the amplitude prove insufficient. White noise is defined as having equal energy per cycle and pink noise equal energy per octave. To derive the latter requires the white noise to be filtered at  $-3 \, dB/octave$  and, since filters usually have slopes of 6 dB/octave, a 3 dB type has to be approximated. Note that other variations in noise colouration may be obtained by filtering the white or pink noise with Project 80 filters 80-6 or 80-7. The low frequency noise is obtained by low pass filtering the pink noise using a 6 dB/octave filter with a cut-off frequency of about 16 Hz (constructed around IC1d). The white and pink noise outputs will be in the range 5-10 V p-p while the low frequency noise is 10 V p-p.

The sample and hold circuit uses the principle of gating a FET, Q2, on and off and storing the sampled voltage on C16, which is buffered by voltage follower IC5b. FET gating is achieved using a CA3140E, configured as a comparator such that a positive clock pulse will cause it to go high (about 13 V) and allow the signal through to be stored on C16. When the clock pulse is near zero, IC4 will swing to about -14 V and gate the FET off. If the signal being sampled is varying rapidly in amplitude, it is essential that the clock pulse be short otherwise the output will not be in discrete steps but will follow the variations in signal amplitude while the clock pulse is high.

The internal clock in the 80-12 uses a CMOS 555 timer whose sampling rate may be varied from about 1 cycle per 4.5 S to 25 Hz. The pulse width is adjustable and the output from the clock, buffered by IC3, is available for use as, say, a



PROJECT 80 NEWSFLASH: Due to considerations of space and time, the final Project 80 module, a combined effects unit (containing an external Input Interface and Dual Ring Modulator), the system keyboard and the keyboard controller will now be available in a booklet at the end of February. To get your copy send a cheque or postal order for £2.95 (including postage and packing) to: ETI/Project 80, 145 Charing Cross Road, London WC2H OEE.

synchronising trigger on an ADSR. Provision is made for using an external clock and the pulse output from the 80-2 VCO or 80-3 VCLFO is suitable.

Achieving the desired results depends on the clock rate and the amplitude of the signal being sampled. The latter may be attenuated by RV2. Additionally, when using a VCO as the clock, the pulse width is another variable for special effects.

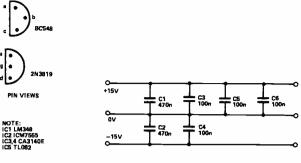
## **Construction And Setting Up**

Setting up the noise generator is simply achieved by adjusting PR1 to obtain the desired amplitude. This may be done in three ways: (a) using a DMM on the white noise output and adjusting PR1 until a reading of about 1V8 to 3V2 is obtained on the AC range; (b) using an oscilloscope and observing the white noise output while adjusting PR1 to obtain a peak to peak output of 5-10 V; or (c) connecting the output of the low frequency noise at R16 to a DC voltmeter and adjusting PR1 until occasional readings of about -7 V are obtained when observed over a period of a few minutes. With most analogue meters the above readings will be approximately halved. With some transistors it may be possible to obtain the correct amplitude of the white and pink noise by increasing the gain with PR1, but the amplitude of the low frequency noise will be too high. In the latter circumstances the best approach is to try another NPN transistor rather than alter the value of R14

Only one adjustment is required in the sample and hold section, namely, to adjust PR2 to obtain a short pulse output from the internal clock based on IC2. This adjustment should be made in the following sequence:-

a) Connect the low frequency noise output to the signal input of the sample and hold with RV2 fully clockwise.

59



- b) Connect the output of the sample and hold to a VCO with the coarse frequency control set to mid position and one of the waveforms connected to an amplifier.
- c) Set RV1 (clock rate) to about 75% rotation which should give a sampling rate of about 2-3 Hz.
- d) Turn PR2 fully anti-clockwise and switch power on.
- e) After a few seconds delay slowly turn PR2 clockwise until the VCO output starts changing frequency in a step-wise manner.
- f) Finally check that the VCO continues to change step-wise over the full range of the internal clock (RV1) and if necessary turn PR2 further clockwise until this is achieved.

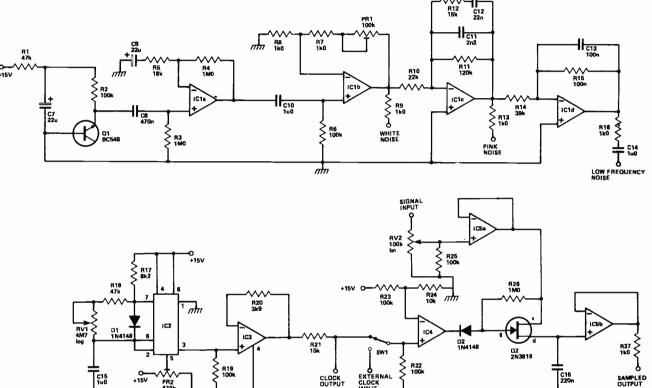


Fig.1 Circuit diagram.

## **HOW IT WORKS**

nhn

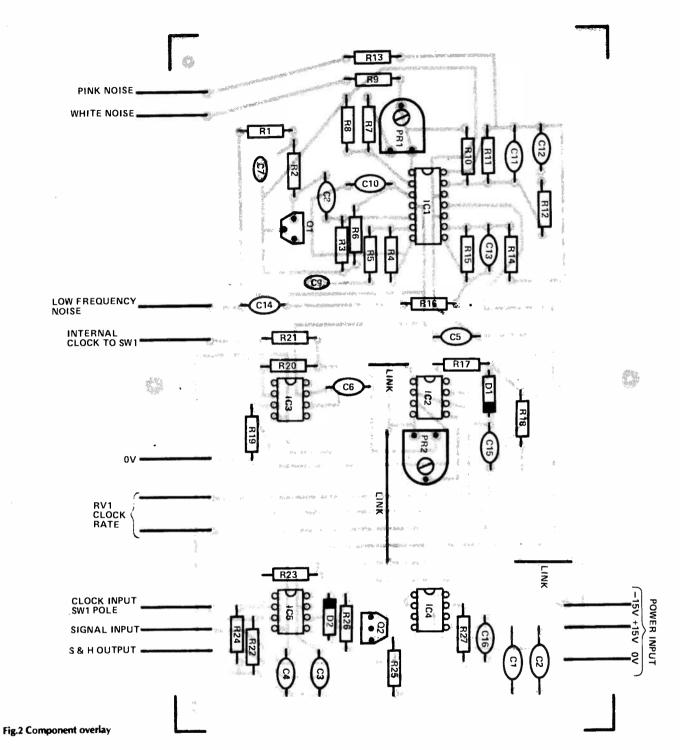
Reverse biasing the NPN transistor, Q1, will generate noise at its baseemitter junction. The few millivolts of noise at the output of Q1 has to be amplified to the levels required for the synthesiser and this is achieved with two AC coupled non-inverting amplifiers configured achieved with two AC coupled non-inverting amplifiers configured achieved with two AC coupled non-inverting amplifiers configured again of the IC1b amplifier may be adjusted from 2 to 102 by means of PR1. The overall gain of the amplifier section may, therefore, be varied from 113 to 5760 times. The amplified white noise is available via R9.

To obtain pink noise it is necessary to filter the white noise by -3 dB/octave and a close approximation over the audio range is obtained with the active filter built around IC1c. R11 and C11 form a first order low pass filter with a cut off frequency of 663 Hz, while R12 and C12 are an augmenting integrator which has an output proportional to the input signal added to an output proportional to the time integral of the input signal. The frequency response of the latter is relatively flat above about 1 kHz and below this frequency the incoming signal is attenuated at a rate of 6 dB/octave. The combination of R11/C11 with R12/C12 achieves the -3 dB/octave response and the pink noise output is available at R13. The low frequency noise is obtained by using a first order low pass filter with a cut off frequency of about 16 Hz and this is obtained with IC1d, R15 and C13 with the output being available via R16 and C14.

In the sample and hold network a signal is applied to the source of FET, Q2, via IC5a configured as a voltage follower and whose signal

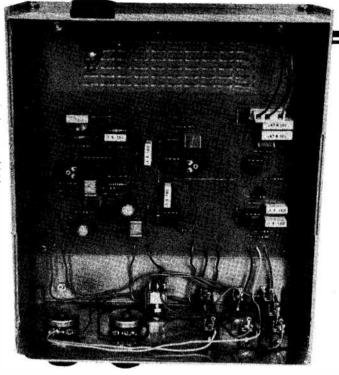
input may be attenuated by RV2. When Q2's gate is positive, the signal passes through and the voltage present at the signal input will change the voltage on C16 accordingly. If Q2 is gated off the last voltage on C16 is held, since leakage is kept low by buffering it with a voltage follower based on IC5b. By sampling the input for only very short dura-tions, the voltage on C16, available at R27, will be a series of discrete steps which may in turn be used to control voltage controlled modules. The negative to positive voltage transition for gating Q2 on for sampling is obtained with IC4 configured as a comparator. With a near zero voltage at the non-inverting input of IC4 its output will be close to the negative rail voltage of - 15 V and Q2 will be off. When a positive pulse is applied to the non-inverting input then IC4 goes positive (about + 13 V) and turns on Q2 so that a sample of the signal voltage can be taken and stored on C16. The internal clock used to turn Q2 on and off via IC4 is based on CMOS 555 timer, IC2. The pin configuration and operational features are the same as a bipolar 555 but the CMOS version has advantages in terms of power consumption and absence of crowbarring the power supply during the output transition. A conventional astable configuration is used and, while D1 allows a wide range of duty cycle, the main adjustment for the latter is the application of a positive voltage to its control voltage input, pin 5, via PR2. The output of the timer is buffered by IC3 so that it may be used for external synchronisation purposes. The output also goes via an SPDT switch, SW1, to comparator IC4. The switch allows external clock sources to be used.

## **PROJECT: Noise Generator**



1	P.	A	R	TS	I	IST	ľ

Resistors ¼ W 5% car	bon	Capacitors		PR1	100k carbon
R1,18	47k	C1,2	470n polyester	PR2	470k carbon
R2,6,15,19,22,23,25	100k	C3,4,5,6,13	100n polyester	Semiconductors	
R3,4,26	1M0	C7,9	22u 25V PCB electolytic	IC1	LM348N
R5	18k	C8	470n MKH polyester	IC2	ICM7555 IPA
R7,8,9,13,16,27	1k0	C10,14,15	1u0 MKH polyester	IC3,4	CA3140E
R10	22k	C11	2n2 polystyrene	IC5	TL082 CP
R11	120k	C12	22n polycarbonate	D1, 2	1N4148
R12	15k	C16	220n MKH polyester	Q1	BC548
R14	39k		• •	Q2	2N3819
R17	8k2	Potentiometers/Trimmers		Miscellaneous	
R20	3k9	RV1	4M7 linear	SW1	5PDT miniature toggl
R21,24	10k	RV2	100k linear	Transistor holder	



## **.PROJECT : Noise Generator**

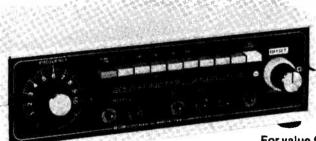


BUYLINES

The 80-12 Noise Generator — Sample & Hold module is available as a kit with PCB and all listed components for £13.17, inclusive of postage and VAT, from Digisound Limited, 13 The Brooklands, Wrea Green, Preston, Lancs. PR4 2NQ.

ETI

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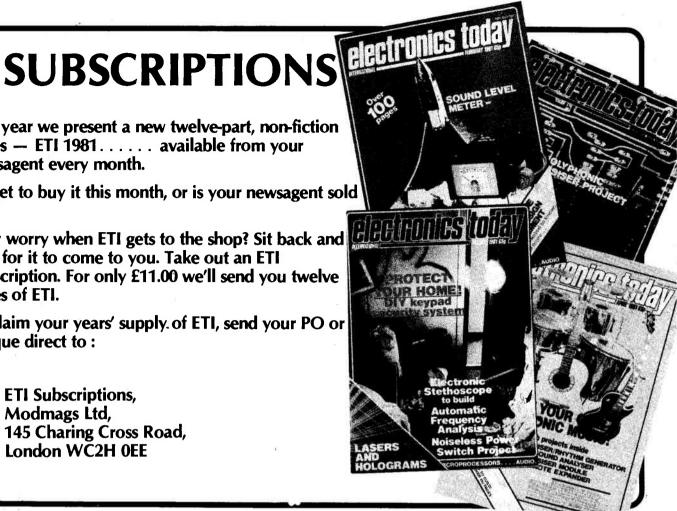
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# DESIGNER'S NOTEBOOK

Certain elementary safety precautions must be taken when handling CMOS ICs or designing CMOS circuits. Ray Marston explains all in this month's 'Notebook'.

arly CMOS ICs earned a reputation for being easily damaged by static electricity, either when being handled or when being soldered into circuit boards, etc. Subsequently, manufacturers tried to overcome this 'fragility' problem by providing the ICs with extensive built-in input and output protection on each gate in each package. These protection networks do a fairly satisfactory job, but provide the design engineer with a few extra problems when designing CMOS circuits. This month's Notebook takes an in-depth look at the subject.

## **CMOS Protection Networks**

CMOS ICs are, by definition, Metal-Oxide Semiconductor devices, in which the input signal is applied to the near-infinite impedance (about 10<sup>12</sup> ohms) of the metal-oxide gate. Typically, the gate oxide has a breakdown voltage of about 80 V: if a gate oxide break-down does occur, the resultant damage to the device is catastrophic and irreversible. To protect the CMOS against excessive input voltages (particularly arising from static energy), all modern CMOS ICs are provided with extensive built-in protection on all inputs and outputs.

Figure 1 shows the standard protection network that is used on the vast majority of B-series CMOS devices. Here, all diodes marked as 'D1' are used to prevent the input or output from swinging more than 600 mV below the  $V_{SS}$  (0 V) rail, and all diodes marked as 'D2' are used to prevent the input or output from swinging more than 600 mV above the  $V_{DD}$  (supply positive) rail. D3 is intended to prevent the  $V_{DD}$  terminal from swinging negative to the  $V_{SS}$  pin (electrostatically) when the device is being handled.

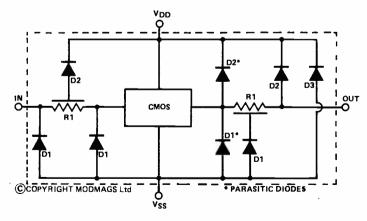


Fig. 1 These are the standard electrostatic-discharge protection networks used on most B-series CMOS ICs. The two diodes associated with the resistors are distributed across the entire resistance, as shown.

There are a couple of minor exceptions to the standard version of the protection network. One of these is the type used on the 4049B and 4050B series of hex buffer/converters which, as shown in Fig. 2, have their inputs free to swing well above the  $V_{\rm DD}$  rail. These particular ICs are specifically intended for use in logic-level conversion applications, in which (for example) the input may come from a  $12\,V$  CMOS network but the output and the IC supply rail are matched to a  $5\,V$  TTL network.

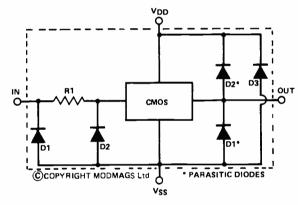


Fig. 2 This protection network is used on the 4049B and 4050B hex buffers. Note that the input is free to swing above the positive supply  $(V_{DD})$  rail.

Another exception is the 4066B type of transmission gate or bilateral switch, and its equivalents. These devices comprise a bilateral electronic switch and a switch-control network. In these circuits, all switch-control networks have the type of input protection shown in Fig. 1, but the switches themselves have the simple protection network shown in Fig. 3.

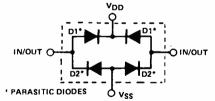


Fig. 3 The 4066B quad bilateral switch has standard B-series protection on its gate control input terminals, but has this simplified form of protection on its 'switch' elements.

Note in Figs. 1-3 that all diodes marked with asterisks are 'parasitic' devices, which just happen to occur fortuitously as an inherent part of the CMOS manufacturing process, while all other diodes are specifically designed into the circuits. Also note that the networks are intended only to give protection

against 'normal' electrostatic discharge voltages. When the networks are subjected to ordinary DC signals, the diodes are liable to burn out if their forward currents exceed 10 mA or so, thereby causing possible catastrophic damage to the IC substrate.

Major CMOS manufacturers such as RCA reckon that an electrostatically charged human body can be approximated by the circuit of Fig. 4, in which the 'body' has an effective capacitance of 100pF and a source resistance of 560R. The manufacturers have carried out extensive tests with this model by charging the 'body' to various voltages and then discharging it (via the 560R series resistor) into different terminal combinations (input, output, Vss, VDD) of CMOS devices to establish worst-case capability figures for the three types of electrostatic-discharge protection networks. It should be noted in these tests that the 560R series resistor acts as a current-limiting voltage dropper, so the voltage actually reaching the CMOS device is far lower than the initial electrostatic voltage.

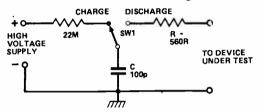


Fig. 4 Manufacturers use this equivalent-body discharge network when evaluating the capabilities of their CMOS protection networks.

