

**ETI**  
**ELECTRONICS**  
TODAY INTERNATIONAL

**DIGITAL VOICE  
EFFECTS BOX**

**Pitch-shift,  
vibrato - and robot!**

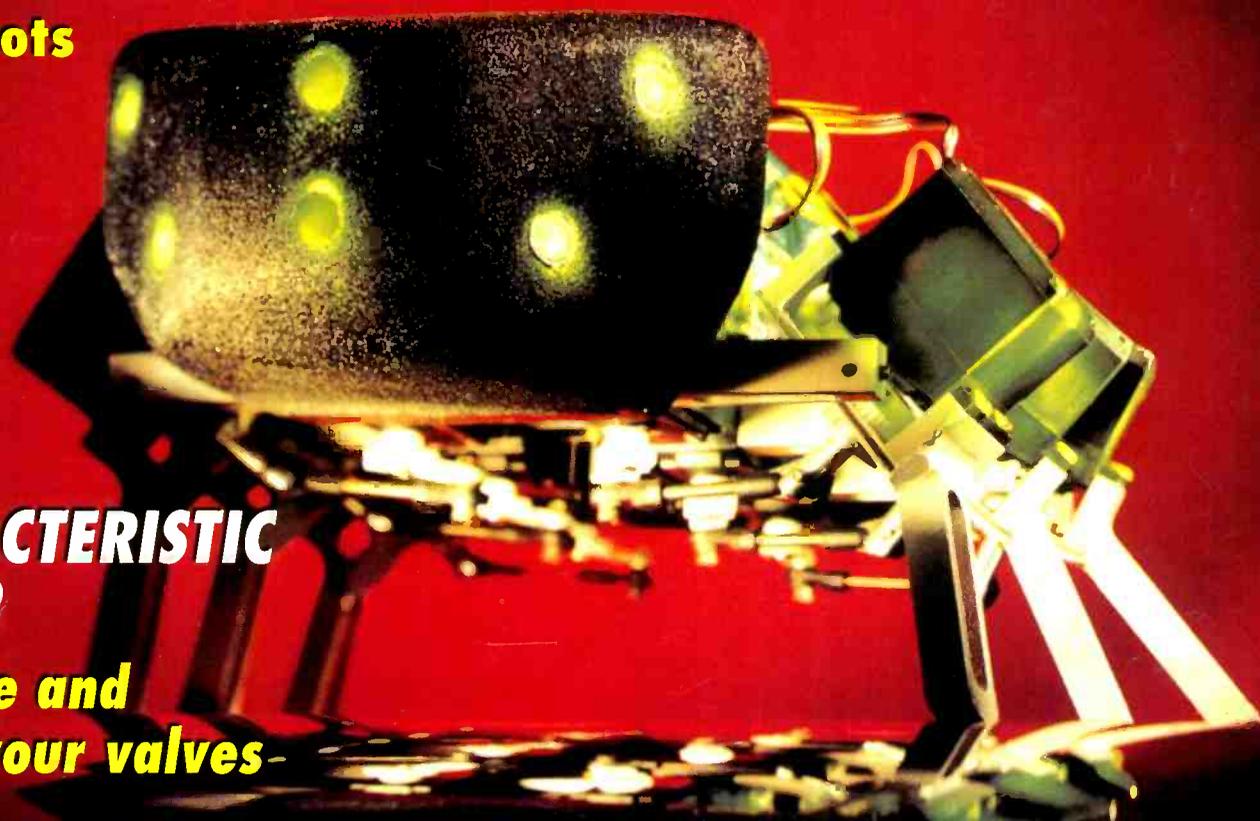
HIGHER  
EDUCATION  
SPECIAL

# THE SECRET OF THE MACHINES

**Will robots  
develop  
minds  
of their  
own?**

**VALVE  
CHARACTERISTIC  
TESTER**

**Measure and  
match your valves**



**PLUS**

**Brake Light Tester**

**Fast Fivers - A Process Timer**

**Speed Controlling DC Motors**

9 770142 722153 08 >

FOR ENTHUSIASTS  
BY ENTHUSIASTS  
NEXUS

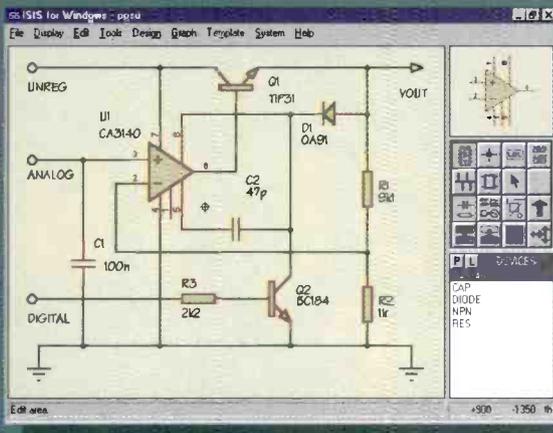
Vol 26 Issue: 8 18 July 1997 £2.50  
USA \$4.95

# PROTEUS

# The IV<sup>th</sup> Generation

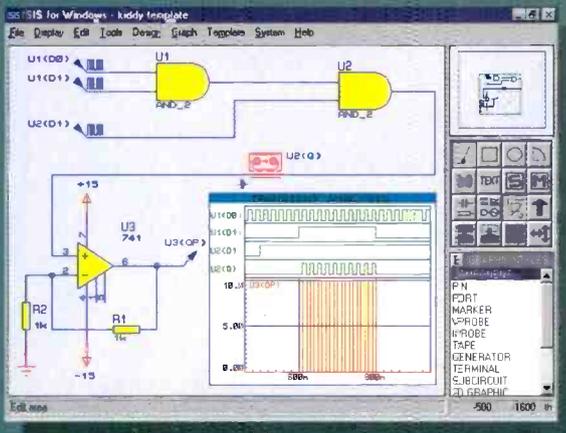
## Schematic Capture

NEW Version IV



- Produces attractive schematics like you see in the magazines.
- Netlist, Parts List & ERC reports.
- Hierarchical Design.
- Full support for buses including bus pins.
- Extensive component/model libraries.
- Advanced Property Management.
- Seamless integration with simulation and PCB design.

## Simulation



- Non-Linear & Linear Analogue Simulation.
- Event driven Digital Simulation with modelling language.
- Partitioned simulation of large designs with multiple analogue & digital sections.
- Graphs displayed directly on the schematic.

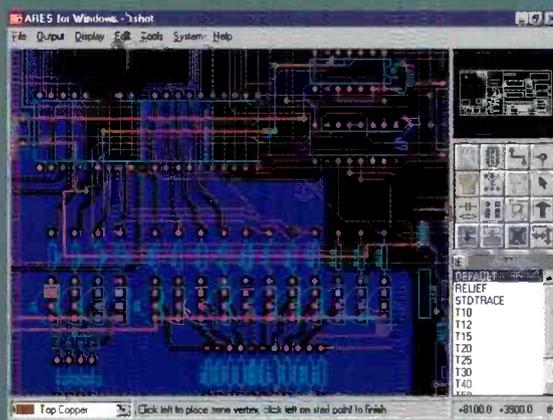
## New Features

- Component Auto-Placer
- Pinswap/Gateswap Optimizer
- Background Regeneration of Power Planes
- Enhanced Autorouting with Tidy Pass
- Full Control of Schematic Appearance
- Extensive New Component Libraries

Available in 5 levels - prices from £295 to £1875 + VAT.  
Call now for further information & upgrade prices.

## PCB Design

NEW Version IV



- Automatic Component Placement.
- Rip-Up & Retry Autorouter with tidy pass.
- Pinswap/Gateswap Optimizer & Backannotation.
- 32 bit high resolution database.
- Full DRC and Connectivity Checking.
- Shape based gridless power planes.
- Gerber and DXF import capability.

# "PROTEUS is particularly good

# with its rip-up-and-retry autorouter"

EWV January 1997

labcenter  
Electronics

Write, phone or fax for your free demo disk, or ask about our full evaluation kit.  
Tel: 01756 753440. Fax: 01756 752857. EMAIL: [Info@labcenter.co.uk](mailto:Info@labcenter.co.uk)  
53-55 Main St, Grassington, BD23 5AA. WWW: <http://www.labcenter.co.uk>

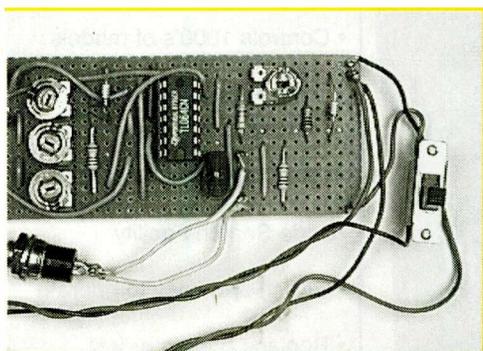
Fully interactive demo versions available for download from our WWW site.  
Call for educational, multi-user and dealer pricing - new dealers always wanted.  
Prices exclude VAT and delivery. All manufacturer's trademarks acknowledged.

# Contents

**Volume 26 No.8**

## **& Features & Projects**

**Next Issue 15th August 1997**



### ***The Secret of the Machines***

Artificial intelligence is gradually moving into many corners of modern life. Could artificial intelligence be self-teaching - could it learn to out-think mankind? Douglas Clarkeson looks at the evidence.

**11**

### ***Digital Voice Modulator***

Robert Penfold's 'voice-box' is based on the HT-8950 voice modulator chip. You can add three levels of pitch-shift, up and down, and a 'robot voice' for machine-men, with added vibrato if you want it. There are mic and line inputs, and operation from long-life HP7 batteries.

**23**

### ***Brake Light Checker***

Functioning brake-lights are arguably even more important on a trailer or caravan than they are on a car. Terry Balbirnie's self-test system warns if caravan and trailer brake lights fail to work when they are needed.

**30**

### ***Higher Education Special***

If you are a school leaver - or just want to new direction in your career - now is the time to decide whether to dedicate the next few years to Higher Education, and where. ETI looks at some established college courses in Electronics and offers some advice about applying.

**39**

### ***Speed Control in DC Motors - Part one***

David Ponting's gift reel-to-reel high-quality tape recorder was absolutely free - all he had to do to put it in working order was create a constant-speed capstan motor drive suitable for both sides of the Atlantic. So began the experiments to find the best control circuit.

**45**

### ***Ham Radio Today***

All the best for Radio Amateurs

**50**

### ***Valve Characteristic Tester - Part One***

Now that valves are popular again in audio amplifiers, pre-amplifiers and filters, Peter Kenyon has designed is a portable unit which helps with matching valve pairs and checking on valve characteristics.

**55**

### ***Fast Fivers - A Process Timer (4)***

This is the Egg Timer of the Future, says Owen Bishop. It can time up to three consecutive stages of a process, a multistage process lasting for half-an-hour or (for a bit more dosh) to seven stages or more.

**64**

## **Regulars**

**News**

**8, 9, 69**

**Practically Speaking**

**37**

Terry Balbirnie goes back to basics on Ohm's Law

**PCB foils**

**70**

**ETI PCB Service**

**71**

**Round the Corner**

**74**



**Subscribe  
& Save**

Phone the  
hotline and take  
advantage of  
our special offer  
detailed on  
page 44

## DIGITAL MULTIMETERS

### CM2300 DIGITAL MULTIMETER



**FEATURES:**

- 3.5 LCD DISPLAY
- HEIGHT 12mm
- MAX READING 1999
- HV INDICATION FOR HIGH VOLTAGE
- SINGLE MANUAL ROTARY SWITCH FOR FUNCTION AND RANGE OPERATION
- ALL RANGES OVERLOAD PROTECTED
- 10A DC CURRENT TEST
- DC VOLTAGE 2V/20V/200V/500V
- AC VOLTAGE 200/500V
- DC CURRENT 200mA
- RESISTANCE 2K $\Omega$  /20K $\Omega$  /200K $\Omega$  /2M $\Omega$
- SUPPLIED WITH TEST PROBES

**ORDER CODE: CM2300**  
**PRICE: 975p**

### CM2400T DIGITAL MULTIMETER WITH TEMP MEASUREMENT

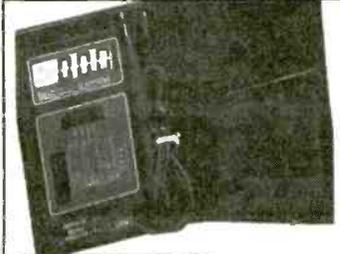


**FEATURES:**

- 3.5 LCD DISPLAY
- HEIGHT 12mm
- MAXIMUM READING 1999
- 10A DC CURRENT TEST
- DC VOLTAGE 200mV/2V/20V/200V/1000V
- AC VOLTAGE 200/750V
- DC CURRENT 0.2mA/200mA/20mA/200mA/20A
- RESISTANCE 200 $\Omega$  /2K $\Omega$  /20K $\Omega$  /200K $\Omega$  /2M $\Omega$
- SUPPLIED WITH TEST PROBES
- TEMPERATURE MEASUREMENT
- CONTINUITY TEST
- DIODE TEST & CONTINUITY CHECK
- ALL RANGES OVERLOAD PROTECTED

**ORDER CODE: CM2400T**  
**PRICE: 1450p**

### CM2900 PACKET DIGITAL MULTIMETER



**FEATURES:**

- 3.5 LCD DISPLAY
- COMPACT AND LIGHTWEIGHT POCKET SIZE
- MAXIMUM READING 1999
- DC CURRENT 7 RESISTANCE OVERLOAD PROTECTED
- SLIDE SWITCHES FOR FUNCTION AND RANGE OPERATION
- SUPPLIED IN WALLET WITH TEST PROBES
- DC VOLTAGE 2V/20V/200V/500V
- AC VOLTAGE 200V/500V
- DC CURRENT 200mA
- RESISTANCE 2K $\Omega$  /20K $\Omega$  /200K $\Omega$  /2M $\Omega$

**ORDER CODE: CM2900**  
**PRICE: 1150p**

### CM3900A DIGITAL MULTIMETER



**FEATURES:**

- LARGE LCD DISPLAY
- HEIGHT 18mm
- MAXIMUM READING 1999 + UNIT
- SINGLE MANUAL ROTARY SWITCH FOR FUNCTION AND RANGE OPERATION
- AUTO POWER OFF (APPROX 15 mins)
- DIODE TEST FUNCTION
- ALL RANGES OVERLOAD PROTECTED
- SUPPLIED WITH TEST PROBES
- DC VOLTAGE: 200mV/2V/20V/200V/700V ACCURACY  $\pm 0.5\%$
- AC VOLTAGE: 200mV/2V/20V/200V/700V
- DC CURRENT A: 200 $\mu$ A/20mA/200mA/2A/20A
- AC CURRENT A: 200 $\mu$ A/20mA/200mA/2A/20A
- RESISTANCE: 200 $\Omega$ /2K $\Omega$ /20K $\Omega$ /200K $\Omega$ /2M $\Omega$ /20M $\Omega$ /200M $\Omega$