The results of the manufacturer's protection capability tests are shown in Fig. 5. As you can see, the standard protection network can withstand a 4 kV electrostatic discharge. A quick calculation shows, however, that this represents a peak protection-diode current of several amps, yet we've already seen that these diodes can withstand DC currents of only 10 mA or so. Puzzled?

PROTECTION NETWORK	WORST - CASE CAPABILITY
STANDARD B.SERIES	4 kV
4049B AND 4050B	1 kV TO 2 kV
4066B BILATERAL SWITCH `	<800 V

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Fig. 5 These are the worst-case capabilities of the three different CMOS protection networks, when tested with the network of Fig. 4.

## **Up The Junction**

Just about the only way of destroying a diode is to literally vaporise its junction, and this can only be done by applying an adequate amount of power for sufficient time for the melting process to take place. Since a junction must inevitably be formed on a substrate, which has a finite mass, all junctions inevitably have a certain amount of thermal inertia and are, in fact, destroyed by energy overloads (power-time product), rather than by simple power overloads.

Consequently, it is quite normal to find that a diode rated at 1 A (for example) can, in fact, withstand brief current surges up to several hundred amps. Similarly, CMOS protection diodes, which have very low DC current ratings (10 mA), can withstand very high levels of surge current (several amps), provided that the surge current duration is very brief. Figure 6 shows the typical surge current capabilities of these protection diodes. Remembering that the 100p — 560R 'human body' equivalent circuit has a time constant of a mere 56 nS, it no longer comes as a surprise to note that these diodes can withstand several amps of peak current from a 4 kV discharge!

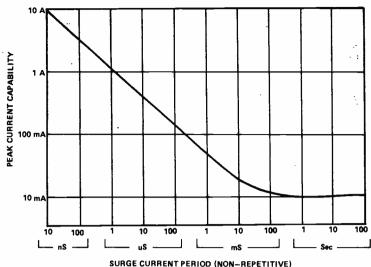


Fig. 6 Typical surge-current capabilities of CMOS protection diodes.

## **CMOS Circuit Design**

By now you will have gathered that you can effectively destroy a CMOS device by simply blowing one or more of its 'protection' diodes with a DC current as low as 10 mA. Consequently, when designing CMOS circuits, precautions must be taken to ensure that excessive diode current cannot flow in the CMOS chips.

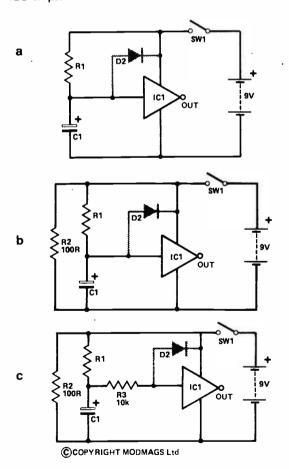


Fig. 7 Circuits (a) and (c) are safe, but circuit (b) will almost certainly cause a front-end 'blow'. See text for explanation.

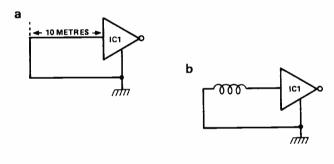
## FEATURE: Designer's Notebook

CMOS ICs can be 'blown' by excessive signals applied to either the input or the output terminals. If several CMOS stages are cascaded, empirical experience shows that a front-end blow will usually destroy only a single device (because low energy levels are normally involved), but a rear-end (output) 'blow' will often have a ripple effect (because high energy levels are involved) and cause the destruction of all ICs in the chain.

The most common cause of front-end 'blow', and its cure, are illustrated in Fig. 7. Here, a capacitor is connected directly between the IC gate and the 0 V line: when SW1 is closed, the capacitor charges up via R1 and eventually attains the full positive supply potential. When SW1 is opened (to switch the circuit off), C1 tries to discharge via D2, the 'upper' input protection diode of the gate.

In the Fig. 7a circuit, the only discharge path for C1 is via D2 and the IC's supply terminals; consequently the discharge currents will be quite low and the IC will probably suffer no damage. In Fig. 7b, on the other hand, a 100R resistor is connected across the supply terminals, so C1 will try to discharge to ground via D2 and R2, and the resulting 90 mA peak current will almost certainly result in the destruction of the chip. In practice, R2 may well take the form of various resistors and semiconductor devices distributed throughout the total circuit.

Figure 7c shows the cure for the Fig. 7b design problem, a 10k resistor wired in series with the gate to limit the C1 discharge currents to a safe value. Whenever you design CMOS circuits and have to connect a capacitor between a gate and the 0 V rail, always make sure that the capacitor discharge current is limited to a safe value, either by a series gate resistor or by some other factor.



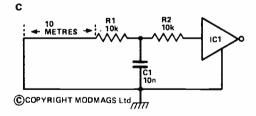


Fig. 8 Long input cables, as in (a), can be equivalent to an inductor (b), and present another front-end blowing hazard. The cure is simple (c).

Figure 8 illustrates another possible cause of front-end 'blowing', and its cure. In Fig. 8a, it seems that the IC's input is safely grounded by the 10 m of input cable (in practice, this cable may go to a low impedance sensor, etc), but in actual fact (Fig. 8b) this cable will inevitably be inductive and can easily pick up unwanted radiation and possibly feed destructive signals to the IC input. Figure 8c shows that the circuit can be rendered safe with a simple filter (R1-C1) and a series gate resistor (R2).

## **Back-end Blowing**

The most common cause of back-end blowing is unexpected back-EMFs (from inductive loads) reaching the CMOS output by breaking through from power-driving circuitry.

Inductive loads, such as relays, can generate surprisingly large back EMFs as their fields collapse at switch-off, as can be proved by connecting a relay in the 'buzzer' mode shown in Fig. 9. Typically, a 12 V relay will generate a back-EMF of about 300 V! If you ever use CMOS to switch a relay or other highly inductive load using a transistor driver, always protect the transistor with a pair of 1N4001 diodes connected as shown in Fig. 10a. If you want to be really safe, you can use another pair of similarly-connected diodes to directly protect the output of the CMOS stage, as shown in Fig. 10b.

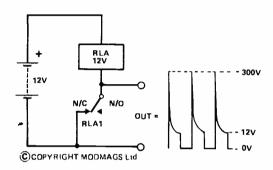
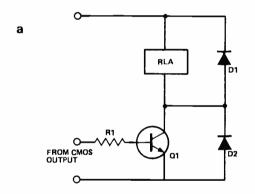


Fig. 9 This 'buzzer' circuit can be used to check the magnitude of the back-EMF from a relay. 300 V is typical!



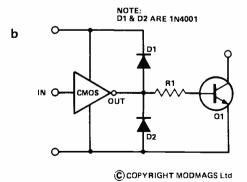


Fig. 10 (a) A transistor relay-driver can be protected with a pair of diodes.
(b) The output of a CMOS stage can be given added protection with a similar arrangement.

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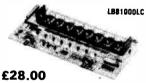


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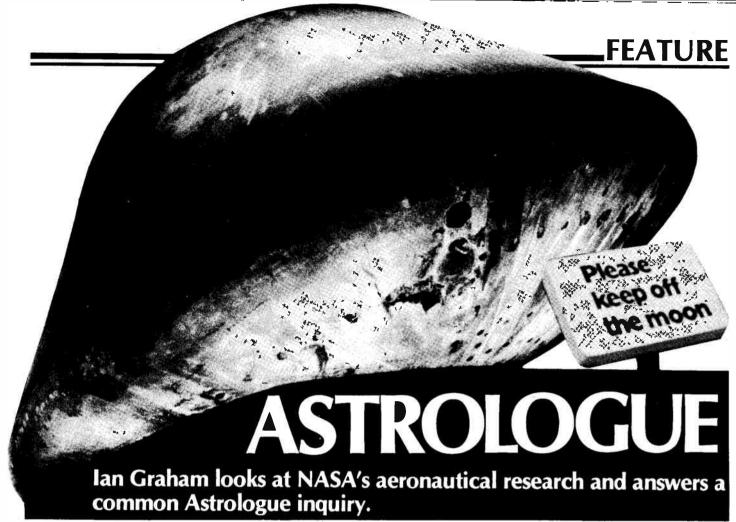
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## **Flying Circus**

Testing out the drawing board ideas has brought some weird machinery into existence. The Bell Tilt Rotor Research Aircraft can, as the name implies, tilt its engines vertically and take off like a helicopter. Once off the ground, the rotors tilt forward into the horizontal attitude and, together with the fixed wing, generate lift in the normal way. This programme is aimed at developing more advanced vertical and short take-off and landing aircraft for use in difficult airport areas where long runways and shallow glide paths are impossible. They could also be a regular feature of future 'bus-stop' airports close to city centres.

## **Pivoting Wings**

We naturally expect aircraft to be symmetrical vehicles. The port wing is always swept back at the same angle as the starboard wing. An aircraft with one wing swept forward and one swept back wouldn't fly. Wrong! Several decades ago, NASA's Robert T. Jones tested the idea in a wind tunnel and it worked.

Scepticism and insufficiently advanced technology meant that the aircraft has not been built until now. It even has advantages over conventional first generation supersonic transports, producing a substantially quieter sonic boom. At low speed, the wing is kept at right angles to the fuselage. At high speed, the whole wing pivots up to 60° to reduce drag. In this configuration, the aircraft looks rather like a pair of flying scissors.

## **HIMAT**

Inevitably, NASA is involved in a great deal of military aircraft research. The next generation of fighters must combine very high speeds and manoeuvrability, but remain within the g-forces that a pilot can withstand. To this end NASA has flight tested a scaled down remotely piloted airframe called HiMAT (Highly Manoeuvrable Aircraft Technology). The futuristic airframe is dropped from a modified B-52. The HiMAT pilot stays on the ground and flies the aircraft from the Dryden Flight Research Centre in front of typical flighter cockpit displays. If ground control is lost, an airborne pilot can take over. If both fail, HiMAT automatically flies in circles until control is regained (or its fuel runs out). I hope to look at HiMAT in detail in a future Astrologue.

## Windy Caverns

The traditional image of aero research at this level is of a cavernous wind tunnel containing a full-size mock-up of the aircraft. This certainly still goes on, but much more advanced techniques can provide a means of 'flying' the aircraft before it is built. Computer dynamic analysis is still used to predict the behaviour of the new design in flight. A tethered scale model can be 'flown' in a wind tunnel to study the aircraft's behaviour at the limits of its performance. All the data from these studies can be used to program a simulator computer to give crewmen experience in handling the aircraft in potentially dangerous situations before they get off the ground in the real thing.

Computer analysis, model testing and simulator flights all contribute to the designers' and pilots' understanding of the behaviour of the aircraft in the air. The fourth stage is the acid test — a NASA research pilot must actually strap the strange new machine to his seat and probe the limits of the flight envelope for himself.

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## **Science Museum**

If you're in London, you can come by a set of Space Frontiers postcards at the Science Museum (nearest tube — South Kensington). 'Men in Space', a six-card set, and 'Man On The Moon', a 12-card set from the Hansen Planetarium in Salt Lake City, are available from the Museum shop.

While you're there it's worth popping into the ground floor 'Exploration' display. The theme is 'the extension of mankind's faculties by artificial means.' This special area is regularly brought up to date. In addition to the third floor space exploration and rocketry display, 'Exploration' features the Apollo 10 Command Module (not a replica — it's the real thing) and a full-size copy of the Apollo 11 Lunar Module.

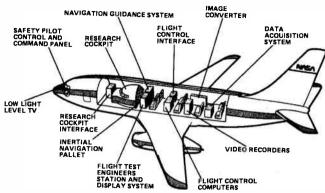


Fig. 1 This modified Boeing 737 was used to study flying and take. off/landing routines in bad weather and the use of 'smart' avionics to assist in air traffic control. The Terminal-Configured Vehicle (TCV) can be flown from the research cockpit with the conventional cockpit crew providing a safety back-up. The aim of the programme is to reduce hold-ups at airports due to bad weather, reduce the separation of aircraft on take-off and landing and save fuel by using the most fuel-efficient landing programs. The end result — airlines and airports can substantially cut their losses.

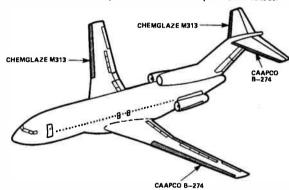


Fig.2 An Air Micronesia Boeing 727 was used to experiment with plastic coatings to reduce skin friction drag on wing and tail surfaces in a tropical environment. Two types of coatings — Chemglaze M313 and CAAPCO B-274 — are being investigated. The location and extent of the coatings on the 727 are shown above. Potential fuel savings from small drag reductions are substantial.

## **SHORTS**

The Arianespace consortium has signed a \$150 million contract with the Columbian government to launch two telecommunications satellites, Satcol 1 and 2, into geostationary orbit in 1984.

The Mark II version of the Skyflash medium range, air-to-air missile has fallen prey to the latest defence cuts. The Mk. II version would have incorporated an improved homing head and electronic counter measures. The Mk I will have to be improved if it is to be a worthwhile weapon in service until the late 1980s.

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HEF4021	107	HEF4075	23	MEF40160	149	NE570N 485	2N3773	297	8D132 8D139	39
HEF4022	103	HEF4076	130	HEF40192	149	NE571N 806	2NJB19	207	BO139	39
MEF 4023	22	HEF4077	72	116740172	.47	RC4138 146	2N3820	ii l	BFRBC	333
HEF4024	2 H	HEF4078	23			TBA1205 88	2N3904	- 13	BFX86	29
HEF4025	22	MEF40B1	23	Voltage		TDA1022 713	2N5457	39	BFY50	17
HEF4026	244	HE#4082	23	Regulators		TDA10348 239	2N5459	35	BEVS)	17
HEE4027	57	MEF4085	80	LM3080A(K)	119	TL081CP 84	40673	88	BRY39	50
HEF402B	89	HEF4086	80	UA723CN	42	TL084CN 156	BC107	14	85X20	21
HEF4029	113	HEF4093	63	UA7806CU	78	UA741CN 20	BC106	34	CL8960	2850
HEF4030	58	HEF4094	219	UA7812CU	78	UA741CT 47	BC10BC	18	TIP31	48
MEF4031	250	HEF4104	208	UA7815CU	78	Zener	BC109	14	TIP32	54
HEF4035	138	HEF4502	114	UA7912CU	97		8C1098	19	TIP41C	78
HEF4040	102	HEF4505	714	UA7915CU	97	Diodes	BC109C	20	TIP42C	76
HEF4041	94	MÉF4508	230	UA78L06CS	38	400mW C4 V 7-C33	BC148	10	TIP 2955	75
HEF4042	83	HEF4510	135	UA78L12CS	38	BZY88/8ZX79	BC156	10	TIP3056	80
HEF4043	100	HEF4511	157	UA78L15CS	38	+ Voltage 9	BC177	17	T1543	36
CAPACIT		Order Code				0.4.0.4	<u> </u>			
-10% to +80		Can 016 + uF		rter Redial Le		Order Code	Electrolyt			der Code
				1 Type, C290/31			-10% to +5			p 034 + µF
μF V 1	8 26	40 63	Mould	ed Typs, 10.2m	n Pitel		μF V	10   16   2	6 36 40	50   63
1.0		9				+ Vetua	.47			7
1.6	- 1	9	a.P	362   384	1 1	F   352   360	.68			7
2.2	- 1	9	.001	7	- 1 :	7 9	1,0			7
3.3	1	9	.0016	7	- 1	15 B 10	1.5	1 1		7
4.7	1	.   . !	.0022	6 7		22 8 11	2,2	]		7
10.0	- l -	9 10	.0033	6   7	- 1	33 11	3.3	] [		7
		10	.0047	6 7	1.	47 14	4.7	1 !	7	8

Skeleton Presets, Miniature

Potentiometer, Rotary 0.5W, E3 Values, 1K-2M2 Lin. 0.25W, E3 Values, 4K7-2M2 Log

0.1W, E3 Velues, 100R-IM, Lin. Vertical Mounting 8 0.1W, E3 Velues, 100R-IM, Lin. Horizontal Mount 8 Skeleton Presets, Standard 0.3W, E3 Values, 100R-4M7, Lin. Vartical Mounting 11 0.3W, E3 Values, 100R-4M7, Lin. Horizontal Mount 11

Pleastic Boxes — Boss Industrial Mouldings Moulded Box and Close Fetting Flanged Ltd ABS Box, C/W Bress Bushes, and Ltd in Orange

Plastic Boxes with Metal Lids ABS Base, C/W Brass Bushes, In Orange 1mm Aluminium Top Panel Finished Grey

Discast Box and Flanged Ltd
Aluminium Box and Ltd on Natural Finish

880 21 30 39 54 1000 28 30 58 1500 35 39 2 2200 42	8 Pin Low Profile Soc 14 Pin Low Profile Soc 16 Pin Low Profile Soc	ket Ten 14 DIL SKT 14
RESISTORS Carbon Film, Fixed 0.25W, E24 Values IRO-10M, 5% To	Order Code	Skeleton Presets, Ministr 0.1W, E3 Values, 100R-IM, 0.1W, E3 Values, 100R-IM,
100/100 (Mult 0.5W, E12 Values IRO-4M7, 10% To	1 10/Velue)	Skeleton Premts, Standa 0.3W, E3 Values, 100R-4M7 0.3W, E3 Values, 100R-4M7
Metal Film, Fixed 0.5W, E24 Values, SRI-IM, 2% Tol.	8 each Res MR30	Potentiometer, Rotary 0.5W, E3 Values, 1K-2M2 L

D.I.L. Sockets

9 13

	+ Value
Motal Glaze, Fixed	
0.6W, E24 Values, IM-33M, 5% Tol.	16 sech Res VR37 • Value

Motal Glaze, Fixed 0.5W, E24 Values, IM-33M, 5% Tol.	Pote 0.5W		ntiometer, Slider , E3 Valum, 2K2-470 , Lin. V, E3 Valum, 1K0 - 1MO Log.	
MAINS TRANSFORMERS	Order	Cods	Plastic Boxes — Boss I	
Secondaries may be connected in sari parallel to give wide voltage range Primeries 0-220, 240V	BE 07		Moulded Box and Close F ABS Box, C/W 8/498 Bush	
FIIImeries 0-220, 2400		- 1		

MAINS TRANSFORMERS	Order Code
Secondaries may be connected on series or parallel to give wide voltage range Primeries 0-220, 240V	
6VA - Clamp Type Construction	235 each
Approx 18% Regulation F.C. 54, H36, W	v35
0-4.5V, 0-4.5V Secondaries 0.5V, 0-6V 0-12V, 0-12V 0-15V, 0-15V 0-20V, 0-20V	Trans 6VA
20VA ~ Clamp Typa Construction	360 auch
Approx 16% Regulation F.C. 70, H4B, W-	48
0-4.5V, 0-4.5V Secondaries	Trans 20 VA

VERO ELECTRONICS PROD	OUCTS	
2.6" x 5" .1" pitch Veroboard	71	200-21089J
3.75" x 5" ,1" pirch Veroboard	79	200-210720
2.5" x 1" .1" pitch Veroboard (5)	85/Pack	200-21076C
3.75" x 5" .1" pitch Plain Board	68	200-21078H
5.82" x 2.9" .1" pitch V-Q D IP Board	135	200-21084 E
Spot Face Cutter	107	203-21013A
Pin Insertion Tool for ,040 type pin	147	203-21015F
OS Pins .040 (100)	44/Puck	200-21087G
SS Pins ,040 (100)	44/Pack	200-210178
Varowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D
Varowire Combs (25)	109/Pack	200-21339F
Verowirs Wire (2)	109 / Pack	200-21340G

VERO ELECTRONICS PROD	THE					
2.5" x 5" .1" pitch Veroboard 3.75" x 5" ,1" pitch Veroboard 2.5" x 1" .1" pitch Veroboard (5)	71 79 85/Pack	200-21089J 200-210720 200-21076C	SWIT(	CHES are Toggia - Honeywell		Order Code
3.75" x 5" .1" pitch Plain Board	68	200-21078H	SPOT		67	SW 8A 1011
5.82" = 2.9" .1" pitch V-Q DIP Board	135	200-21084E	SPOT	C/Off	81	SW 8A1021
Spot Face Cutter	107	203-21013A	SPOT	Double Bies To Centre	90	SW 8A1041
Pin Insertion Tool for ,040 type pin	147	203-21015F	DPDT		99	SW BA2011
OS Pins .040 (100)	44/Peck	200-21087G	DPOT	C/Off	111	SW 8 A 2021
SS Pins ,040 (100)	44/Pack	200-210178				
Varowire Kit (1-pen, 2-wire, 25-comb)	454/Kit	200-21341D	Miniat	are Push – C,&c K		
Varowire Combs (26)	109/Pack	200-21339F	SP	Push To Make, Momentary	62	SW 8531
Verowirs Wire (2)	109/Pack	200-21340G	SP	Push To Breek, Momentary	62	BW 8533

GMT ELECTRONICS PROJECTS	KIT	BUILT UP	
FREE-STANDING COMPLETE TELETEXT UNIT - FULL SPEC	£199-90	£275-00	
TELETEXT DECODER BOARD + REMOTE HAND CONTROL	£135-90	£160-00	
TELETEXT COMPATIBLE TUNER AND P.S.U.	£ 46-90	£ 57-00	
TELETEXT COMPATIBLE PAL ENCODER + MODULATOR	£ 22-90	£ 35-00	
F.E.T.OUTPUT 100W MONO POWER AMPLIFIER MODULE	£ 27-50	£ 35-00	
X-BAND DOPPLER RADAR ALARM MODULE - MARK II	£ 35-90	£ 44-00	
ONE AMP P.S.U. MODULE (SPECIFY 5 OR 12 VOLTS)	£ 7-50	£ 10-00	
SIMULATED INERTIA MODEL TRAIN CONTROLLER	£ 22-50	£ 35-00	
SIMULATED INERTIA SLOT RACER CONTROLLER	£ 27-50	£ 40-00	
MODEL TRAIN STEAM SOUND SIMULATOR MODULE	£ N/A	£ 5-00	

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DRUM MACHINE

Drums, cymbals, snares and bongos. You can simulate these instruments with this 'double percussion' project. The instruments can be played either

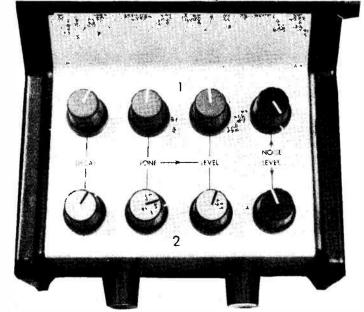
manually or automatically using a built-in sequencer. Design by Ray Marston. Project development by Steve Ramsahadeo.

his attractive little musical instrument has two 'percussion simulator' channels. Channel 1 can be used to simulate the sounds of normal drums only: channel 2 can be used to simulate the sounds of all types of drums, including snares, plus metallic percussion sounds such as cymbals, etc. On each channel, the envelope decay times and the basic musical tones, etc., are fully variable using the manual controls, to enable a wide range of percussion sounds to be simulated. The outputs of the two channels are mixed internally and can be fed to an external power amplifier from a single output socket. The complete instrument is powered from a 12 V battery pack.

# Play It, Sam

The instrument can either be played manually, automatically, or by a combination of the two methods. In the manual mode, each channel can be played using a small speaker, connected to the channel input: the speaker acts as a 'drum head' transducer and triggers a percussion sound when the cone is tapped with a finger or stick.

The instrument can be played automatically using the built-in eight-step double sequencer. Each channel of the sequencer is used to control one of the channels of the percussion



instrument, and can be programmed with a DIL package of eight SPST switches to generate any one of a variety of rhythms. The sequencer can be used in the fully automatic mode, in which it continuously cycles through the eight-step sequence, or can be used in a triggered, or manual initiate, mode in which it runs through a single eight-step sequence each time that an external switch is momentarily closed. The manual initiate facility enables the internally-generated rhythm to be manually synchronised to an external beat (with a foot switch, etc.), or to be introduced into the music only in those parts where it is required.

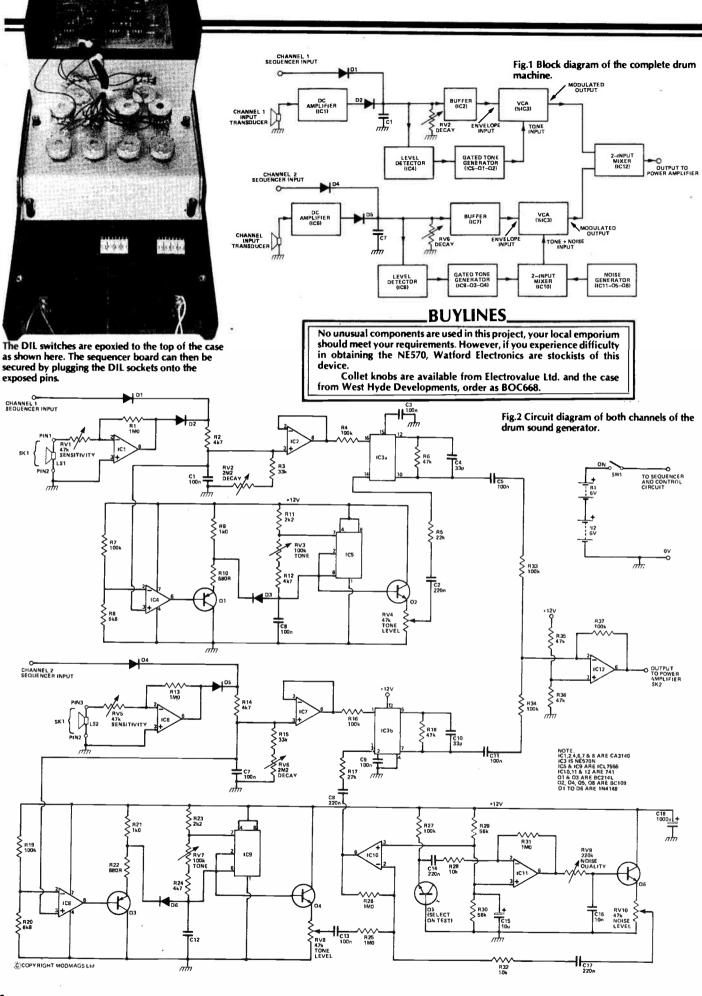
The manual and automatic playing methods operate in the OR mode. In other words, manually-initiated percussion sounds can be played at the same time as the automatically initiated sounds. A particularly attractive way of using the instrument is to play it mainly in the manual mode, but to occasionally bring in a few bars of automatic sequencing with a foot switch, using the manual initiate facility. The unit thus acts as a highly versatile musical instrument.

# Construction

The circuitry is built up on two PCBs, a single large board being used to hold all of the components (except the pots and switches) of the main double percussion instrument, and a smaller board being used for the components of the sequencer circuit. The unit uses a good deal of interwiring between the PCB and the total of eleven control pots, etc., so some care is required in the construction.

Start the construction by building up the main PCB, taking the usual care over the component polarities. Use Veropins to facilitate the connections from the PCB to the ten control pots.

When construction of the main PCB is complete, give it a functional check by temporarily connecting the ten pots to the unit, wire a couple of small speakers (impedance not important) to the two input terminals, connect the unit to a 12 V supply and take the output to an external power amplifier. Check that plain drum sounds can be manually generated on channel 1, and all types of percussion sounds from channel 2. Note on channel 2 that Q5 is used as a white noise source (for generating cymbal)



# HOW IT WORKS

The basic instrument contains two essentially similar channels (see block diagram), each comprising a voltage-controlled amplifier (VCA), a gated tone generator and an envelope generator. The envelope generator produces the characteristic fast-attack/slow-decay modulation waveform of a percussion instrument and can be activated by either an external transducer (a speaker) or the pulse input of an automatic sequencer unit.

The outputs of the two channels are added in a two-input mixer and are made available at a phono socket, where they can be fed to a power amplifier. The channel 1 circuitry produces modulated tone signals only, and can be used to generate a range of simple drum sounds. The channel 2 circuitry incorporates a noise generator and a two-input mixer as well as a tone-generator, and can be used to reproduce all of the sounds of channel 1 plus snare drums, cymbals,

The two channels of the instrument are basically similar, so let's start off with a detailed description of channel 1. When used in the manual mode the instrument is played using an external transducer such as a speaker (LS1), which is connected to the input of high-gain DC amplifier IC1. Each time that the transducer is tapped, the output of IC1 jumps abruptly positive and rapidly charges C1 via D2-R2: C1 then discharges exponentially via R3-RV2, to produce the characteristic fast-attack/slow decay modulation waveform of a percussion instrument. The waveform is then fed to one half of dual VCA IC3 via unity-gain buffer IC2, where it is used to control the gain of the VCA.

gain buffer IC2, where it is used to control the gain of the VCA.

Note that the C1 modulation generator can be activated by either the transducer or by a pulse signal fed to C1 via D1-R1 from the independent sequencer circuit (auto mode). The C1 voltage is monitored by comparator IC4, which gates on astable IC5 whenever the C1 voltage exceeds a few hundred millivolts. The astable generates a symmetrical ramp waveform, which is buffered by Q1 and fed to the 'tone' input of VCA via level control RV4. The tone of the astable can be varied over the range 83 Hz to 1.4 kHz with RV3.

Thus, each time the channel is activated (by the transducer or by a sequencer) a modulation waveform is fed to one input of the VCA and a tone signal is fed to the other, to produce a modulated tone signal at output pin 10 of IC3. The signal is fed to one input of two-input mixer IC12. A wide variety of drum sounds can be simulated by suitable adjustment of RV2, RV3 and RV4.

Channel 2 is similar to channel 1, except that the output of the tone generator (from RV8) is fed to the VCA via a two-input mixer designed around IC10. The other input to this mixer is derived from a

Fig.3 Circuit diagram of the eight-step sequencer unit.

noise generator designed around Q5-IC11 and Q6. Here, the reversebiased base-emitter junction of Q5 is used as a noise source and the noise signal is then amplified by IC11, filtered by RV9-C16 and made available via level control RV10.

The instrument is powered from a 12 V supply, derived from eight 1V5 cells. This supply is also used to power the Auto-Manual Eight-Step Sequencer unit.

The sequencer unit has two output channels, each of which produces a single or repeating sequence of up to eight 5 mS output pulses: the sequencing period can be varied over a wide range by a clock (or 'tempo') generator, and individual pulses can be programmed in or out on each channel with a dual-in-line package of eight SPST switches. The unit is designed to automatically sequence the double percussion instrument.

The unit comprises a clock generator (IC1), a 4017 counter (IC2) and two sets of switch-programmable clock/decoder coincidence detectors (IC1 and D3 to D18). The clock generator is designed around a 555 astable and generates a series of 5mS pulses, with the inter-pulse period variable over a wide range by RV1. The pulses are used to clock IC2

IC2 is a 4017 counter with ten decoded outputs. These outputs sequentially go high on the arrival of each new clock pulse, with only one output being high at any moment in time. On each channel the decoded 4017 outputs that are required are fed to one side of a two-input AND gate (IC3a-IC3b or IC3c-IC3d) via a bank of diodes and switches, while the 5mS clock pulse is fed to the other side of the AND gate. The programmed sequence of 5 mS pulses are thus generated at the output of each AND gate.

When the unit is operated in the manual mode, the 4017 sequences automatically for the first eight clock pulses and then stops as its '9' output goes high and activates the inhibit pin: the single automatic sequence can be re-initiated by momentarily closing PB1 and thus resetting the 4017, so that the '1' output goes high on the arrival of the next clock pulse. The manual facility enables the sequencer to be manually synchronised to an external beat.

When the unit is operated in the auto mode the reset and inhibit pins of IC2 are shorted together by SW3. This configuration effectively causes the 4017 to see a double clock pulse as the '9' output goes momentarily high, thereby causing the '0' output to go high as the IC resets but then causing the '1' output to go high almost immediately. The net effect of all this is that the sequence repeats continuously when SW3 is set to the auto mode.

Below: the sound generator board and batteries are mounted in the lower half of the case. RV1 (tempo control) can be seen mounted on the side — all other pots are situated on the front panel.

CHANNEL 2 OUT TO 04

C COPYRIGHT MODMAGS LIN

sounds, etc), and may have to be selected on test to produce an adequate noise level.

Proceed next with the construction of the sequencer circuit on the smaller PCB. Note that the two sets of DIL switches MUST be mounted in sockets, and that capacitor C2 is mounted on the *underside* of the PCB.

You can now proceed with the assembly of the two boards and all other components in the specified case. Note the following points. The large PCB is secured to the base of the case with stand-off pillars: leave sufficient space at the rear of the case to accommodate the battery pack (eight 1V5 cells). The ten percussion-control pots are mounted on the front section of the top half of the case.

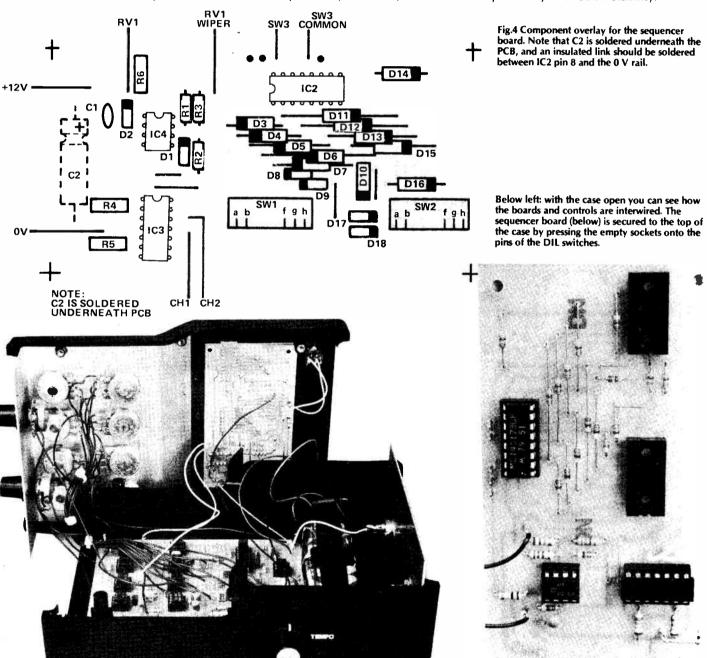
The sequencer board is secured to the rear half of the top section of the case by the board's DIL switches, which are epoxied to the case. Proceed as follows.