**ORDER CODE: CM3900A**  
**PRICE: 2900p**

### CM3920 DIGITAL METER WITH TEMP MEASUREMENT



**FEATURES:**

- TEMPERATURE MEASUREMENT
- DIODE & TRANSISTOR HFE TEST
- LARGE LCD DISPLAY
- HEIGHT 18mm
- MAXIMUM READING 1999 + UNIT
- SINGLE MANUAL ROTARY SWITCH FOR FUNCTION AND RANGE OPERATION
- AUTO POWER OFF (APPROX 15 mins)
- DIODE TEST FUNCTION
- ALL RANGES OVERLOAD PROTECTED
- SUPPLIED WITH TEST PROBES
- DC VOLTAGE: 200mV/2V/20V/200V/1000V ACCURACY  $\pm 0.5\%$
- AC VOLTAGE: 200mV/2V/20V/200V/700V
- DC CURRENT 2mA/20mA/200mA/20A
- AC CURRENT A: 200mA/20A
- RESISTANCE: 200 $\Omega$ /2K $\Omega$ /20K $\Omega$ /200K $\Omega$ /2M $\Omega$ /20M $\Omega$
- CAPACITANCE: 2nF/20nF/200nF/2 $\mu$ F/20 $\mu$ F

**ORDER CODE: CM3920**  
**PRICE: 4100p**

### CM2700 AUTORANGING DIGITAL MULTIMETER



**FEATURES:**

- 3.75 LCD DISPLAY WITH DECIMAL POINT
- 33 SEGMENT BAR GRAPH DISPLAY
- OVERRANGE INDICATOR
- ROTARY SWITCH FOR FUNCTION SELECTION
- AUTO POWER OFF (APPROX 15 mins)
- AUTO POLARITY WITH INDICATION
- DIODE TEST & CONTINUITY TEST WITH BUZZER
- ALL RANGES OVERLOAD PROTECTED
- LOW BATTERY INDICATION
- SUPPLIED WITH TEST PROBES
- DC VOLTAGE: 320mV/3.2V/32V/320V/500V
- AC VOLTAGE: 320mV/3.2V/32V/320V/600V
- DC CURRENT A: 320 $\mu$ A/3200 $\mu$ A/32mA/320mA/10A
- AC CURRENT A: 320 $\mu$ A/3200 $\mu$ A/32mA/320mA/10A
- RESISTANCE: 320 $\Omega$ /3.2K $\Omega$ /32K $\Omega$ /320K $\Omega$ /3.2M $\Omega$ /32M $\Omega$

**ORDER CODE: CM2700**  
**PRICE: 4050p**

### CM3230 DIGITAL CAPACITANCE METER

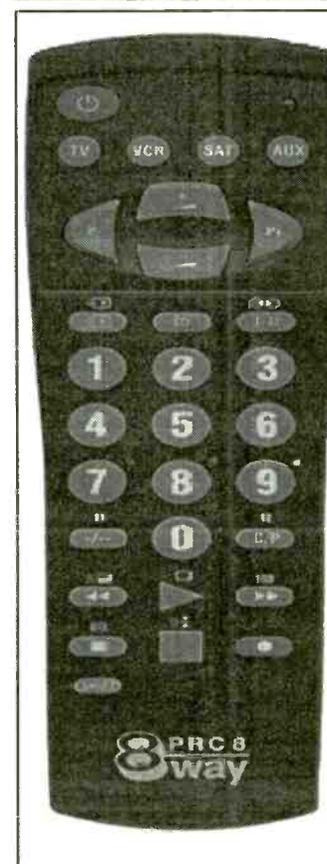


**FEATURES:**

- 3.5 LCD DISPLAY
- HEIGHT 18mm
- MAXIMUM READING 1999
- CAPACITANCE 9 RANGES FROM 200pF - 20000 $\mu$ F
- MEASURING FROM 1pF - 20000 $\mu$ F
- SINGLE MANUAL ROTARY SWITCH FOR FUNCTION AND RANGE OPERATION
- ZERO ADJUST KNOB

**ORDER CODE: CM3230**  
**PRICE: 3950p**

## 8 Way Preprogrammed Universal Remote Control



A single remote control to operate Television, Videos and Satellite Receivers. Plus Auxiliary Options!!

- Replaces up to 8 remotes with one
- Simple 4 digit setup routine
- Controls 1000's of models
- Teletext functions with Fastext
- Clear (large key) layout
- Code Search Facility
- Stylish and easy to operate
- Replace broken or lost remotes
- Original Remote note required

**Order Code: 8 WAY**  
**Price: 1450P + VAT**

# GRANDATA LTD

K.P. HOUSE, UNIT 15, POP IN COMMERCIAL CENTRE,  
SOUTHWAY, WEMBLEY, MIDDLESEX, ENGLAND HA9 0HB  
Telephone: 0181-900 2329 Fax: 0181-903 6126  
OPEN Monday to Saturday.  
Times: Mon-Fri 9.00-5.30 Sat 9.00-2.00

PLEASE PHONE US FOR TYPE NOT LISTED HERE AS WE ARE  
HOLDING 30,000 ITEMS AND QUOTATIONS ARE GIVEN FOR  
LARGE QUANTITIES

Please send £1 P&P and VAT at 17.5%. Govt, Colleges, etc.  
Orders accepted. Please allow 7 days for delivery. Prices quoted are subject  
to stock availability and may be changed without notice.  
TV and video parts sold are replacement parts.  
Access & Visa Card accepted  
WE STOCK TV AND VIDEO SPARES, JAPANESE TRANSISTORS AND TDA  
SERIES. PLEASE RING US FOR FURTHER INFORMATION.

## SATELLITE POWER SUPPLY REPAIR KITS

<b>ALBA</b>	<b>CODE</b>	<b>ECHOSTAR</b>	<b>CODE</b>	<b>MIMTEC</b>	<b>CODE</b>
SAT660	SATPSU2	SR5500 EARLY PSU WITH ADJ 6500, SR7700, SR8700	SATPSU12 SATPSU13	SOPRENSON TYPE PSU ONLY	SATPSU15
<b>AMSTRAD</b>	<b>CODE</b>	<b>FERGUSON</b>	<b>CODE</b>	<b>NETWORK</b>	<b>CODE</b>
SRD510, SRD520, SRD540, SRD550 SRDR45 SRD500 SRX320, SRX340, SRX345, SRX350 SRX100 SRD600 SAT250, SR950, SRD700, SRD950, SRX1002, SRX2001, SRX301, SRX501, SRX502 SRD2000	SATPSU3  SATPSU4 SATPSU5 SATPSU6 SATPSU14 SATPSU16  SATPSU18	SRD 5, SRD16 SRV1 SRDE4	SATPSU1 SATPSU2 SATPSU11	9000, 9200	SATPSU2
<b>BRITISH TELECOM</b>	<b>CODE</b>	<b>FINLUX</b>	<b>CODE</b>	<b>NOKIA</b>	<b>CODE</b>
SVS300	SATPSU17	SR5700	SATPSU12	SAT1500	SATPSU2
<b>BUSH</b>	<b>CODE</b>	<b>GOODMANS</b>	<b>CODE</b>	<b>PACE</b>	<b>CODE</b>
IRD150 IRD155	SATPSU12 SATPSU19	ST700	SATPSU1	PRD800, PRD900, PSR800, PSR900 MRD920, SS9000, SS9010, SS9200, SS9210, SS9220 D100, D150, MSS100 APOLLO, MSS200, MSS300 MSS500, MSS1000	SATPSU1 SATPSU2  SATPSU6 SATPSU8 SATPSU9 SATPSU10
<b>CHURCHILL</b>	<b>CODE</b>	<b>GRUNDIG</b>	<b>CODE</b>	<b>PHILIPS</b>	<b>CODE</b>
D3MAC DECODER	SATPSU7	STR1 GIRD200, FIRD3000	SATPSU1 SATPSU2	STU802/05M STU801	SATPSU1 SATPSU2
		<b>MANHATTAN</b>	<b>CODE</b>	<b>THOMSON</b>	<b>CODE</b>
		850, 950	SATPSU1	SRS4	SATPSU2
		<b>MASPRO</b>	<b>CODE</b>	<b>TOSHIBA</b>	<b>CODE</b>
		SRE250S/1, SRE350S/1 SRE250S, SRE350S, SRE450S	SATPSU1 SATPSU2	SAT99, TU-SDU200	SATPSU1

CODE	PRICE	CODE	PRICE	CODE	PRICE	CODE	PRICE
SATPSU1	650p	SATPSU6	650p	SATPSU11	835p	SATPSU16	730p
SATPSU2	650p	SATPSU7	650p	SATPSU12	1735p	SATPSU17	850p
SATPSU3	650p	SATPSU8	730p	SATPSU13	3125p	SATPSU18	1175p
SATPSU4	650p	SATPSU9	900p	SATPSU14	3135p	SATPSU19	650p
SATPSU5	650p	SATPSU10	1230p	SATPSU15	77 5p		

### PACE SATELLITE TUNERS

MODELS	CODE	PRICE
PRD800, MSS200 (2GHZ) (221-2077062)	TUNER01	1650p
PRD900, MSS500, MSS1000 (2GHz) (221-2177012)	TUNER02	1650p

### PACE SWITCH MODE TRANSFORMERS

MODELS	CODE	PRICE
PACE9000	PACE9000	800p
PACEPRD800, PRD900	PRD800	550p

## SATMETER

THE SATMETER IS A PROFESSIONAL PORTABLE SATELLITE STNGTH METER DESIGNED FOR THE INSTALLATION AND MAINTENANCE OF SATELLITE TV SYSTEMS. THE SATMETER CAN BE USED AS STAND ALONE METER WITH POWERING THE LNB AS WELL AS IN LOOP. THROUGH OPERATION WITH SATELLITE RX POWERING THE LNB.

ACOUSTICAL SIGNAL: ON SIGNAL STRENGTH  
INPUT IMPEDENCE: 75 Ohm  
MAX.INPUT SIGNAL: -10 DBM

LED INDICATOR: VERTICAL/HORIZONTAL  
POWER AMPLIFIER: 18 DB

FREQUENCY RANGE: 900 TO 2050 MHZ  
DETECTION RANGE: -60 TO -10 DBM

**ORDER CODE: TOOL 22      PRICE: 8500p**

## SATELLITE LNB'S

MAKE & MODEL	ORDER CODE	PRICE	MAKE & MODEL	ORDER CODE	PRICE
Cambridge AE22/AE5 0.8dB standard 10.95-11.70 GHz Gold Range	LNB1	2160p	Cambridge AE7 Twin O/P H+V Both Enhanced	LNB7	4000p
Cambridge AE14 Universal LNB 10.7-11.7/11.7-12.75 GHz	LNB2	2500p	Cambridge AE2 Dual O/P H-V Separate Enhanced	LNB8	3550p
Cambridge AE21/AE5 Single O/P Switching LNB 1.0dB Standard	LNB3	2050p	Grundig Super Universal 'Anis' 10.7-12.75 GHz 0.8dB	LNB9	2600p
Cambridge AE19/AE6 Single O/P Switching LNB 1.0dB Enhanced	LNB4	2050p	Grundig Universal 'Anis' 10.7-12.75 GHz 1.0dB	LNB10	2250p
Cambridge AE23/AE12 0.8dB Enhanced 10.7-11.8GHz Gold Range	LNB5	2160p	Cambridge AE1 Twin O/P H+V Both Standard	LNB11	4000p
Cambridge AE8 Dual O/P H-V Separate Enhanced	LNB6	4000p			

## FUSES

CURRENT RATING	TIME LAG (20MM)		QUICK BLOW (20MM)	
	ORDER CODE	PRICE	ORDER CODE	PRICE
100mA	FUSE36	75p	FUSE37	60p
160mA	FUSE01	75p	FUSE17	60p
250mA	FUSE02	75p	FUSE18	60p
315mA	FUSE03	75p	FUSE19	60p
400mA	FUSE04	75p	FUSE20	60p
500mA	FUSE05	75p	FUSE21	60p
630mA	FUSE06	75p	FUSE22	60p
800mA	FUSE07	60p	FUSE23	60p
1A	FUSE08	60p	FUSE24	60p
1.25A	FUSE09	60p	FUSE25	60p
1.6A	FUSE10	60p	FUSE26	60p
2A	FUSE11	50p	FUSE27	60p
2.5A	FUSE12	50p	FUSE28	60p
3.15A	FUSE13	55p	FUSE29	50p
4A	FUSE14	55p	FUSE30	50p
5A	FUSE15	60p	FUSE31	50p
6.3A	FUSE16	60p	FUSE32	50p

### CERAMIC PLUG TOP

CURRENT RATING	ORDER CODE	PRICE
3A	FUSE33	100p
5A	FUSE34	100p
13A	FUSE35	100p

### 20mm CERAMIC TIME LAG

CURRENT RATING	ORDER CODE	PRICE
6.3A	FUSE38	100p
8A	FUSE39	100p
10A	FUSE40	100p
3.15A	FUSE41	85p
4A	FUSE42	85p
5A	FUSE43	85p

### 38mm CERAMIC TIME LAG

CURRENT RATING	ORDER CODE	PRICE
10A	FUSE48	815P

### 32mm CERAMIC SLOW BLOW

CURRENT RATING	ORDER CODE	PRICE
8A	FUSE44	185P
10A	FUSE45	185p
15A	FUSE46	185p
20A	FUSE47	210p

NB.

ALL FUSES ARE MADE IN THE UK AND FULLY MEET BS4265 & BS1362 SAFETY STANDARDS AND SHOULD NOT BE COMPARED WITH CHEAP IMPORTED TYPES.