First, hold the board in position below the case top and very

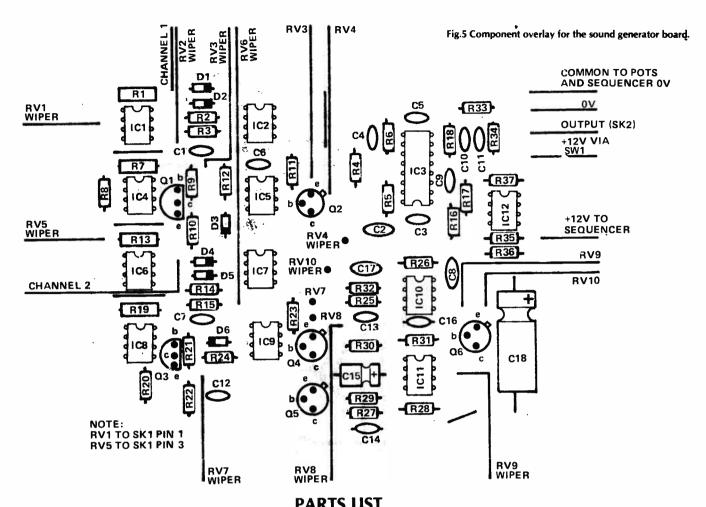
carefully mark out the precise outlines of the two switches. Now cut two holes in the case top, to allow the switches to pass through the case. Next, remove the switches from their PCB sockets, push them into the holes so that the top faces are flush with the case top and then fix the two switches into place with epoxy or super-glue. When the glue has set, fit the PCB to the switches (and thus the case) by carefully inserting the DIL switches in the sockets. Tempo control RV1 is mounted on the right hand side of the lower half of the case.

Finally, to complete the construction, fit all the remaining switches and sockets into place and complete the interwiring. We recommend that you use jack sockets to connect the two 'drum head' speakers to the unit, configured so that the input pins short out if the speakers are removed.

When using the completed unit, note that, if the 'drum head' speakers are not used, they must be replaced by short circuits, to eliminate the possibility of circuit instability.



# **PROJECT: Drum Machine**



IC10,11,12 741 SW3 SPST miniature toggle	CONTROL CIRCUIT		Miscellaneous		
R1,13,25,26,31	Resistors (all 1/4 W. 5%)		SW1	SPST miniature toggle	
R2,12,14,24			SK1		
R3,15 33k L51,2 50 mm loudspeaker R4,7,16,19,27,33,34,37 100k 10 off collet knobs, caps and nut covers R5,17 22k Case (see Buylines) 2 off HP7- four section battery holders 8 8 off HP7 batteries R8,20 6k8 8 off HP7 batteries R9,21 1k0 SEQUENCER R11,23 2k2 R29,30 56k R1 2 R29,30 56k R1 2 R29,30 S6k R2 R3 22k R29,30 56k R2 R3 22k R29,30 S6k R1 2 R4,5 R3 22k R29,30 S6k R1 R4,5,8,10 47k linear R4,5 R4,5 27k RV1,4,5,8,10 47k linear R6 1000k R1 2000k RV2,6 2M2 linear R0,37 100k linear R0,39 20k linear RV1 220k linear RV1,12,13 100n ceramic C1,3,5,6,7,9,11,12,13 100n ceramic C2,8,14,17 220n polycarbonate C2,8,14,17 220n polycarbonate C1,13,5,6,7,9,11,12,13 100n ceramic C1 100 25 V axial electrolytic C1 100 25 V axial electrolytic C1 100 C2 470u 25 V axial electrolytic C1 10n ceramic C1		4k7	SK2		
R4,7,16,19,27,33,34,37 R5,17		33k			
R5,17		100k	10 off collet kno	obs, caps and nut covers	
R6,18,35,36		22k			
R8,20 6k8 8 9 off HP7 batteries R9,21 1k0 R9,21 1k0 R10,22 680R SEQUENCER R11,23 2k2 Resistors (all ¼W, 5%) R28,32 10k R2 3k3 R3 22k Potentiometers RV1,4,5,8,10 47k linear RV2,6 2M2 linear RV3,7 100k linear RV9 220k linear RV9 220k linear RV9 220k linear RV1 20k linear		47k			
R9,21 1k0 R10,22 680R SEQUENCER R11,23 2k2 R28,32 10k R1 2k2 R29,30 56k R2 R2 3k3 R3 22k Potentiometers RV1,4,5,8,10 47k linear RV2,6 2M2 linear RV3,7 100k linear RV3,7 100k linear RV9 220k linear RV9 220k linear  C2,8,14,17 220n polycarbonate C4,10 33p ceramic C5,8,14,17 210n ceramic C11 2u2 35 V tantalum C2,8,14,17 220n polycarbonate C13,5,5,7,9,11,12,13 100 ceramic C4,10 33p ceramic C15 10u 25 V axial electrolytic C16 10n ceramic C16 10n ceramic C18 1000u 16 V axial electrolytic C18 1000u 16 V axial electrolytic C19		6k8	8 off HP7 batte	ries	
R10,22		1k0			
R11,23		680R	SEQUENCER		
R28,32       10k       R1       2k2         R29,30       56k       R2       3k3         Potentiometers       R4,5       27k         RV1,4,5,8,10       47k linear       R6       100k         RV2,6       2M2 linear       Potentiometers         RV9       220k linear       RV1       220k linear         Capacitors       C1       2u2 35 V tantalum         C1,3,5,6,7,9,11,12,13       100n ceramic       C1       2u2 35 V tantalum         C2,8,14,17       220n polycarbonate       C2       470u 25 V axial electrolytic         C4,10       33p ceramic       C1       555         C15       10u 25 V axial electrolytic       Semiconductors         C16       10n ceramic       IC1       555         C18       1000u 16 V axial electrolytic       IC2       4017B         Semiconductors       IC3       4011B         IC1,2,4,6,7,8       CA3140       IC3       4011B         IC3       NE570N       Miscellaneous         IC5,9       7555       SW1,2       8-SPST dual-in-line lateral swit         IC10,11,12       741       SW3       SPST miniature toggle			Resistors (all 1/4)	W. 5%)	
R2		10k			
Potentiometers   R3   22k		56k			
Potentiometers					
RV1,4,5,8,10	Potentiometers				
RV2,6 2M2 linear RV3,7 100k linear Potentiometers RV9 220k linear RV1 220k linear  Capacitors C1,3,5,6,7,9,11,12,13 100n ceramic C1 2u2 35 V tantalum C2,8,14,17 220n polycarbonate C2 470u 25 V axial electrolytic C4,10 33p ceramic C15 10u 25 V axial electrolytic Semiconductors C16 10n ceramic IC1 555 C18 1000u 16 V axial electrolytic IC2 4017B Semiconductors IC3 4011B Semiconductors IC3 4011B IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle		47k linear			
RV3,7 100k linear 220k linear RV1 220k linear RV1 220k linear  Capacitors C1,3,5,6,7,9,11,12,13 100n ceramic C1 2u2 35 V tantalum C2,8,14,17 220n polycarbonate C2 470u 25 V axial electrolytic C4,10 33p ceramic C15 10u 25 V axial electrolytic Semiconductors C16 10n ceramic IC1 555 C18 1000u 16 V axial electrolytic IC2 4017B IC3 4011B Semiconductors IC1 550 10-D18 1N4148 IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle		2M2 linear	RO	TOOK	
RV9   220k linear   RV1   220k linear		100k linear	Potentiometers		
C1,3,5,6,7,9,11,12,13 C2,8,14,17 C2,8,14,17 C33p ceramic C51 C12 C24 C470u 25 V axial electrolytic C55 C16 C17 C18 C18 C19		220k linear		220k linear	
C1,3,5,6,7,9,11,12,13	Capacitors		Capacitors		
C2,8,14,17       220n polycarbonate       C2       470u 25 V axial electrolytic         C4,10       33p ceramic       Semiconductors         C15       10u 25 V axial electrolytic       Semiconductors         C18       1000u 16 V axial electrolytic       IC1       555         IC2       4017B         IC3       4011B         IC1,2,4,6,7,8       CA3140         IC3       NE570N       Miscellaneous         IC5,9       7555       SW1,2       8-SPST dual-in-line lateral swite         IC10,11,12       741       SW3       SPST miniature toggle	C1,3,5,6,7,9,11,12,13	100n ceramic		2u2 35 V tantalum	
C4,10 33p ceramic C15 10u 25 V axial electrolytic C16 10n ceramic C18 1000u 16 V axial electrolytic C19 1000u 16 V axial electrolytic C10 1000	C2,8,14,17	220n polycarbonate		470u 25 V axial electrolytic	
C16 10n ceramic IC1 555 C18 1000u 16 V axial electrolytic IC2 4017B IC3 4011B Semiconductors D1-D18 1N4148 IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle	C4,10	33p ceramic		,	
C16 10n ceramic IC1 555 C18 1000u 16 V axial electrolytic IC2 4017B IC3 4011B Semiconductors D1-D18 1N4148 IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swite IC10,11,12 741 SW3 SPST miniature toggle	C15	10u 25 V axial electrolytic	Semiconductors	•	
C18 1000u 16 V axial electrolytic IC2 4017B IC3 4011B Semiconductors D1-D18 1N4148 IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit	C16	10n ceramic			
C3	C18	1000u 16 V axiał electrolytic			
Semiconductors         D1-D18         1N4148           IC1,2,4,6,7,8         CA3140           IC3         NE570N         Miscellaneous           IC5,9         7555         SW1,2         8-SPST dual-in-line lateral swit           IC10,11,12         741         SW3         SPST miniature toggle				4011B	
IC1,2,4,6,7,8 CA3140 IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle	Semiconductors			1N4148	
IC3 NE570N Miscellaneous IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle	IC1.2.4.6.7.8	CA3140	5.5.0	• • • • • • • • • • • • • • • • • • • •	
IC5,9 7555 SW1,2 8-SPST dual-in-line lateral swit IC10,11,12 741 SW3 SPST miniature toggle		NE570N	Miscellaneous		
IC10,11,12 741 SW3 SPST miniature toggle		7555		8-SPST dual-in-line lateral switche	
217					
	Q1,3	BC214L	PB1	momentary push button	

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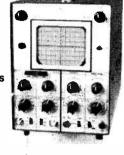
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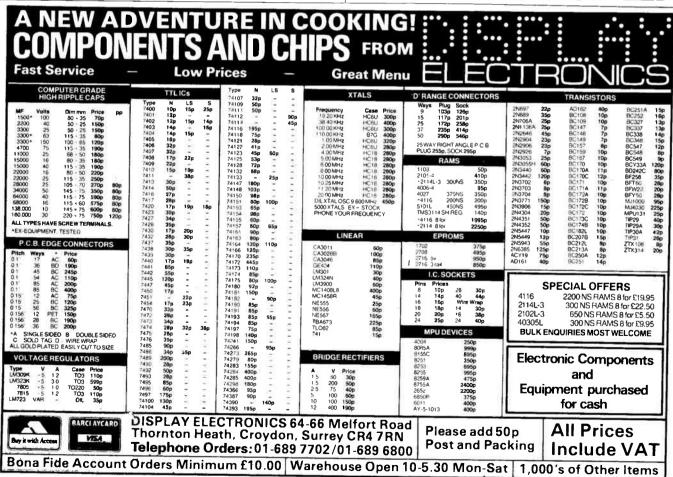






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6/12 position with additional where the rotor is coils.
Device can be used as a tacho. Diagram supplied. Will actually work on 5 volts. 12: 24 recommended.

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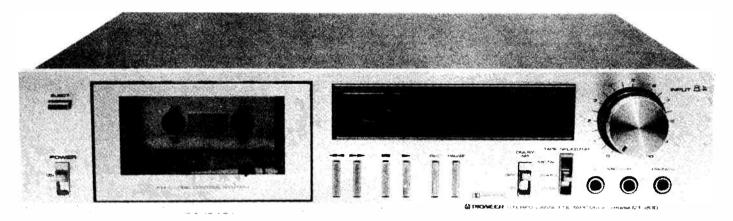
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# **AUDIOPHILE**



Yes, you read it right... Audiophile is back! Ron Harris takes pen in hand again to review a couple of Pioneer tape decks, and enthuses over some old friends.

R ight. Put down the trannie radios, pack away the pine needles — Audiophile has returned! That man at the back with the yellow handbag who whispered "Oh gawd, not again" can leave now of his own accord, or be carried out later when the boys get round to landscape his anatomy.

To all my regulars who sorely missed these pages and who wept and wailed their grief to the dawn — thank you. To any tasteless cloth-eared ingrate who thinks I should have stayed away — read on, read on, there is yet hope and charity for such as ye in the halls of the righteous! (ie here...).

For my return trick, I'm taking a look at two tape machines from Pioneer's cassette deck range, one from each end: the CTF-1250, which is their flagship design, and the CT-200, an interesting new release at the budget end of the price scale. Thus we shall be all things to all men... I think.

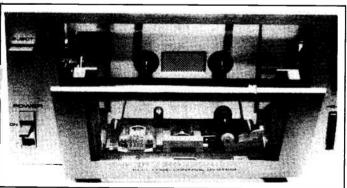
# **Tape For All Seasons**

The new CT-200 is a basic, no-nonsense machine intended mainly for the first time hi-fi man who doesn't wish to have to upgrade again in a hurry. It is compact and sports little in the way of excess controls. Normal VU meters are fitted, with no peak indicators. Logic control is employed for the tape transport mechanism and, strangely, Pioneer have opted for captive phono leads on the input/output connectors. Surely a yard of screened lead and a phono plug can't cost less than a plain ordinary panel socket?

Apart from this the CT-200 is distinguished only by its normality! There are no frills and no gimmicks at all. The controls worked impeccably at all times and the meters were fast enough to give reliable results when recording.



As you can see from this detail of the control section of the CT-200, Pioneer have kept it simple. The meters are conventional VU, with no peak indicators, but this should not deter an intended purchase, as they are still pretty good at their jobs! Transport controls are solenoid operated, a plus point at the price.



Unusual is the way in which virtually a whole section of the front panel unhinges to accept a cassette. Can be a little un-nerving the first time, you think something somewhere has dropped off, if you'll pardon the expression!

The heads are easily accessed for cleaning.

The one minor annoyance was the switching 'thump' generated whenever the mains power was interrupted. A small thing, but one which Pioneer should attend to, ASAP.

# **Resulting Tests**

The test bench brought forth no gremlins from the design and a scrutiny of the results will show that good figures were returned on all counts. The signal-to-noise and metal tape figures are particularly impressive for a machine in this price

Sensitivity was slightly below the spec., at about 80 mV, but this is still a very reasonable figure and one that, together with the input impedance of 90k, should ensure that the CT-200 will work happily with the majority of amplifiers.

Wow and flutter is very well controlled and proved unobtrusive in use. All in all the machine gave a surprisingly good account of itself under test and one which does it credit at the price.

Frequency response : LH tape :-25 Hz - 14 kHz  $\pm$ 4 dB (-20 dB) CrO<sub>2</sub> :- 25 Hz - 17 kHz  $\pm$ 3 dB

DIN:-

CrO<sub>2</sub>:-

 $25 \text{ Hz} - 18 \text{ kHz} \pm 2 \text{ dB}$ Metal :-25 Hz - 18 kHz ± 3 dB

FeCr :-

Signal-to-noise Ratio :-(best result, Dolby on)

-65 dB

Wow and Flutter:

 $\pm 0.15\%$ 

Harmonic Distortion:-

WRMS:- ±0.05%

Line Sensitivity:-

1.2% (0 dB)

80 mV

Input Impedance:-

90k

Table 1 — Test Results CT-200

# **Auditioning**

Having duly done my duty with the meters and measures, it was down to the nice part of the job — settling back in a chair and listening to the deck playing coherent music as opposed to all those monotonous tones. Again the CT-200 provided a surprise - put simply, it sounded better than I suppose I'd expected. The sound was clean and sharp, with little trace of the

old 'cassette sound' that was so immediately recognisable a couple of years back. The machine was always detectable against a reference, as would be expected for a £100 deck, but was never anything less than satisfying to listen to.

Overall it represents very good value for money and can be thoroughly recommended. It just goes to show how far budget hi-fi — and tape in particular — has come of late.

# **Battleship Engineering**

The CTF-1250 is a massive machine which is some 161/2 x 7½ x 14½ inches in size, and 26 lb in weight. Once more into the truss dear friends, or block up the living room with tape deck

For all that, the front panel is tightly packed with controls, buttons and things that glow in the night. There is even a control to turn down the brightness of the fluorescent display, lest its brilliance offend thee.