**\*\* ALL THE ABOVE PRICES ARE FOR PACKS OF 10 FUSES \*\***

# TRANSISTORS

PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE
AC125	30P	BD647	50P	BU409	85P	BUX48A	150P	MPSA14	15P	2N3533	100P
AC126	30P	BD649	50P	BU412	175P	BUX5	800P	MPSA20	15P	2N3585	650P
AC127	30P	BD645	40P	BU413	175P	BUX80	180P	MPSA42	15P	2N3702	9P
AC128K	40P	BD676	40P	BU414B	250P	BUX81	160P	MPSA43	15P	2N3703	9P
AC141K	45P	BD677	38P	BU415A	170P	BUX84	50P	MPSA44	40P	2N3704	9P
AC176	22P	BD678	40P	BU426A	70P	BUX85	50P	MPSA55	12P	2N3705	9P
ACY18	48P	BD679	40P	BU433	120P	BUX86	30P	MPSA56	12P	2N3706	9P
ACY19	48P	BD680	40P	BU500	100P	BUX87	50P	MPSA57	15P	2N3707	9P
AD149	60P	BD681	40P	BU500D	225P	BUX98A	350P	MPSA92	20P	2N3710	12P
AF126	50P	BD682	45P	BU505	90P	BUY18S	150P	MPSA93	20P	2N3711	12P
AF139	30P	BD705	50P	BU505D	90P	BUY47	150P	MPSU10	200P	2N3771	85P
BC107	8P	BD707	50P	BU505DF	90P	BUY57	125P	MPSU45	550P	2N3772	90P
BC108	8P	BD709	50P	BU506	100P	BUY69A	200P	MPSU56	400P	2N3773	100P
BC109	8P	BD711	50P	BU506D	70P	BUY71	250P	MPSU60	350P	2N3792	150P
BC109C	10P	BD736	50P	BU506DF	120P	BUZ10	65P	MRS10	35P	2N3797	18P
BC140	20P	BD826	50P	BU508A	70P	BUZ11	200P	MR856	36P	2N3819	30P
BC142	20P	BD828	50P	BU508AF	90P	BUZ11A	175P	OC28	350P	2N3820	70P
BC143	20P	BD839	55P	BU508APH	80P	BUZ14	550P	OC29	250P	2N3823	40P
BC147	8P	BD897	50P	BU508D	90P	BUZ20	225P	OC35	350P	2N3866	110P
BC149	8P	BD899	50P	BU508DF	115P	BUZ21	250P	OC36	250P	2N3903	11P
BC159	8P	BD977	50P	BU508DR	130P	BUZ24	350P	OC45	50P	2N3906	11P
BC160	30P	BDX33	60P	BU508V	110P	BUZ25	450P	OC200	180P	2N3924	375P
BC171	10P	BDX37	100P	BU508VF	100P	BUZ32	25P	R2008B	100P	2N3927	375P
BC172	10P	BDX44	100P	BU526	75P	BUZ36	800P	R2010B	100P	2N4031	25P
BC173	14P	BDX47	75P	BU536	100P	BUZ44A	525P	S2000A3	175P	2N4033	25P
BC178	14P	BDX54C	75P	BU546	125P	BUZ45A	800P	S2000AF	175P	2N4036	29P
BC179	14P	BDX62C	150P	BU603	125P	BUZ50B	500P	S2055A	175P	2N4220	175P
BC182	7P	BDX63C	175P	BU606D	225P	BU53A	800P	S2055AF	200P	2N4347	130P
BC182L	7P	BDX64C	175P	BU608D	120P	BUZ71	75P	S2530A	100P	2N4391	60P
BC183	7P	BDX65	80P	BU626	120P	BUZ71AF	100P	S2800M	100P	2N4392	60P
BC183L	7P	BDX66C	175P	BU705	130P	BUZ72A	150P	TIP29	15P	2N4393	55P
BC184	7P	BDX67C	275P	BU706DF	175P	BUZ72AF	100P	TIP29A	22P	2N4399	200P
BC184L	7P	BDX71	70P	BU706F	150P	BUZ73A	150P	TIP29C	25P	2N4401	12P
BC212	7P	BDX77	175P	BU724A	100P	BUZ76A	110P	TIP29E	40P	2N4403	12P
BC212L	7P	BDX87C	175P	BU801	70P	BUZ80	200P	TIP30	25P	2N4416	120P
BC213	7P	BDX88C	150P	BU806	70P	BUZ80AF	200P	TIP30C	20P	2N4420	75P
BC213L	7P	BDW24	55P	BU807	60P	BUZ83	200P	TIP31A	22P	2N4427	75P
BC214	7P	BDW93	50P	BU807F	75P	BUZ90A	27P	TIP31C	22P	2N4920	50P
BC214L	7P	BDW94	50P	BU808DF	300P	BUZ91A	400P	TIP32	24P	2N4922	30P
BC237	7P	BDY29	225P	BU810	110P	BY448	200P	TIP32A	21P	2N4923	30P
BC238	7P	BDY56	225P	BU824	450P	BYT11	25P	TIP32C	28P	2N5038	175P
BC239	7P	BDY58	500P	BU826	120P	C106D	28P	TIP33	50P	2N5061	20P
BC300	20P	BDY90	125P	BU826A	160P	COY80	40P	TIP33C	60P	2N5088	20P
BC301	20P	BDY92	100P	BU902	110P	IRF120	225P	TIP34	65P	2N5109	100P
BC302	20P	BF137	35P	BU903	110P	IRF130	475P	TIP34C	65P	2N5116	175P
BC303	20P	BF167	30P	BU910	80P	IRF140	550P	TIP35C	65P	2N5154	150P
BC304	25P	BF181	18P	BU912	100P	IRF150	550P	TIP36C	65P	2N5160	600P
BC327	7P	BF183	20P	BU920	100P	IRF240	425P	TIP42A	20P	2N5179	40P
BC328	7P	BF195	7P	BU922	110P	IRF250	375P	TIP41C	22P	2N5192	50P
BC337	7P	BF199	8P	BU930	130P	IRF300	600P	TIP42A	20P	2N5241	500P
BC338	7P	BF200	16P	BU932	175P	IRF340	325P	TIP42C	22P	2N5245	45P
BC441	28P	BF225	30P	BU941	250P	IRF350	750P	TIP47	30P	2N5294	40P
BC446	8P	BF240	16P	BU2508A	130P	IRF10	650P	TIP48	40P	2N5296	30P
BC477	18P	BF245	25P	BU2508AF	130P	IRF10	150P	TIP50	60P	2N5320	50P
BC516	22P	BF254	15P	BU2508D	130P	IRF520	150P	TIP51	80P	2N5322	55P
BC537	25P	BF255	12P	BU2508DF	150P	IRF530	150P	TIP52	80P	2N5401	10P
BC546	8P	BF256	18P	BU2520AF	225P	IRF540	200P	TIP54	85P	2N5416	40P
BC547	8P	BF257	18P	BU2520DF	225P	IRF610	150P	TIP102	70P	2N5448	12P
BC548	8P	BF259	18P	BU2525A	325P	IRF611	150P	TIP105	65P	2N5457	45P
BC549	8P	BF262	25P	BU2525AF	325P	IRF612	180P	TIP106	65P	2N5458	55P
BC550	8P	BF263	25P	BU2527AF	400P	IRF630	150P	TIP107	65P	2N5460	55P
BC556	8P	BF273	15P	BUF405A	200P	IRF640	350P	TIP110	40P	2N5461	75P
BC557	7P	BF311	20P	BUH315	200P	IRF642	200P	TIP111	40P	2N5462	45P
BC558	8P	BF336	20P	BUH15D	250P	IRF650	200P	TIP112	35P	2N5484	55P
BC559	8P	BF337	20P	BUH515	200P	IRF710	150P	TIP112H	50P	2N5551	12P
BC560	8P	BF338	20P	BUH515D	250P	IRF720	200P	TIP115	50P	2N5671	350P
BC637	20P	BF362	30P	BUH517	275P	IRF730	150P	TIP116	30P	2N5672	400P
BC638	20P	BF367	13P	BUH517D	175P	IRF740	150P	TIP117	30P	2N5680	55P
BC640	20P	BF371	17P	BUH715	425P	IRF820	150P	TIP120	37P	2N5884	175P
BCY33	200P	BF421	18P	BUV93	375P	IRF830	160P	TIP121	35P	2N5886	325P
BCY34	200P	BF422	21P	BUK444	200P	IRF840	150P	TIP122	30P	2N6031	250P
BCY70	16P	BF423	25P	500B		IRF9140	1000P	TIP125	30P	2N6049	55P
BCY71	16P	BF455	12P	BUK444	200P	IRF9150	150P	TIP128	40P	2N6059	150P
BCY72	16P	BF458	19P	800B		IRF9511	150P	TIP127	35P	2N6098	50P
BD115	30P	BF462	50P	BUK445	200P	IRF9520	150P	TIP130	30P	2N6099	45P
BD124P	50P	BF471	28P	600B		IRF9530	400P	TIP131	30P	2N6107	40P
BD131	25P	BF472	28P	BUK446	400P	IRF9531	200P	TIP132	30P	2N6109	40P
BD132	25P	BF479	30P	800B		IRF9540	300P	TIP136	40P	2N6211	400P
BD133	50P	BF494	16P	BUK455	200P	IRF9541	200P	TIP137	55P	2N6248	150P
BD135	20P	BF495	16P	600B		IRF9610	150P	TIP162	110P	2N6284	250P
BD136	20P	BF525	16P	BUK456	200P	IRF9620	150P	TIP141	65P	2N6287	225P
BD137	20P	BF596	16P	BUW81A	150P	IRF9622	200P	TIP143	75P	2N6292	40P
BD138	20P	BF615	30P	BUW81A	1900P	IRF9630	325P	TIP145	50P	2N6385	120P
BD139	20P	BF617	30P	BUW82	1900P	IRF9640	375P	TIP146	70P	2N6403	160P
BD140	20P	BF670	40P	BUW82	200P	IRF9640	375P	TIP147	80P	2N6427	25P
BD144	90P	BF763	40P	BUW82A	200P	IRF9640	375P	TIP147	80P	2N6427	25P
BD157	38P	BF870	22P	BUW82A	200P	IRF9640	375P	TIP147	80P	2N6427	25P
BD168	30P	BF871	22P	BUW82A	200P	IRF9640	375P	TIP147	80P	2N6427	25P
BD175	30P	BF960	38P	BUW82A	200P	IRF9640	375P	TIP147	80P	2N6427	25P
BD177	30P	BF961	35P	BUT11A	55P	IRFP240	300P	TIP2955	50P	2N6491	90P
BD179	32P	BF964	38P	BUT11AF	55P	IRFP250	400P	TIP3055	50P	2N6547	300P
BD181	45P	BFQ232	75P	BUT12	80P	IRFP350	325P	TIPL760	100P	2N6609	375P
BD182	60P	BFQ252A	60P	BUT13	310P	IRFP450	400P	TIPL762A	200P	2N6660	375P
BD184	60P	BFQ90	85P	BUT18	80P	IRFP460	400P	TIPL763A	200P	2N6675	175P
BD187	30P	BFQ91	90P	BF18AF	80P	IRFP480	775P	TIP1791A	80P	2N6678	225P
BD201	33P	BF143	30P	BUT30V	1700P	IRFP9140	1450P	TIS90	15P	4N35	50P
BD202	38P	BFX29	20P	BUT56A	100P	IRFP9240	500P	TIS93	20P		
BD203	42P	BFX84	20P	BUT76A	80P	IRFPC50	600P	ZTX107	11P		
BD204	42P	BFX85	20P	BU190	1300P	IRFRC20	250P	ZTX108	11P		
BD222	31P	BFX87	15P	BU192	1200P	IRFZ42	275P	ZTX109	12P	BY127	8P
BD225	31P	BFX88	15P	BU198	1500P	IRFZ44	275P	ZTX112	20P	BY133	8P
BD232	31P	BFX89	60P	BUV20	650P	MJ900	200P	ZTX300	10P	BY164	40P
BD233	30P	BFY50	14P	BUV21	400P	MJ10001	200P	ZTX301	16P	BY179	35P
BD234	32P	BFY51	24P	BUV23	475P	MJ1001	200P	ZTX302	10P	BY184	32P
BD235	28P	BFY52	14P	BUV24	350P	MJ2501	100P	ZTX303	20P	BY206	11P
BD236	30P	BFY56	25P	BUV25	110P	MJ2955	55P	ZTX304	10P	BY207	20P
BD237	21P	BFY64	25P	BUV26	150P	MJ3000	100P	ZTX320	20P	BY227	19P
BD238	24P	BFY90	45P	BUV27	150P	MJ3020	100P	ZTX501	13P	BY228	28P
BD239	30P	BLY48	85P	BUV28	110P	MJ4032	175P	ZTX502	10P	BY298	15P
BD2											