Basically the machine is possessed of full tape optimisation facilities, a digital tape counter, full logic controls which can be operated from the counter, and peak reading meters which can be set to one of three modes.

Rather than waste an issue describing it all in a thousand words, take a look at the photo and diagram, the caption to which should explain the myriad machinations of the machine.

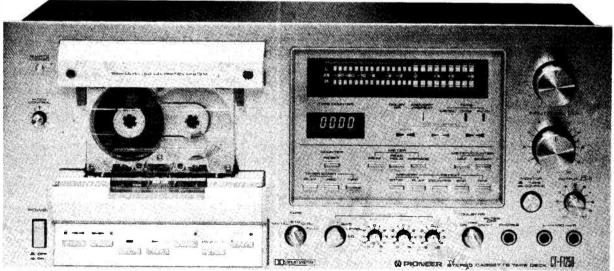
# Results Of A Test

Table 2 gives a brief extract from the test results, in a form which can be compared to those for the CT-200. As you can see, there is not the difference you may expect, considering how many more bits of green paper are required to obtain the 1250. Those buttons cost money.

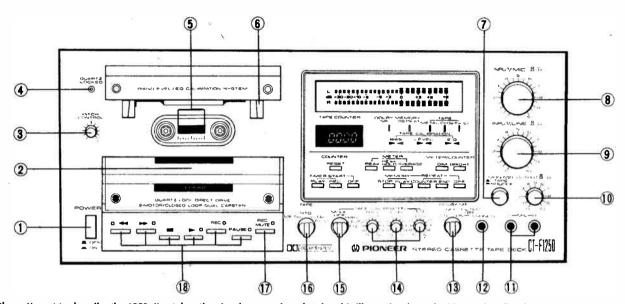
All results are given with the machine optimised for the tape in use. With the system employed here, such a set-up is easy and certainly yields improved results for relatively little effort. The figures are generally 'good' for a cassette deck but are nothing outstanding by any means. The CTF-1250 turned in solid, repeatable performance on all the important parameters.

# Listening In

Under audition the 1250 proved a difficult machine to live with. No insult intended, it was just well-nigh impossible to stop playing with the controls and listen to it! In practice, once a par-



The exact opposite of the CT-200 in every way! This is the daunting 1250, Pioneer's tape flagship. Those impressive meters have three modes of operation, peak reading or hold and average.



Rather than attempt to describe the 1250, I've taken the visual approach and stolen this illustration from the Pioneer handbook! 1) Mains Power: One fault here is that it is not 'de-thumped'. 2) Dust Cover: fits over the heads which would otherwise be very vulnerable. A nice touch this.

3) Pitch Control: yes, that's right the speed is quartz locked and can be varied if required. 4) PLL Indicator: activates when speed is correctly set. 3) PICE CONTROL: yes, that's right the speed is quartz locked and can be varied it required. 4) PLL Indicator: activates when speed is correctly set.

5) Remaining Tape Markers: just the usual backlight to show how much tape is left. 6) Tape Guide: accurately machined guide paths to make sure you put the cassette in straight. 7) Monitor: standard stuff for a 3-head design, chooses tape or source. 8) Mic Level: ganged input control for the front panel jacks.

9) Line Input: ditto for the two inputs on the rear panel. Friction linking is a little too strong! 10) Output Level: click stopped at 0 dB. 11) Mic Inputs: 'A'' jack sockets. 12) Headphone Output: provides a healthy output to drive a pair of dynamic phones. 13) Dolby/Filter: allows use of the NR with/without MPX filtering. 14) Tape Calibration: just set the Mode switch to required parameter and adjust the appropriate control until the calibration lights indicate purity. Simple and efficient. 15) Mode Control: used with 14. 16) Tape Selector: standard choice of four tape types. 17) Record Mute: useful for killing ads. when taping from radio etc. 18) Solenoid Controls: all transport controls are logic locked and virtually idiot-proof.

ticular brand of tape has been settled on, and the control settings noted, there is little reason to fiddle around at all.

The metering is superb and about the most useful I've encountered anywhere. The sound quality is, again, good, but not as good as can be obtained elsewhere for £450. Some sacrifice has to be made if you want to buy all those lovely facilities.

Best results — regardless of optimisation, strangely enough were obtained with Maxell tapes and in particular the UDX-II. Sony Metal came a close second, which although providing a cleaner result, showed some signs of treble lift whatever I did to the optimiser.

Frequency response: LH:-25 Hz - 15 kHz  $\pm$  3 dB CrO<sub>2</sub>:- $(-20 \, dB)$ 25 Hz — 17 kHz ±3 dB

Metal :-

 $25 \text{ Hz} - 19 \text{ kHz} \pm 3 \text{ dB}$   $25 \text{ Hz} - 16 \text{ kHz} \pm 3 \text{ dB}$ FeCr:-

Signal-to-noise Ratio :--66 dB

(best result, Dolby on)

Wow and Flutter:

DIN:-0.1%

WRMS: 0.03%

Harmonic Distortion:-

0.9% (0 dB)

Line Sensitivity:-

60 mV

Input Impedance :-

50k

Table 2 — Test Results CTF-1250

# **Sum Summary**

Adding it all up, the CTF-1250 comes out as a very crafty compromise; one that will appeal to many. Its sound is not of the ultimate quality, but its facilities and versatility are second to none.

The CT-200 is a well-conceived and well-executed budget deck that offers excellent value for money and an outstanding sound quality for the class.

# **Audio Updates**

At present I'm working on a feature called 'Sonic Holography' for next month's ETI — and if you don't know what that is (S.H. not ETI!) then you're gonna have to buy our next issue, 'cos I ain't gonna tell you now — as part of which I've had the chance to renew my acquaintance with the Gale loudspeakers. I thought that since such opportunities occur but rarely, I'd drop the reader's letters and ramble on about them for a while instead.

# Any Port In A Gale?

Few products, especially loudspeakers, can claim to have stood the ravages of time and changing tastes as successfully as the Gale GS401. It is now many years since Ian Gale first unleashed his chrome-end, unconventionally horizontal transducer upon the ears of the world and, if anything, its standing has risen with the passing of the summers.

Infinite baffle enclosure (330 x 605 x 270 mm) Four unit design (2 x 200 mm; 1 x 100 mm; 1 x 19 mm)

dome)

Crossover frequency: 475 Hz and 5 kHz Efficiency: 20 W produces 96 dB at 1 m

Power handling: 40 W - 200 W RMS per channel into

8R amplifiers recommended

Fuse-protected against overload

Table 3 — Specification of Gale GS401A

Above: the imposing Gale 401, in chrome livery. The stands are also available in a black finish and personally I prefer it that way!

# FEATURE: Audiophile

It is basically a four unit, infinite baffle (sealed box) design of prodigious power handling and excellent imaging. Long before 'phase linearity' gathered unto itself the role of buzzword, the Gales were presenting an essentially phase stable performance, witnessed by the incredible square wave performance. This is one of the few loudspeakers through which such a signal may pass and emerge with some semblance of accuracy.

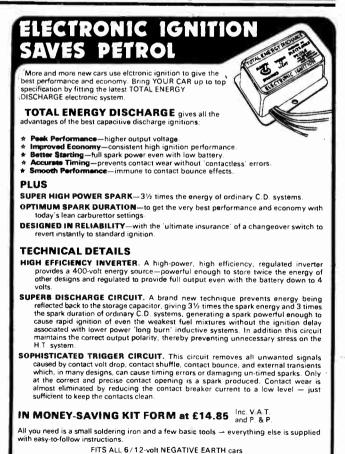
I had the Gales at home for a period of some weeks and grew to appreciate their virtues more with time. Comparing them to my usual reference — the KEF 105 II — they have a relatively similar approach to music. The 105 has a better defined bass register and a more transparent treble, but the Gales run them mighty close indeed — and at half the price!

Anyone who is about to spread over £400 on the counter for a pair of speakers would be well advised to hold onto the cash until he'd given the 401s a chance to show what they can do. They are more room dependent than most transducers in this league and less coloured than any when set up correctly. Still an outstanding design then, and a lasting credit to their designer.

# **Trailer**

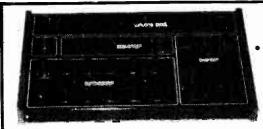
Next month it's back to pickups for a trio of moving coils from Mayware, Ultimo, and Ortofon. I'll also be putting down some words on a new Japanese speaker (shock horror...), the Mitshubishi DS-32B which has been specially designed for non-oriental ears.





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7473	3 <b>2p</b>	74LS221	110p	4076	88
7474	32p	74L5240	210p	4077	23p
7475	40p	74LS241	200p	4078	29
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7490	35p	74LS244	175p	4082	25 p
7492	50p	74LS245	220p	4085	86p
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74LS01	12p	4001	190	4515
74LS02	13p	4002	19p	4516
74LS03	13p	4006	75p	4518
74LS04	13p	4007	19p	4520
74LS08	20p	4008	80p	4521
74LS10	19p	4009	35p	4526
74LS11	20p	4010	45p	4527
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74LS13	35p	4012	24p	4529
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74LS30	18p	4020	88p	4572
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74LS37	35p	4022	88p	4303
74LS38	35p	4023	22p	
74LS40	25p	4024	50p	740
74LS42	56p	4025	20p	74C20
74LS47	78p	4026	130p	74C76
74LS48	85p	4027	45p	74C85
74LS49	99p	4028	75p	74C97
74LS73	30p	4029	80p	74C98
74LS74	30p	4030	50p	74C107
74LS75	42p	4031	195p	74C160
74LS85	98p	4033	145p	74C161
74L586	39p	4035	104p	74C162
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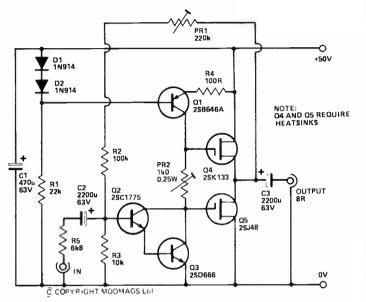
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The circuit is basically quite conventional with Q2,3 being used as a Darlington pair, common emitter driver stage. The main collector load for this is formed by a constant current generator circuit using Q1 and its associated components. This gives a current of about 6-7 mA in the driver stage. Such a low current is acceptable due to the very high current gain of the complementary source follower MOSFET output devices. PR2 is used to set the appropriate quiescent output current through the output stage and the slightly negative temperature coefficient of the output devices makes any thermal stabilisation here totally unnecessary. R2,3 and PR1 are used to bias the amplifier. No phase or frequency compensation components are needed due to the excellent high frequency performance of the two output transistors.

Before initially connecting the supply to the circuit, set PR1 at about half maximum resistance. PR1 is then adjusted to give half the supply voltage at Q4 and Q5 source terminals and PR2 is advanced to give the circuit a quiescent current consumption of approximately 100 mA. The circuit has an input sensitivity of about 500 mV into 6k8



for full output. Current consumption is about 800 mA RMS at 20 W RMS output and almost 1 A with an output of 30 W RMS. The transistors are available from Ambit International.

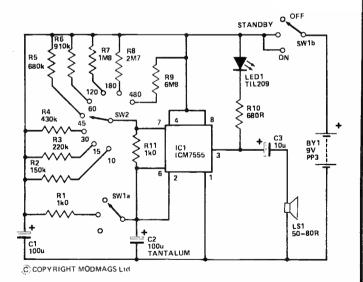
# **Call Charge Reminder**

The idea of this simple circuit is to give the user some idea of the number of units that are being accumulated while a telephone call is in progress. It is not intended to give a readout of the number of units, but instead gives a warning (clicking) sound each time an extra unit is accumulated. This enables a very simple and inexpensive circuit to be used and is effective in that it prevents the user from losing track of time.

A CMOS version of the 555 timer device (the ICM7555) is used as the basis of the unit. Using the CMOS version has the advantage of giving a much lower current consumption (about 100 uA). Before starting to dial the required number the unit is switched to the standby mode using SW1. This connects power to the circuit, but the 555 astable is blocked from operating properly by R1 which holds timing capacitor C2 into a charged state.

When the call is answered, SW1 is switched to the on position and R1 is then disconnected so that the unit is able to function normally. However, the astable cycle does not start at the normal point with C2 charging from zero. Instead, C2 is rapidly discharged to one third of the supply voltage through R11 and IC1 and then starts to charge again. This is important, since the initial cycle of the circuit would otherwise be significantly elongated (an effect that occurs with virtually all astable circuits).

The operating frequency of the unit is controlled by SW2 and the series of timing resistors (R2-9). The telephone dialling instructions booklet should be consulted to ascertain the time per unit of the call you are about to make and SW2 is then set to the appropriate time. The output of IC1 is normally high, but at the end of each cycle it briefly



goes low, giving a clicking sound from LS1 and giving a brief flash from optional indicator LED 1. Each click, including the one that occurs as the unit is switched to the on position, indicates an extra unit has been accumulated.

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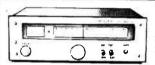
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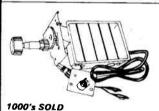
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# THE LEPTONS

No, not more aliens for Captain Kirk to deal with, but a family of subatomic particles. Lepton means 'light particle', but some of them aren't, and they may not be made up of quarks either. Confused? So are the particle physicists. A.S. Lipson explains.

nce upon a time, physics was simple (well, nearly...). Subatomic physics especially, seemed to be fairly clear cut. Around the turn of the century, J. J. Thomson had discovered the electron, which carried a negative electrical charge. A few years later, Max Planck had stated the existence of the photon, or 'particle of light'. There was one other particle; the proton, which was positively charged, and had a mass about 1836 times that of the electron. The proton and electron were known to exist within atoms. That was the entire list of subatomic particles, and it looked as though everyone would live happily ever after.

Then things got complicated. In the 1930s and 40s, more particles started turning up, and they have continued to do so to the present day. First there were the neutron and mu-meson. Then there were the pi-mesons, or pions (three different ones!), the Kaons, the positron, the anti-proton, the anti-neutron, the anti-muon, a few different particles called Sigmas, and no less than four variations on a type of particle known as a neutrino (of which we will see more later). The list seemed endless.

Eventually, the physicists managed to start simplifying the situation. It became apparent that many particles — the proton and neutron, for example, might be made up of various combinations of a few even more basic particles — called quarks. Instead of having all those different particles; maybe everything could be explained in terms of just three or four quarks. There was a particular group of particles, however — collectively known as 'leptons' — which did not seem to be made up of quarks. It's these particles which concern us in this article.

# **Light Matter**

The word lepton comes from the Greek word 'lepto', meaning light, since the earliest leptons discovered were particles with relatively little mass. It is now known that not all leptons are light, after all, but the name has stuck.

The first lepton to be discovered was the electron, which has a negative electric charge of  $1.6 \times 10^{-19}$  coulombs, and a mass of  $9.1 \times 10^{-31}$  kg. (It will be convenient for the purposes of this article to refer to particles as having a mass of so many times the mass of the electron, so for the moment we can say simply that an electron has mass 1. Using this scale, a hydrogen atom has a mass of nearly 2000). The next particle to enter our story is the neutron. The neutron is not a lepton, but its relationship with the electron leads us to the next important point — the neutrino.

The neutron is a fairly massive particle; on the electron's scale it has a mass of 1839. It carries no net electrical charge — hence its name. One important feature of the neutron is that, like many particles, it is unstable. An isolated neutron will tend, after an average time of 15 minutes or so, to disintegrate, producing a proton (mass 1836) and an electron. You will notice that, since the neutron carries no charge, when it turns into a positively charged proton, it is necessary that an equal and op-

Particle	Mass (x electron mass)	Charge (in coulombs)	Lifetime	Lepton
Proton Neutron Electron Electron- neutrino Muon- neutrino Tau	1836 1839 1	1.6 x 10 <sup>-19</sup> Zero -1.6 x 10 <sup>-19</sup> Zero -1.6 x 10 <sup>-19</sup> Zero -1.6 x 10 <sup>-19</sup> Zero	Stable 2.2 x 10 <sup>-6</sup> S Stable	No No Yes Yes Yes
Tau- neutrino	Very small	Zero 	3 x 10 <sup>-12</sup> S Stable	Yes

Table 1. Particles discussed in the article (antiparticles left out for simplicity).

posite charge — the electron — is created at the same time, so that the total charge remains zero. All well and good, then; sometimes a neutron spontaneously changes into a proton and an electron.

# Think Of A Particle. . .

Unfortunately, it isn't quite that simple. You see, when this reaction was first observed to happen, physicists weren't too happy with it. It seemed that certain physical laws which had always held before weren't holding any more. But then it was spotted that all the laws would be holding, if only there was another particle taking part in the reaction. This particle, although it had never been observed, was christened the 'neutrino', from Italian words meaning 'little neutral one' — since the neutrino, if it existed, would have little or no mass and be electrically neutral. The fact that the neutrino had never been detected was easily explained — all the methods used to detect subatomic particles depended on their having measurable masses and charges. The neutrino had neither. In fact, neutrinos react with other matter very rarely. If a beam of neutrinos was aimed at a concrete slab a light-year thick, by far the majority would get through easily!

You may think it a little bit far-fetched that scientists would actually *invent* a new particle — one that had never been found — just to explain why some physical laws didn't seem to work. Why not just change the laws? Well, all through the history of science, it has invariably turned out that the simplest explanation of a set of events is the correct one. In this case, it was simpler to keep the old, simple set of laws and invent a new particle, than it would have been to invent a whole new set of more complicated laws. This, at least, was how the physicists reasoned, and as it happened, they were right! In 1956, twenty-five years after its original invention, the neutrino was discovered! In fact, it was found that the particle produced when a neutron

turned into a proton and an electron was not a neutrino, but its 'antiparticle', the antineutrino. This, however, was a small point, and the discovery of the actual existence of the neutrino is regarded as a major triumph for theoretical physics, which had predicted its existence all those years before.

So now our family of leptons contains two particles, the electron and the neutrino (and their antiparticles 'positron' and the 'antineutrino' respectively). This wasn't the case for long, though. In the late 1930s, another lepton was discovered in cosmic rays high up in the atmosphere. This particle was called the mu-meson, or muon for short. It was given the symbol  $\mu$  , the Greek letter mu. There are only two real differences between the muon and the electron. Firstly, the muon has a much greater mass, about 207 times that of the electron; and secondly, the muon, like the neutron, is unstable, although on average it has a much shorter lifetime. Under normal conditions, a muon will disintegrate after only about one five hundred thousandth of a second, turning into an electron and producing two neutrinos. Apart from these two differences, however, the electron and muon are strikingly similar. For instance, both carry the same charge,  $-1.6 \times 19^{-19}$  coulombs. The anti-muon carries a positive charge of the same magnitude, just as does the anti-electron, or positron. The similarity between the two particles has been puzzling physicists ever since the discovery of the muon. But there's one more thing puzzling them, too. . . .

# **Identical Twins?**

It was found that many of the reactions involving electrons also involved neutrinos. Similarly, many reactions involving muons also involved neutrinos. The neutrinos that reacted along with electrons didn't seem to be the same as those which reacted along with muons. Apparently, there were two types of neutrinos. If you examined a neutrino from a reaction involving an electron, you would find that it could not be made to take part in a reaction involving a muon. Similarly, a neutrino from a muon reaction could not be made to react with an electron. Neutrinos, then, had to be divided into two groups; 'electron neutrinos' and 'muon neutrinos'. What is the difference between the two types of neutrino? The somewhat embarrassing answer (for a physicist) is that, even today, nobody really knows. They are different, but we don't know why. All we do know is that reactions involving electrons tend also to involve electron neutrinos, whereas reactions involving muons tend to involve muon neutrinos. When a reaction involves both electrons and muons, both types of neutrinos are involved. For instance, when a muon turns into an electron, a muon neutrino and an electron antineutrino are produced (see Fig.1b). The two types of neutrinos are like almost-identical twins — you can't tell the dif-ference just by looking at them, but only by looking at the different ways they behave. And, of course, each of the two types of neutrino has its own anti-neutrino, as well.

# Three's A Crowd....

As if the situation wasn't already complicated enough, experiments conducted in the last five years or so indicate (wait for it) that there's yet another lepton. This one, called the tau particle (and given the symbol  $\tau$  — the Greek letter tau) is, again, just like the electron and muon, but with a still greater mass (about 3500 times the mass of an electron — nearly as massive as a molecule of hydrogen! As far as subatomic particles go, this is well into the heavyweight league), and with a still shorter average lifetime before it distintegrates into other particles. As yet, experiments are not conclusive, but it seems that the tau particle also has its own pair of neutrinos — the tau neutrino and the tau antineutrino. Unsurprisingly, these neutrinos refuse to take part in electron or muon reactions, unless a tau particle is also involved.

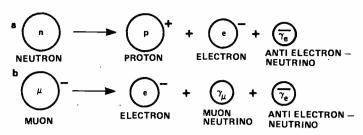


Fig. 1. (a) Neutron turning into proton and electron, giving off antineutrino. (b) Muon disintegrating to produce electron, muon-neutrino and anti electron-neutrino.

# Any Answers?

So that is the situation at the moment. There are three known leptons which carry electric charge — the electron, the muon and the tau (each also having a positively charged antiparticle) and correspondingly, three sets of a pair of neutrinos — the electron-, muon- and tau-neutrinos, with their antiparticles. There are a lot of questions still to be answered. Are there any more leptons, like the electron, muon and tau, but with still greater masses, and shorter average lifetimes? If there are, do they also have their own neutrinos? And for that matter, what is it that makes, say, a muon neutrino different from a tau neutrino? There's one more major problem too.....

# A Massive Question

It has been known for several decades now that neutrinos have very little, or perhaps no mass at all. In fact, there has been a tendency among physicists to believe that the latter is the case — that the neutrino has no mass, although this has never been proved. Very recent experiments, however, make it look as though perhaps the neutrinos do have masses after all. If this is so, then physicists may have to rethink a lot of theories. Do neutrinos have mass? We shall just have to wait and see and maybe everyone will live happily ever after.

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CERAMIC CAP (50V)	NE555 26p						AD149	40p	BF194/5	12p	2N69B 20	
33 pF to 4700 pF 4p	NE556 *45p	791B/24 <b>80p</b>	404B		74B0	32p	AD161/2	28p	BF196/7	12p	2N706 14	
POLYSTYRENE CAP (50V)	NE566 140p	.DPTO/	4049	50p	74B5	140p					2N914 <b>20</b>	
10 pF to 1000 pF 5p		ELECTRONIC	4050B	50p	74B6	18p	AF114	30p	BF19B	10p		
	SN76023N 120p	2N5777 40p	4066	60p	7490	28p	AF124	35p	BF200	23p	2N91B <b>35</b>	
POLYESTER CAP (100V)	SN76115N <b>*80p</b>	OCP71 65p	406B/9	22p	7491	57p	AF125/6	35p	BF224B	14p	2N1302/3 35	
1 nF to 6B nF <b>6p</b> ; 100 nF 150 nF <b>8p</b> ; 220	TBA641B 200p	ORP12 80p	4070B/1	22p	7492/3	30p	AF127	35p		*22p	2N1304 35	
nF <b>9p</b> ; 330 nF <b>10p;</b> 470 nF <b>11p</b> ; 6B0 nF	TBAB00 <b>75p</b>	DL704 110p	4072/3	22p	7494	50p	BC107/B	10p	BF25B	28p	2N1306 30	рĮ
7p; 1uF 7p; 1.5 uF 7p; 2.2 uF 20p;	TBA B10S 110p	DL704 110p	4081/2	26p	7495	40p	BC109	10p	BF259	40p	2N130B 35	
3.3uF 15p★; 4.7uF: 15p★	ZN414 90p	LEDs:	4081/2 4086	20p	7495	37p	BC140	20p	BFR39	30p	2N1613 25	
ELECTROLYTIC CAP (uF/V)	ZN1034E 220p						BC142/3		BFR40	20p	2N1711 13	
1/25 to 47/25 <b>6p</b> ; 6B/25 <b>7p</b> ; 100/35,	DIODES	0.125" & 0.2"	4510	100p	7497	200p		30p	BFR79	32p	2N1893 25	
150/25 8p; 160/25: 5p#; 200/12:		Red 12p	4511B	100p	74100	60p	BC147/B	10p				
	OA47 8p	Green 16p	4516/B	105p	74105	43p	BC149	10p	BFRBQ	20p		P
6p; 250/12 7p; 220/25 10p; 470/25,	OA91 7p	Yellow 16p	4520/B	105p	74107	22p	BC157/B	12p	BFX29	25p	2N2219 23	
500/30 12p; 470/40 mini 15p; 640/	OA200 5p	Rect. Green 25p	TTL		74109	34p	BC159	12p	BFXB4	25p	2N2222A <b>23</b>	
16. 8p; 1000/10 10p; 1000/40 24p;	OA202 <b>6p</b>	0.125" Clip 3p	7400/1	16p	74110	40p	BC169C	13p	BFXB5/6	20p	2N2369 17	рI
1500/25: <b>24p*;</b> 2200/6.3 <b>12p</b>	1N916 <b>4p</b>	0.2" Clip <b>3p</b>	7402/3	16p	7411B	84p	BC171	10p	BFXB7/B	25p	2N24B4 <b>25</b>	рΙ
ZENER DIODES (400mW)	1N414B 4p		7404/5		74121	25p	BC173	8p	BFY50/1	20p	2N2646 46	
2V7 to 33V 8p	1N4001/2 4p	DIL SOCKETS		16p	74122	30p	BC177/B	16p	BFY52	22p	2N2904/5 21	
VEROBOARDS (.1" copper)		Bpin <b>≄8p</b>	7406	18p			BC1777B		BRY39	50p	2N2906/7 21	
2.5" x 5" 65p		14 pin <b>★9p</b>	7407	25p	74123	50p		16p				
3 75" x 5" 80p	1N4004/5 <b>6p</b>	16 pin <b>★10p</b>	740B	22p	74125/6	42p	BC1B2	10p	BSX19	12p		
	1N4006/7 <b>8p</b>	18 pin <b>16p</b>	7409	13p	74132	65p	BC1B2L	∗8р	BSX20	22p	2N3053 <b>20</b>	
RESISTORS (5% E12)	1N5400 <b>11p</b>	22 pin <b>20</b> p	7410	13p	74141/5	46p	BC1B3B	10p	BU205	150p	2N3054 <b>30</b>	
10 Ohms to 10Mohms 2p	1N5401 <b>12p</b>	24 pin <b>21p</b>	7411/2	17p	74150	85p	BC1B4	10p	BU20B	210p	2N3055 45	
PRESETS (.15W HORIZONTAL)	1N5402 <b>13p</b>	28 pin <b>25p</b>	7413	30p	74151	65p	BC1B6	25p	MJ2955	110o	2N3442 <b>140</b>	ro II
100 Ohms to 2 Mohms 7p	1N5404 14p	40 pin 35p	7414	45p	74153	43p	BC1B7	15p	MJE340	52p	2N3702 to	
POTENTIOMETERS (1/4W)	BRIDGE				74154	66p	BC207/9	13p	MJE3055	80n	2N3711 11	n I
Linear & Log Scales	RECTIFIERS	CMOS AE	7416	20p	74154	46p	BC212	10p	MPF102	45p	2N3772 *70	
4K7 to 2M2 33p		4000 <b>16p</b>	7417	25p					MPF104/5	40p	2N3773 <b>250</b>	
		4001B <b>17p</b>	7420	15p	74156	42p	BC212L	*8p				
LINEAR LF351N 44p	WO6M 20p	4002 <b>16p</b>	7421	30p	74157	38p	BC213L	10p	MPF106	45p		
CIRCUITS LF356N 85p	1A750V <b>20p</b>	4006B <b>75p</b>	7422	26p	74160	57p	BC214	10p	OC2B/35	50p	2N3B20 40	
709-B <b>28p</b> LM301AN <b>30p</b>	1A/200V 23p	4007 <b>*16</b> p	7427	20p	74161	55p	BC214L	±8p	TIP29	40p	2N3B23 70	
710-14 <b>35p</b> LM308N <b>*38p</b>	1A/400V 28p	400B <b>85p</b>	742B	28p	74162/3	60p	BC23B	18p	TIP29B	42p	2N3B66 <b>65</b>	рΙ
741-B 22p LM31BN 120p	1A/600V 29p	4009 <b>42</b> p	7430	16p	74164/5	56p	BC261B	23p	TIP30	40p	2N3903/4 15	p I
747-14 <b>50p</b> LM318H <b>120p</b>	1A5/75V 22p	4010 <b>48</b> p	7432	28p	74166	95p	BC301/3	32p	TIP30B	42p	2N3906 15	
	2A/50V 30p						BC32B	17p	TIP31	30p	2N4037 45	
748-B <b>35</b> p LM324N <b>57</b> p		4011B <b>20p</b>	7433	38p	74173	110p			TIP31A	31p	2N4058 10	
CA301B 70p LM339N 52p		4012 <b>25p</b>	7437	14p	74174/5	55p	BC461	40p	TIP31A	40p	2N4059 10	
CA3028A <b>85p</b> LM34BN <b>90p</b>	3A/100V 60p	4013B <b>45p</b>	7438	18p	74176/7	70p	BC477	35p				
CA3046 <b>50p</b> LM377N <b>175p</b>	3A/600V 75p	4014/5B <b>80p</b>	7440	13p	741BQ	35p	BC47B	20p	TIP33	65p	2N4060 10	
CA3054N <b>40p</b> LM3B0N <b>90p</b>	THYRISTORS	4016 <b>44p</b>	7441	52p	741B1	80p	BC479	23p	TIP33C	70p	2N4061 10	
CA3080 78p LM3B1N ±120p	4A/300V 20p	4017 <b>70p</b>	7442	32p	741B2	45p	BC547/8	12p	TIP34A	75p	2N545B <b>40</b>	
CA3090AQ 200p LM3B2N 120p	4A,400V 40p	401B <b>85</b> p	7443	60p	74190	50p	BC549	12p	TIP35B	200p	2N5459 <b>40</b>	
CA3130E 95p LM1310N 115p	12A/100V 30p	4019 <b>50p</b>	7444	100p	74191	90p	BC557/B	140	TIP36A	200p	2N6027 30	p I
	BA/400V 75p		7445		74191/3	60p	BC559	14p	TIP36B	210p	3N128 50	o I
CA3140E 48p LM145BN *40p		4020B 100p		64p				-				-
MINIMUM 4001B 15p 4016A	25p 7473	16p   1N4005 4.				15p	CA3090A0	70p	160 uF / 25			9p
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Case
15 BC114 transistors
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4 BD131 transistors
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6 pra 25038/258496 AF 0/P sim to
AC128/176
20 7V5 400mW seners
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10 58V 1W zener
10 58V 1W zener
200 18 5% 14W carbon film resistors
100 300pf 63V polystyrene preformed
cape
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long K166 100 3300pF 630V polyester PC mntg

K188 18 F544 PNP Si TO92 transistors. Vce 20V, His 300 K189 30 1N649 600V 0.4A diodes, pre-formed for H mntg. K190 16 82785 8V2 250mW zener diodes K191 26 80 900 600 10 p Hat's witching diode, 800V 6A K192 25 RGP10B 100V 1A switching diode

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good number of fuzzbox circuits have appeared in the past which attempt to emulate the sound of an overdriven valve amp; the majority of these look great on a scope but still sound rough. The chief characteristic of valve amps is the way they overload; rounding off the peaks as opposed to transistor circuits which clip off the peaks, producing predominant odd harmonics. FET amps produce overload in a similar way to valve amps, and a cheaper and better (or worse) way to obtain this is to use CMOS gates in the linear mode. Figure 1 shows the overload for a triangular waveform. In the final circuit we have used a very versatile and much under-used CMOS IC, the CD4007 dual complementary pair and inverter. One complementary pair is wired as a second inverter - the two inverters are used as amplifiers and give a combined gain of 60 dB. One of the remaining CMOS FETs is used as a voltagecontrolled resistor which can vary between from several megohms to a few hundred ohms. The output of the amplifier is passed to a detector which controls the resistance of the FET, and this is fed back to various parts of the circuit to give the expansion and compression effects. Figure 2 shows the input/output characteristics for the various functions. The compressor is effective over a 30 dB range.

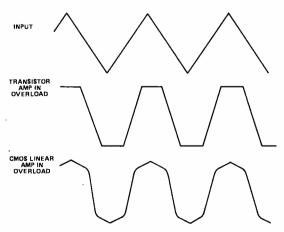


Fig.1 Clipping characteristics for two types of amplifier under overload conditions.



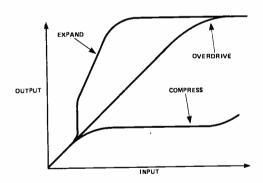


Fig.2 Input/output characteristics for various functions of the effects unit.

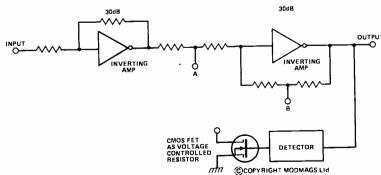


Fig.3 This diagram shows the basic principle of the unit.



The unit has six functions, as follows:

- 1. Overall overdrive
- 2. Overall compression, for sustaining
- 3. High frequency compression, for bass overdrive
- 4. Overall expansion, for sustained overdrive
- 5. Mid expansion, for mid to high accentuation
- 6. High frequency expansion, for high accentuation

The effect of all these functions is variable, with the exception of overdrive.

# Construction

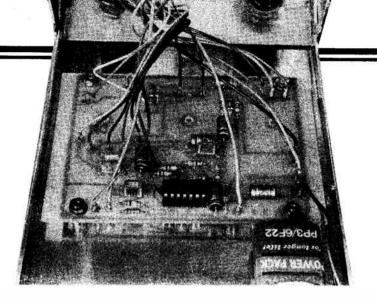
The PCB is designed to accept the control components (SW2 and pots) if PCB-mounting of these components is preferred, to give a very compact construction. For the prototype this was not necessary as we used a custom-built housing (see Buylines). The box comes unpunched so if you want to arrange the controls and sockets differently you can get a drill and do your own thing. If you use a different housing remember that a metal case should be used to maintain proper screening.