## TRANSISTORS

PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE	PART	PRICE
<b>IC SOCKETS</b>											
8 PIN	4P	1A/50V	18p	TIC116C	59p	8156	300p	4075	13p	7430	25p
14 PIN	5P	1A/100V		8A300V	70p	8224	240p	4076	42p	7437	28p
16 PIN	6P	WO2	19p	TIC116D		8226	240p	4077	13p	7438	30p
18 PIN	9P	WO4	21p	8A400V		8250	750p	4078	13p	7442	38p
20 PIN	10P	LA/400V		TIC126D	75p	8251	200p	4081	13p	7447	60p
22 PIN	12P	LA/600V	23p	12A/400V	90p	8253	160p	4082	13p	7450	22p
24 PIN	13P	WO8	28p	TIC126M		8257	220p	4085	36p	7451	10p
28 PIN	13P	1A/800V		12A/600V	28p	8271	340p	4086	30p	7454	25p
40 PIN	15P	BR81D	33p	C1060		8279	270p	4089	75p	7473	25p
<b>ZENER DIODES</b>											
400m	WATT	BR82D	33p	4A/400V		8283	400p	4093	18p	7481	90p
2V7 TO 39V	5P	2A/100V		BR103	37p	8284	440p	4094	44p	7482	60p
1.3	WATT	BR84D	37p	BR303	85p	8287	260p	4094	58p	7485	25p
2V7 TO 39V	9P	2A/400V		BT106	180p	8288	650p	4098	50p	7489	75p
<b>VOLTAGE REGULATORS</b>											
7805	25P	BR86D	43p	BT119	100p	82C206PLCC	500p	4099	42p	7493	35p
7806	25P	2A/200V	43p	17088	200p	8748	700p	4501	26p	7495	48p
7808	25P	BR84D	37p	17089	200p	8755	800p	4502	36p	74132	42p
7812	25P	2A/400V		SG 264	800p	8126	95p	4504	35p	74141	55p
7815	25P	BR88D	43p	SG 264	800p	8128	110p	4505	80p	74145	70p
7818	25P	2A/800V	43p	SG613	1500p			4506	58p	74157	45p
7824	25P	BR32	43p					4507	30p	74160	50p
7824	25P	2A/200V	43p					4508	67p		
7824	25P	BR32	43p					4510	32p		
7824	25P	2A/200V	43p					4511	13p		
7824	25P	BR32	43p					4512	38p	74HC03	14p
7824	25P	2A/200V	43p					4513	38p	74HC08	18p
7824	25P	BR32	43p					4514	65p	74HC10	20p
7824	25P	2A/200V	43p					4515	65p	74HC11	14p
7824	25P	BR32	43p					4516	36p	74HC14	26p
7824	25P	2A/200V	43p					4517	100p	74HC14	26p
7824	25P	BR32	43p					4518	36p	74HC20	19p
7824	25P	2A/200V	43p					4519	28p	74HC27	20p
7824	25P	BR32	43p					4520	35p	74HC31	24p
7824	25P	2A/200V	43p					4521	86p	74HC73	24p
7824	25P	BR32	43p					4522	18p	74HC74	24p
7824	25P	2A/200V	43p					4523	38p	74HC74	24p
7824	25P	BR32	43p					4524	41p	74HC76	28p
7824	25P	2A/200V	43p					4525	28p	74HC77	35p
7824	25P	BR32	43p					4526	65p	74HC85	33p
7824	25P	2A/200V	43p					4527	40p	74HC86	29p
7824	25P	BR32	43p					4528	140p	74HC107	28p
7824	25P	2A/200V	43p					4529	29p	74HC123	35p
7824	25P	BR32	43p					4530	36p	74HC125	32p
7824	25P	2A/200V	43p					4531	140p	74HC126	33p
7824	25P	BR32	43p					4532	60p	74HC132	33p
7824	25P	2A/200V	43p					4533	30p	74HC133	33p
7824	25P	BR32	43p					4534	40p	74HC137	52p
7824	25P	2A/200V	43p					4535	120p	74HC138	33p
7824	25P	BR32	43p					4536	140p	74HC147	42p
7824	25P	2A/200V	43p					4537	35p	74HC153	32p
7824	25P	BR32	43p					4538	50p	74HC154	44p
7824	25P	2A/200V	43p					4539	170p	74HC157	90p
7824	25P	BR32	43p					4540	180p	74HC158	34p
7824	25P	2A/200V	43p					4541	55p	74HC160	44p
7824	25P	BR32	43p					4542	55p	74HC161	44p
7824	25P	2A/200V	43p					4543	48p	74HC162	44p
7824	25P	BR32	43p					4544	30p	74HC163	44p
7824	25P	2A/200V	43p					4545	48p	74HC164	44p
7824	25P	BR32	43p					4546	58p	74HC165	56p
7824	25P	2A/200V	43p					4547	120p	74HC166	60p
7824	25P	BR32	43p					4548	45p	74HC174	38p
7824	25P	2A/200V	43p					4549	30p	74HC175	38p
7824	25P	BR32	43p					4550	18p	74HC190	46p
7824	25P	2A/200V	43p					4551	20p	74HC192	53p
7824	25P	BR32	43p					4552	16p	74HC193	41p
7824	25P	2A/200V	43p					4553	18p	74HC194	46p
7824	25P	BR32	43p					4554	35p	74HC195	46p
7824	25P	2A/200V	43p					4555	20p	74HC221	80p
7824	25P	BR32	43p					4556	35p	74HC235	55p
7824	25P	2A/200V	43p					4557	10p	74HC240	48p
7824	25P	BR32	43p					4558	30p	74HC241	47p
7824	25P	2A/200V	43p					4559	25p	74HC242	55p
7824	25P	BR32	43p					4560	20p	74HC243	60p
7824	25P	2A/200V	43p					4561	30p	74HC245	48p
7824	25P	BR32	43p					4562	45p	74HC251	25p
7824	25P	2A/200V	43p					4563	32p	74HC257	40p
7824	25P	BR32	43p					4564	32p	74HC259	52p
7824	25P	2A/200V	43p					4565	20p	74HC273	42p
7824	25P	BR32	43p					4566	25p	74HC280	61p
7824	25P	2A/200V	43p					4567	15p	74HC283	61p
7824	25P	BR32	43p					4568	13p		
7824	25P	2A/200V	43p					4569	13p		
7824	25P	BR32	43p					4570	13p		
7824	25P	2A/200V	43p					4571	13p		
7824	25P	BR32	43p					4572	13p		
7824	25P	2A/200V	43p					4573	13p		
7824	25P	BR32	43p					4574	13p		
7824	25P	2A/200V	43p					4575	13p		
7824	25P	BR32	43p					4576	13p		
7824	25P	2A/200V	43p					4577	13p		
7824	25P	BR32	43p					4578	13p		
7824	25P	2A/200V	43p					4579	13p		
7824	25P	BR32	43p					4580	13p		
7824	25P	2A/200V	43p					4581	13p		
7824	25P	BR32	43p					4582	13p		
7824	25P	2A/200V	43p					4583	13p		
7824	25P	BR32	43p					4584	13p		
7824	25P	2A/200V	43p					4585	13p		
7824	25P	BR32	43p					4586	13p		
7824	25P	2A/200V	43p					4587	13p		
7824	25P	BR32	43p					4588	13p		
7824	25P	2A/200V	43p					4589	13p		
7824	25P	BR32	43p					4590	13p		
7824	25P	2A/200V	43p					4591	13p		
7824	25P	BR32	43p					4592	13p		
7824	25P	2A/200V	43p					4593	13p		
7824	25P	BR32	43p					4594	13p		
7824	25P	2A/200V	43p					4595	13p		
7824	25P	BR32	43p					4596	13p		
7824	25P	2A/200V	43p					4597	13p		
7824	25P	BR32	43p					4598	13p		
7824	25P	2A/200V	43p					4599	13p		
7824	25P	BR32	43p					4600	13p		
7824	25P	2A/200V	43p					4601	13p		
7824	25P	BR32	43p					4602	13p		
7824	25P	2A/200V	43p					4603	13p		
7824	25P	BR32	43p					4604	13p		
7824	25P	2A/200V	43p					4605	13p		
7824	25P	BR32	43p					4606	13p		
7824	25P	2A/200V	43p					4607	13p		
7824	25P	BR32	43p					4608	13p		
7824	25P	2A/200V	43p					4609	13p		
7824	25P	BR32	43p					4610	13p		
7824	25P	2A/200V	43p					4611	13p		
7824	25P	BR32	43p					4612	13p		
7824	25P	2A/200V	43p					4613	13p		
7824	25P	BR32	43p					4614	13p		
7824	25P	2A/200V	43p					4615	13p		
7824	25P	BR32	43p					4616	13p		
7824	25P	2A/200V	43p					4617	13p		
7824	25P	BR32	43p					4618	13p		
7824	25P	2A/200V	43p					4619	13p		
7824	25P	BR32	43p					4620	13p		
7824	25P	2A/200V	43p					4621	13p		
7824	25P	BR32	43p					4622	13p		

## New semiconductor design centre

### **Fears expressed over decline in science students**

Cypress Semiconductor Corporation is making a multi-million pound investment in one of the largest microchip design centres in the UK, in Basingstoke, Hampshire. The new centre will design various semiconductor products including SRAMS, CPLD and FCT logic chips. Working with Cypress design centres in North America and Asia the UK centre will participate in the company's 24-hour, round-the-clock design projects. At the end of one working day, a project can be handed over to another centre in a different time zone. As many as 60 new design posts will be created. Cypress is working with educational establishments in the UK to encourage the training of future electronics design engineers. Fears have been expressed that a decrease in the number of good science students will have an adverse effect on recruitment in the UK where there have traditionally been high levels of expertise in semiconductor design. "This is particularly important in the light of falling numbers of school pupils studying subjects such as physics," says design centre director David Rees. "When young people are thinking about their future career paths, we need to be sure that they understand the advantages and opportunities available to engineering graduates."