We used a volume control with a built-in on/off switch instead of the standard method of using the input jack, as the latter approach produces a 9 V peak back into the source circuit and can cause damage if this circuit is active.

If the guitar has a low sensitivity pickup, it may be necessary to increase the value of R2 accordingly. The unit only consumes 3 mA so the batteries should last guite a while.

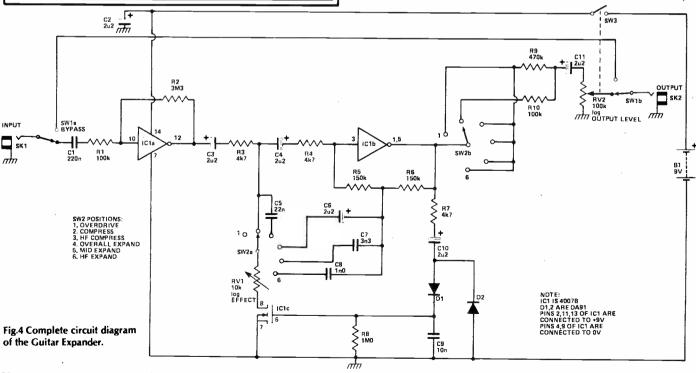
# **HOW IT WORKS**

CMOS inverters may be used in the same manner as op-amps in the inverting mode, with the added bonus that they are self-biasing. The input is fed into IC1a, configured as a high gain, high impedance amplifier to give a gain of around 30 dB. This is decoupled and passed through a resistor pair to a second amplifier stage, which has a resistor pair in its feedback (see Fig. 3). If point A is now taken to ground via a resistance, gain is reduced; if this is done to point B, gain is increased. The final output is passed through a detector to give a voltage proportional to the signal level; this voltage is used to control the CMOS FET. If the FET is taken to point A or point B, then the overall gain is proportional to the final output signal. Thus if the output reduces the signal, it is self compressing. If it increases it, the signal is expanded. By making these gain variations frequency-dependant, we can accentuate or subdue the high frequency as required, at various break points to give the effects required. The output signal has to be attenuated to return it to its original level.



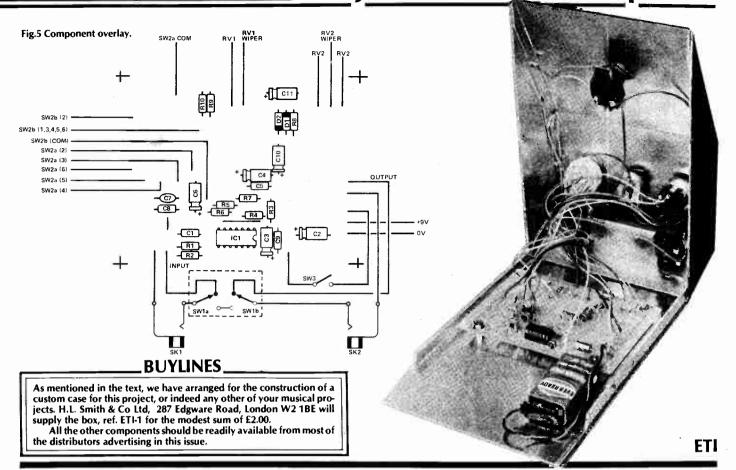
# PARTS LIST

Resistors (all 14W, 5	i%)
R1, 10	100ku
R2	3M3 ,
R3, 4, 7	4k7 🟏
R5, 6	150k
R8	1M0
R9	470k/
Potentiometers	
RV1	10k logarithmic
RV2	100k logarithmic with integral switch
Capacitors	_
C1	220n polyester
<b>52</b> , 3, 4, 6, 10, 11	2u2 16 V axial electrolytic
C5	22n polyester
C7	3n3 ceramic or polycarbonate
C8	1n0 ceramic or polycarbonate
C9	10n polyester
Semiconductors	
IC1	CD4007
D1, 2	OA91
Miscellaneous	
SW1	DPDT latching footswitch
SW2	2-pole 6-way rotary switch
SK1, 2	mono jack sockets
Battery clip (PP3), me	etal box (see Buylines).



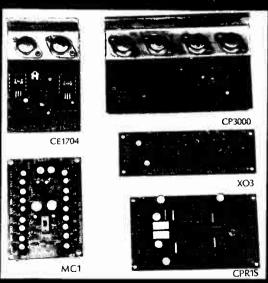
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**PROJECT**: Guitar Note Expander



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Numerous applications are possible with Crimson modules. For example, a complete Hi-Fi Pre & Power amplifier of 40-125WRMS/channel can be built using our Hardware kits (see Hobby Electronics review, August 1890). Alternatively, Mono or Stereo slave amps of up to 500WRMS can be built into proprietory flight cases, while other uses include active loudspeaker systems such as designed by R.I. Harcourt in Wireless World October/November 1980. Further details of how to use the modules are contained in the Users/ Application Manual available at £0.50.

SPE	IFICA	TIO	NS									
Туре	O PSohms*	0/P40	hms*	PSU	H/\$+nks	Slew	S/N	Sensitiv	vity	H D liyp)	FR	Size
CE 608	36			CPS1	50mm	auv/.s	110dB	775mV		0 0035=-	1 5H2 50KHZ 1 3/181	80 - 120 - 25
CE 1004	44	,	0	CP53	100mm	JUVIUS	110/18	175001		0 0035	1 5H7 50Kh7 30B	80 - 120 - 25
CE1008	65			CP53	100mm	30V/15	110dB	775111		0 0035	1.5Hz 50Khz - 3dh- 1.5Hz 50Khz - 3dB-	80 - 120 - 25
CE1704	65	1.3	21	CPS6	150mm FM1	301105	11008	775m1		0.0035%		80 - 120 - 25 80 - 120 - 25
CE1708	125			CPS6	150mm FM1	JUV 1-15	110dB	775m\		0 0035	1 5H2 50KHZ 3HB 1 5H2 50KHZ 3HB	161 - 102 - 35
CP3000			50	CPS6	FM2	RIVAIS	1104B	1/574		0 0035 : D 008 :	20Hz 20Khz	138 - 80 35
CPR1 S	Output		5mV	AEG1		1000	70dB	2 BmV P		0.008	20H7 20KH7 20H2 20KH7	8u - 120 35
MCNS:	Outpul		n٧	AEG!			65d8 90d8	70uV/1		0.01 :	X over points	150 - 50 - 20
XO2 XO3	Output	775 Z	500m b	REGI		41 5						
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# Greenbank Greenbank Electronics (Dept T4E) 92 New Chester Road, New Ferry Wirral, Merseyside L62 5AG (Tel: 051-645 3391) UV 141, UV ERASER ----. 0-0 ioned for both the professional and Can etase up to 14 proms. Special short wave ultraviolet tube. Erase time variable between 5 and 50 minutes in 5 minute steps (preventing over exposure which may shorten prom fife). Sliding tray carries proms on conductive foam. Safety interlock switch prevents the timing circuit from operating and switching on the tube with the tray open. 'Mains On' and 'Tube On' indicators. Smart textured case. Complete instructions supplied. upplied complete with mains plug and flex ith mains plug and flex Model UV 141. Price £77.70 Model UV 140: Price £61.20 **TEX MICROSYSTEMS** "EPROMPT" UV ERASER

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This is used in conjunction with "Kemitron" Z80 boards to interface to kim single density \$7.5 8." floppy disks, it is not available as a bare board, but only built and tested. Regrettably Kemitron do not supply circuit diagram £185.00

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2)14/4045-JKx 4
6 x 2)14
2)14L-JK x 4
4)18-JK x 8



# CARAVAN LIGHTS CHECKER

# A project that will pay for itself in the first ticket from the police that you don't collect. Submitted by Graham Packer of Soutergate.

any ETI readers, besides boring the pants off their neighbours with dreary electronics, are just as antisocial when it comes to cluttering up the highways with their sluggish caravans. Now that they (and their caravans) are in hibemation until summer, the time is at hand to reach for soldering iron and component catalogue and make amends.

Most caravans receive their power supply and lighting signals by way of a multiway plug and socket, terminating on a 'choc-block' terminal strip under the front seat/bed. This is where the 'guts' of the project goes. The cable is merely chopped and the large plastic box inserted. The display unit can be mounted anywhere that is visible from the driving mirror and double sided tape (the thick foamy kind) may be used to hold it on the wardrobe or side of the kitchen unit.

For once, no complicated electronics; just the most basic of electromagnetic devices, the relay, albeit in its more refined form of the reed insert. These reeds, originally developed for electronic telephone exchanges, need about 20 to 50 ampere turns to pull them in. The current drawn by a caravan sidelight, brakelight or indicator lamp can be found by calculation (or just asking people) and the correct number of turns wound around the reed.

Reed inserts may be obtained from a number of sources and be of dubious vintage. Therefore, it's best to wind on 40 or 50 turns of 22 swg insulated wire and check them out first with the test circuit shown.

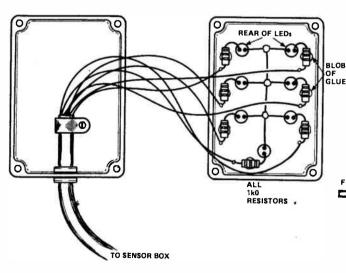
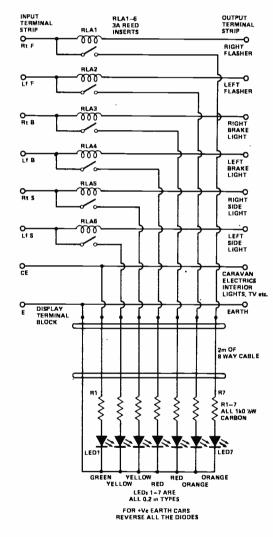


Fig. 1 Construction details of the display box.



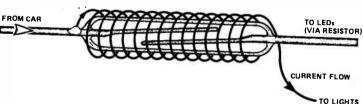
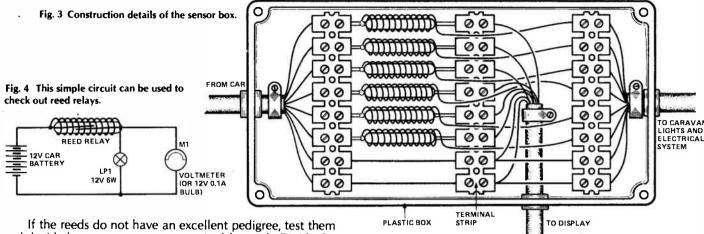


Fig. 2' Circuit diagram with relay assembly/wiring details.

100



If the reeds do not have an excellent pedigree, test them and decide how many turns are required for each. Divide the ampere turns by the current to be drawn and there's the number you need. Add 25% for luck. As a rule of thumb, 6 W sidelights need about 40 turns in two or three layers, or 20 turns if they are fore and aft. You could put separate current sensors in each line and make your caravan look like a mobile Blackpool Illuminations! Brake and indicator lights need only 12 turns.

Solder one end of a length of 20 swg insulated wire to one end of a reed and wind carefully along its entire length. Be careful not to break the glass as it will slice into your fingers with the greatest of ease. Hold the reed in your left hand with the loose end of wire pulled taut by your little finger and apply cyanoacrylate (Superglue). Two days later it should be possible to remove the completed current sensing relay from your hand!

Install the reeds between the two choc-blocks as shown in the diagram by holding the terminal blocks on a flat surface to ensure that no twisting action takes place when the assembly is finally installed in its box. Cyanoacrylate may now be used to mount the complete assembly in its box. Complete the wiring and install in your beloved behemoth.

The green 'power-on-to-the-caravan' light only consumes 15-20 mA and as long as the caravan is being pulled daily (as it would be on holiday) the overnight drain is negligible.

A complete kit of parts, including solder and superglue is available from Packer Communications, Bridge End Barn, Soutergate, Cumbria LA17 7TW for £12.75 including post and VAT.

# Oscilloscopes are essential tools for checking circuit operation and diagnosing faults, and an enormous range of models is available. But which is the right scope for a particular application? Which features are essential, which not so important? What techniques will get the best out of the instrument? Ian Hickman, experienced in both professional and hobbyist electronics, has written this book to help all oscilloscope users – and potential users. After introducing basic principles for readers new to the subject, he explains in detail the features of typical simple and advanced real-time oscilloscopes, plus accessories such as probes and cameras. He advises on how to choose and operate scopes, and how to avoid common pitfalls; he also describes special-purpose instruments, from small portable scopes to storage scopes and spectrum and logic analysers. Finally, to give readers a better understanding of how oscilloscopes work, he explains the principles of the cathode-ray tube and basic scope circuitry. NEW BOOK Illustrated with many photographs and two-colour diagrams, the book will appeal to everyone who needs to know about oscilloscopes, from the school student to the graduate, from the hobbyist to the technician. Available from your local bookseller or in case of difficulty from the Publisher.

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

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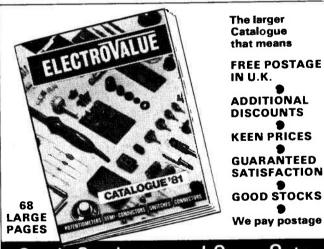


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6810	1.43	74LS 33	0.25 0.25	74LS193	0.97
6821	1.93	74LS 37 74LS 38	0.25	74LS194 74LS195	0.58 0.58
6840	5.87	74LS 36	0.20	74LS195	0.56
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450ns	5.75	74LS 73	0.30	74LS245	1.69
2114 1kx4		74LS 74	0.27	74LS247	0.57
200ns	2.50	74LS 75	0.42	74LS248	1.05
4027 4kx1		74LS 76	0.30	74LS249	1.05
200ns	1.65	74LS 83	0.76	74LS251	0.64
4116 16kx1	02022	74LS 86	0.26	74LS253	0.64
150ns	2.95	74LS 90	0.52	74LS258	0.56
4116 16kx1	0.50	74LS 91	1.13	74LS259	1.61
200ns	2.50	74LS 92	0.56	74LS273	1.37
		74LS 93	0.55	74LS279	0.51
8-BIT CONVE		74LS 95	0.68	74LS283	0.63
ZN425E(A/D)	3.50	74LS109 74LS112	0.36 0.36	74LS293 74LS366	0.73
ZN427E(A/D)	6.28 3.00	74LS112	0.36	74LS366 74LS367	0.54 0.54
ZN426E(D/A) ZN428E(D/A)	4.78	74LS113	0.36	74LS367	0.54
ZN428E(D/A) ZN429E(D/A)	2.10	74LS114	0.50	74LS300	1.11
Data Converte		74LS122	0.83	74LS373	0.70
Handbook	1.00	74LS124	1.49	74LS375	0.70
Hallabook	1.00	74LS125	0.41	74LS377	1.37
l		74LS126	0.41	74LS378	1.03
74LS 00	0.20	74LS132	0.71	74LS379	0.78
74LS 00 74LS 01	0.21	74LS136	0.41	74LS386	0.41
74LS 02	0.20	74LS138	0.56	74LS390	0.96
74LS 03	0.20	74LS139	0.56	74LS393	0.85

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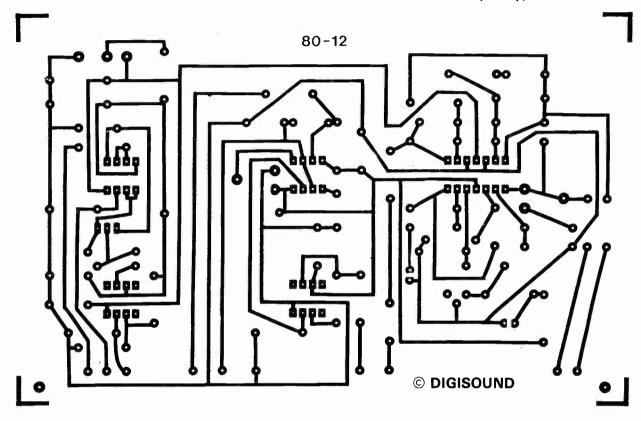
**MIDWICH** 

Computer Co. Ltd., Hewitt House Northgate Street, Bury St. Edmunds Suffolk IP33 1HQ

Tel: (0284) 701321 Telex: 817682

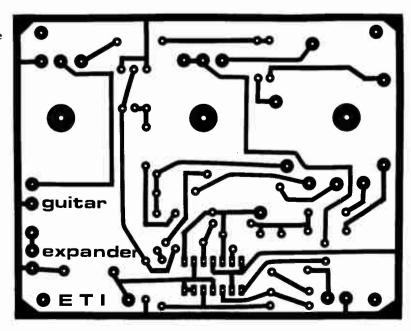
# PCB FOIL PATTERNS

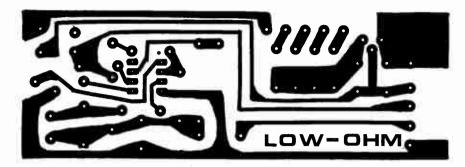
Please note that the foil pattern for the VCSA is too large to go into the magazine. A large SAE will secure a photocopy.



Above: Foil pattern for this month's Project 80 module. Note that Digisound hold the copyright on this board and firms may not reproduce the PCBs for sale.

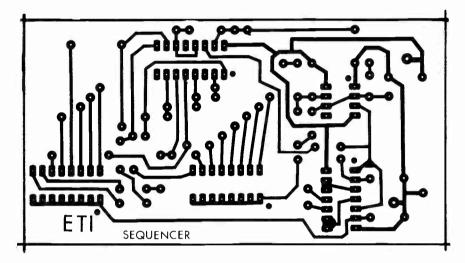
Right: Foil pattern for the guitar expander.

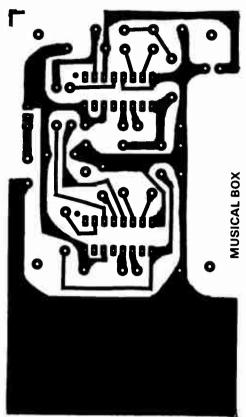




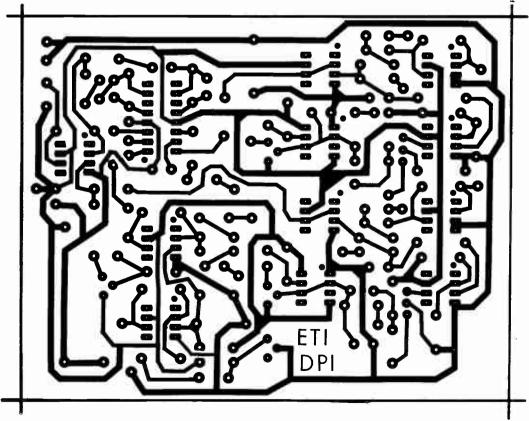
Above: The Low-ohm Meter foil pattern.

Right: Musical Box PCB — this has been designed to fit into the specified case.





Above and below: The two foil patterns for the ETI Drum Machine.





Y: Bandwidth DC-20MHz (-3dB) . Sensitivity 5mV-20V/cm (±3%) X: Timebase 0.2s-40ns/cm incl. x5 Magn. • Trig. 3Hz-30MHz (4mm)

Dual trace • X-Y Operation • Calibrator • Screen 8x10cm • 2kV

**HM 412** 

Y: Bandwidth DC-20MHz (-3dB) • Sensitivity 2mV-20V/cm (±3%) X: Timebase 2s-40ns/cm incl. x5 Magn. • Trig. DC-40MHz (5mm) Dual trace • Algebr, addition • X-Y Operation • Screen 8x10cm Sweep delay • Overscan, Trigger, Delay indications • Trigger filter Z-Modulation • Calibrator • Graticule illumination • 2kV

HM 512

Y: Bandwidth DC-50MHz (-3dB) • Sensitivity 5mV-50V/cm (±3%) X: Timebase 5s-20ns/cm incl. x5 Magn. • Trig. DC-70MHz (5mm)

Dual trace • Algebr. addition • X-Y Operation • Screen 8x10cm

Delay line • Sweep delay • After delay triggering • Trigger filter Single shot + Reset • Overscan, Trigger, Ready, Delay indications var. Hold-off • Z-Modulation • Graticule illumination • 12kV

**HM 812** 

Y: Bandwidth DC-50MHz (-3dB) • Sensitivity 5mV-50V/div. (±3%)
X: Timebase 5s-20ns/div. incl. x5 Magn. • Trig. DC-70MHz (0.5div.)
Dual trace analog storage with var. Persistence and Auto-Storage
Algebr. addition • X-Y Operation • Screen 8x10div. (7.2x9cm)
Delay line • Sweep delay • After delay triggering • Trigger filter
Single shot • Overscan, Trigger, Ready, Delay, AS indications
var. Hold-off • Z-Modulation • X-Guard circuit • Calibrator • 8.5kV



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£2.20 2716 5 volt £5.25 2114 450ns 2708 450ns £3.95

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The special offer of the century (only Swanley could do the first of the century (only Swanley could do the free power supply and modulator kit and our free guard bend kit (e) trilizant breakthough in inself for this kit extends the display to 32 x 32, gives 1200 and 300 Baud tape speeds, increases the computing speed by 50% and converts the display to 50Hz for flicker free viewing). Guard band kit is also suppleed separately for £10. AK extra ram £16.85. Case £27. Cassatta recorder £17. Cegman inproved monitor rom £26.80. Assemblier editor tape £25. Word processor program £10. Display scansion kit 30 lines x 54 characters, for Superboard 2 (Not 3) £20. Chespo memory expansion offer:— Buy a 510 expansion board with BK ram on board and space for another 16 K for £159 and get a free 5V AA power kit and any exter ram you want for £37 K. Buy a minifloppy disc drive + case + power supply + DOS to £275 and we will do the extra ram for £2 / K. (max. 18K)

(max. 10K)
New Series 2 Challenger C1P: — cheapo 4K version
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Buy any of the below and get a free interface kit and word processor programme for UK101 or Superboard 2:— OKI Microline 80 (ellustrated) £329. Base 2 800MST £295. Saikosha GP80 £225.

MEMORY CHIPS 2114 450ns £2.15, 4116 200ns £2.63, 4027 £1.30, All low current.

# \* SINCLAIR PRODUCTS

x SINCLAIN F NUOVOLTS
Sinclair products only are all post free. SC110
Oscilloscope £138. Adapter £4. Rechargeable batteries
£7.95. X1 probe £8.65. &6. Cerry case
£8.80. PFM200 £8.45. Adapter £4. Case £1.73.
connector ki £11.27. PDM 35 £22.85. adapter £4.
case £1.73. DM 235 £86.50. DM 350 £78.60.
OM450 £107.95. adapter £4. case £8.60. rechargeable batts £7.85. Microvision TV £69, adaptor £8.88.

# ★ BATTERY ELIMINATORS

3-way type 6/7½/9V 300me 53,50. 100ma radio types with press studs 9v £4.85, 9+9V £6.25. Car convertor 12v input, output 3/4½/6/7½/9V 800ma £3.04.

# \* BATTERY ELIMINATOR KITS

100ma radio types with press-studs 9v £1.79, 9+9v £2.80. Stabilized 8-way types 3/4/y/8/7/7/9/912/15/18/100ma £3.12, 1 Amp £8.30. Stabilized power kits 2-18v 100ma £3.12, 1.30v 14 £8.50, 1-30v 24 £75.30. TIL and computer supplies 5V stabilized 1/54 £3.50. TIL and computer supplies 5V stabilized 1/54 £3.50. TIL and computer supplies 5V stabilized 1/54 £3.50. TIL suppl

# \* TV GAMES

Stunt cycle chip + kit £20.95. AY-3-8600 + kit £12,98, AY-3-8550 + kit £9.26.

\* PRINTED CIRCUIT MATERIALS

Cetching list: sconomy £3.42, standard £5.76. 40 sq ss pcb 50p. 1 lb FeC1 £2.20. Etch resist pens: conomy 50p. dalo 90p. Drill bits 1/32" or 1mm 35p. tching dish 92p. Laminate cutter £1.30.

# \* BI-PAK AUGIO MODULES

# \* COMPONENTS

★ COMPONENTS

1N4184 1.59. 1N4002 3.7p. NE555 8 dil 28p. 7418 dil 20p. bc182, bc184, bc212, bc214, bc547, bc549 6.1p. Resistors 5% 4W E12 10R to 10M 1.8p. 0.8p for 50-4 or one value Polyester capacitors 180∨.015, 0.8bml 2.8p. 047. 1mf 4.4p. 01mf 3.8p. 022, 0.33ml 3.7p. 15.22, 33ml 3.8p., 47ml 6.8p., 102 to 10m 5p. Ceramic capacitors 50∨ E6 22pt to 47m 2.5p. Electrolytic capacitors 50∨ E6 22pt to 47m 2.5p. Electrolytic capacitors 50∨ E5 22pt to 47m 2.5p. Electrolytic capaci

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# CHROMATHEQUE 5000 5 CHANNEL LIGHTING EFFECTS SYSTEM



Panel size 19.0" x 3.5".

Depth 7.3"

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  $8\Omega$ ) MIXER/AMPLIFIER

ONLY
£49.90+VAT!

MATCHES THE CHROMATHEQUE 5000 PERFECTLY!

Panel size 19" 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 an adaptable input imixer which accepts a wide range of sources such as a microphorie, guitar, etc. There are wide range tone controls and a master volume control. Mechanically the MPA 200 is simplicity itself with minimal wiring needed making construction very straightfo/ward.

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

SP2-200 2-CHANNEL 100W AMPLIFIER



Panel size 19.0" x 3.5". Depth 7.3"

NEW!

COMPLETE KIT
ONLY
£64.90 + VAT!

The power amplifier section of the MPA 200 has proved not only very economical but very rugged and reliable too. This new design uses two of these amplifier sections powered by separate power supplies fed from a common toroidal transformer. Input sensitivity is 775mV.

Power output is 100 rms into 8 ohms from both channels simultaneously. The kit includes fully finished metalwork, fibreglass PCBs, controls, wire, etc. — complete down to the last nut and bolt!

# **POWERTRAN**

SYNTHESIZER KITS ON PAGE 8. MORE KITS AND ORDERING INFORMATION ON INSIDE FRONT COVER.



DE LUXE EASY TO BUILD LINSLEY HOOD 75W STEREO AMPLIFIER £85.00 + VAT

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

All kits also available as separate packs (e.g. PCB, component sets, hardware sets, etc.). Prices in our FREE CATALOGUE,



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!

Above 2 kits are supplied with fully finished metalwork, ready assembled high quality teak veneer cabinet, cable, nuts, bolts, etc. and full instructions — in fact everything!

# BLACK HOLE CHORALIZER

The BLACK HOLE designed by Tim Orr, is a powerful new musical effects device for processing both natural and electronic instruments, offering genuine VIBRATO (pitch modulation) and a CHORUS mode which gives a "spacey" feel to the sound achieved by delaying the input signal and mixing it back with the original. Notches (HOLES), introduced in the frequency response, move up and down as the time delay is modulated by the chorus sweep generator. An optional double chorus mode allows exciting antiphase effects to be added. The device is floor standing with foot switch controls. LED effect selection indicators, has variable sensitivity, has high signal/noise ratio obtained by an audio compander and is mains powered — no batteries to change! Like all our lists everything is provided including a highly superior, rugged steel, beautifully finished enclosure.

COMPLETE KIT ONLY £49.80 +VAT (single delay line system)

De Luxe version (dual delay line system) also available for £59.80 + VAT

Cabinet size 10.0" x 8.5" x 2.5" (rear) 1.8" (front)



HIGH POWER MODULE KITS

125 WATT MODEL £10.50 plus £1.15 p&p (Illustrated) 200 WATT MODEL £14.95 plus £1.15 p&p

125 watt RMS

SPECIFICATIONS

Operating voltage (DC) Loads

50-80 Max 4-16 ohms Frequency response measured at 100 waits 25Hz-20KHz Sensitivity for 100 watts
Typical T.H.D. @ 50 watts 4 ohms load 400mV @ 47K 0.1%

205 x 90 and 190 x 36 mm Dimensions The P.E. power amp kit is a module for high power applications disco units, guitar amplifiers, public address systems and even high power domestic systems. The unit is protected against short circuiting of the load and is safe in an open circuit condition. A large safety margin exists by use of generously rated components, result, a high powered rugged unit. The PC Board is backprinted, etched and ready to drill for ease of construction, and the

aluminium chasis is preformed and ready to use. Supplied with all parts, circuit diagrams and instructions

# **ACCESSORIES**

125W model

Suitable Mains Power Supply Unit for 125W model

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£1.00 plus 25 p p&p Suitable LS coupling electrolytic for £1.25 plus 25p p&p £7.50 plus £3 15 p&p

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- \*Incorporates suppression circuits \* Now with tape input sock

All the electronic components to build the radio, you supply only the wire and solder as featured in the Practical Electronics March issue Features Pre-set tuning with five push button options. black illuminated tuning scale, with matching rotary control knobs. one, combining on/off volume and tone-control, the other for manual tuning, each set on wood simulated fascia The P.E. Traveller has a 6 watts output, neg ground and incorporates an integrated circuit output stage, a Mullard IF module LP1181 ceramic filter type, pre-aligned and assembled and a Bird pre-aligned push button tuning unit. The radio fits easily in or under dashboards

Complete with instructions

plus £2 00 p&p

**CONSTRUCTORS PACK 7A** 



# 30 + 30 WATT STEREO AMPLIFIER **BUILT AND TESTED**

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READY TO PLAY £32.90 plus £380 080

# HI FI STEREO AMPLIFIER . **MODULES**

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- Multiar LF 1 10 so but presument software in terains and auxiliary inputs £1.95 plus 70p p&p
   Mulliard LP 1184 built preamplifier suitable for magnetic/ceramic and auxiliary inputs £4.95 plus 80p p&p
   Matching LC 10 + 10 Stereo Power amplifier kit. £3.95
- Matching LC 10 10 disease.
   Matching power supply kit with transformer. £3.00 plus £1.96 p&p.
   Matching set of 4 slider controls complete with knobs for bass, treble and volumes. £1.70 plus 80p p&p.



# plus £2 90 p&p 10+10 WATT STEREO AMPLIFIER KIT

- Featuring latest SGS/ATES TDA 2006-10 watt output I C's
- realuring lates 355 ALES 10A 2006 10 Watt output 10 \$
   with in-built thermal and short circuit protection
   Mullard Steree Preamplifier module
   Attractive black winyf finish cabinet. Size 9" x 83%" x 3%" approx
   Converts to a 20 watt Disco amplifier

To complete you just supply connecting wire and solder. Features include din injust sockets for ceramic cartridge, microphone, tape or tuner. Outputs—tape, speakers and headphones. By the press of a button it transforms into a 2D watt mono disc amplifier with two deck mixing. The kit incorporates a Mullard LP1183 per amp module plus power amplifier assembly kit and mains power supply. Also featured 4 sider level controls, rotary bass and treble controls and 6 push button switches. Silver finish fascie panel with matching knobs and contrasting ready made black viryl, finish cabinet and ready made metal work. For further information instructions are available rotes 150. Fee with kit. further information instructions are available price 50o. Free with kit.

# **SPECIFICATIONS**

BSR chassis record deck with manual set down and return, complete with stereo ceramic cartridge £8.50 plus £3 15 p&p when purchased with amplifie Available separately £10.50 plus £3 16 p&p

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STEREO DISCO PREAMPLIFIER

matching above modules, suitable for twin deck mixing with P.F.L. output and Mic/Tape input. Ready built, ready to play with circuit diagram and application notes to suit £21.95 plus our power module kits.

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nush-null switches and treble controls and master volume

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# NEXT MONTH. NEXT MONTH. NEXT MONTH. NEXT MONTH.



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You can't afford to miss it!

# Anatomy Of The Space-Shuttle

A special HE report on the forthcoming NASA Space-Shuttle launch. We investigate what the technical problems have been, why it's overdue, and give you a timetable running up to the launch and beyond

# **Tremolo**

Just the effect you want TOT your guitar to complement the Fuzzbox in the March issue, although it will work with any electronic musical instrument. Simple-to-build, even simpler-to-use yet it won't burn a hole in your pocket

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# High Fidelity Comes To HE

Announcing a special audio project for HE: a hi-fi, high-power amplifier system which you can tailor according to your budget by making use of our special-offer kits. We start with the pre-amplifier in the April issue. This pre-amp requires *no wiring* except for the leads to the power supply! You can use it with your own amplifier too

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# Acorn Atom

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BK Electronics16	R. 0/	1
BN Electronics	2 3	•
BNRS	10	,
Butterworths	10	4
Calculator Sales & Service	94	1
Cambridge Learning	5	_
Campbell Clark Cabinets	86	j
Castle Electronics	98	3
Chiltmead	8	١
Chordgate Ltd	63	3
Chromasonics48	& 49	9
Clef Products	8	5
Comp Comp Comp 114 8	ኔ 115	5
Crimson Elektrik	97	7
Crofton Electronics	. 103	3
Delta Tech & Co	91	3
Display Electronics 65	& 80	7
Doram Electronics	60	q
Drallim Davis Electronics		2
Floatro-i-o Docier		
Electronize Design	0	2
Electro Supplies	,44	_
Electrovalue	10	3
GMT Electronics	/	4
Greenbank	9	9
Greenweld	94	4
G.S.C19	& 62	2
Hameg Ltd	100	6
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I.L.P 32, 33	& 64	4
Keelmore	49	9
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Langstone Electronics	34
LB Electronics	86
L & B Electronics	
LEM Services	
Linsac	
Manor Supplies	
Maplin	116
Marshalls	90
Micro Circuits	
Microdigital	80
Midwich Computers	103
Mitrad	73
NIC Models	70
Parndon Electronics	
T. Powell	52
Powertran2, 8 8	k 107
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R.T.V.C	108
Safgan Electronics	80
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