*David Rees of Cypress Semiconductor: concern about school leavers*

Cypress Semiconductor's product lines include static rams, eproms and specialty memories; programmable logic devices (PLDs), data communications products and personal computer chipsets, timing devices and USB microcontrollers. The company has a World Wide Web site at <http://www.cypress.com>.

### **Free licenses for Radio Amateurs under 21**

The Radiocommunications Agency has announced that Amateur Radio Licences will be issued free of charge to all qualified users under the age of 21 from 1st July 1997. New applicants registered on or after 1st July will be issued free of charge, and existing licence holders will not be charged this year providing their expiry falls on or after that date.

Technology Minister John Battle said: "The Agency has taken this step to encourage more young people into amateur radio. Radio in its many forms has made a massive impact this century on all aspects of our life. We should do all we can to help young people develop an interest in one of the key technological areas for the next century."

There is widespread concern that the attractions of home computing, and also the falling standards that many fear have taken place in education, have combined to discourage younger people from taking up amateur radio. Another factor is that miniaturisation and integration have made high level radio electronics now inaccessible to most Amateurs, even with higher qualifications, so that amateur radio's contribution to the cutting edge of radio has been shifted to experimental or low power areas, and out of what many see the mainstream.

The Novice Licence was launched in 1991 to help young people enter Amateur Radio in easier stages. In 1996 the Radio Society of Great Britain (RSGB) announced that it was to concentrate on keeping prices down and extending services to encourage Amateurs to pursue their hobby. The saving of the £15-per-year License fee will help younger people who are not earning or earning low wages. Amateur radio has also been a major factor in bringing youngsters into Electronics.

For more information contact the Radiocommunications Agency  
Tel. 0171 211 0158.

## Old PCB retirement scheme in Basingstoke

Cradle-to-Grave electronics Capital of the UK, Basingstoke is now the home of a new recycling scheme aimed at recovering and reprocessing valuable electronic parts instead of allowing their wasteful disposal in landfill sites. The electronics take-back scheme is launched by Project Integra, the waste management strategy, in conjunction with Intex Logistics of Horndean, and local firm PW Recycling. Electronic scrap will be collected and stripped down to recover re-useable ics and other components before the PCBs are refined for their residual value of tin, lead, copper, gold and other metals. The plastic casings will also be analysed for type and then broken down for re-sale to the plastics industry. If the trial is a success, a similar scheme could be set up countrywide.

### **OVERSEAS READERS**

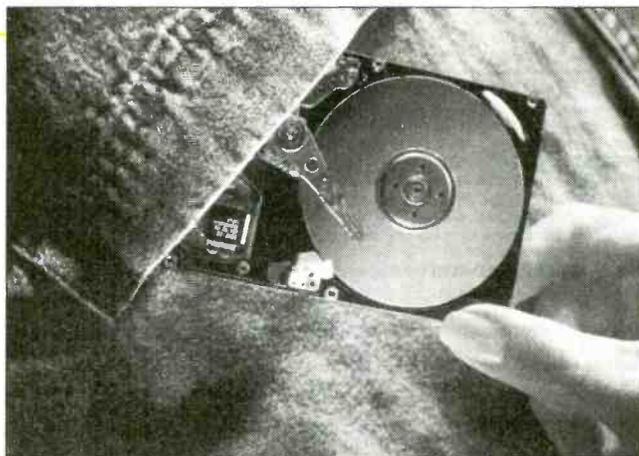
To call UK telephone numbers, replace the initial 0 with your local overseas access code plus the digits 44.

# The World's first 5 GB laptop disk drive

IBM have produced a laptop hard disk drive not much bigger than the palm of a child's hand, but able to hold a record-breaking 5 billion bytes (5.1 gigabytes) of data.

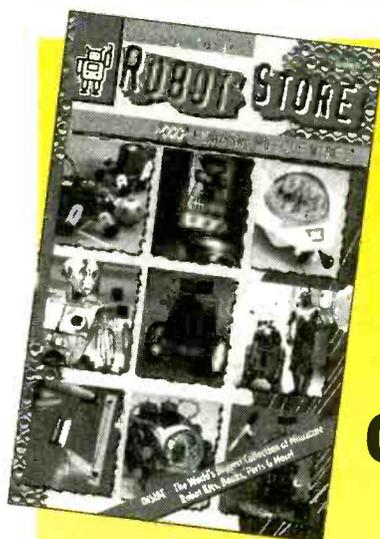
The IBM 2.5 in Travelstar 5GS can store 50 years' worth of a typical daily newspaper, or about 1 million printed pages - a stack of paper as tall as a 62-story building. (No wonder newspaper libraries are looking at compact data storage.)

Whereas the Travelstar 5GS, which is about two-thirds of an inch (17 mm) thick, will go into premium notebook computers. Aimed mainly at notebook users who don't want to store their newspaper collection, the compact drive will allow users to take advantage of space-demanding applications such as long multimedia presentations, games with advanced graphics and video conferencing. The main contributor to this compact storage is IBM's new MRX (magneto-resistive extended) drive-head technology. No bigger than the head of a pin, the MRX head component sends out stronger signals than older heads, enabling it to reach and write larger volumes of information. "MRX is a major step beyond the older-generation magneto-resistive head technology," said Bob Scranton, vice president of technology at IBM's Storage Systems Division.



Another IBM 2.5 in disk drive with MRX head technology sets a new density record, storing the most data per square inch of any disk drive: 2.64 billion bits. The Travelstar 4GT is only half an inch (12.5 mm) thick and it destined for new ultra-portable laptops. The 4GT is also designed to be the most rugged 2.5 in disk drive, based on its non-operational shock rating. (This is the measurement of how much force is applied to the drive before it no longer functions fully.)

IBM expects to ship the drives to OEMs (Original Equipment Manufacturers) in July, and manufacturers including Dell Computer, Gateway 2000 and IBM expect to have them on the market in their notebook computers this year.



## Robot Store Catalogue

Robot builders can now obtain the Mondotronics Robot Store catalogue no. 13, "The World's Biggest Collection of Miniature Robot Kits, Books, Parts and More".

The current catalogue features touching and seeing robots, programmable robots, robot muscle wires, many gear and motor kits, and the MicroBench (tm) Pic-driven 24-channel user-definable I/O workbench, able to take downloaded programs and run independent of the main computer. Also new this time is the Soccer'bot Kit, six-legged football-playing robots. No soldering with this kit.

For a catalogue with more information contact Mondo-tronics Inc., 524 San Anselmo Ave. 107-13, San Anselmo CA 94960. Tel. (USA) 415 455 9330 Fax 415 455 9333 email info@mondo.com. Web site: [www.IRobotStore.com](http://www.IRobotStore.com).

## Maritime radio is handed over by the RA

Responsibility for maritime radio operator exams and certification, maritime radio performance specifications and type approval of maritime radiocommunications equipment, including compliance with the Electromagnetic Compatibility Directive, has been transferred from the Radiocommunications Agency to the Marine Safety Agency of the Department of Transport as of 30 June 1997.

Announcing the changes, Minister for Science, Energy and Industry Mr John Battle said: "This transfer will bring a number of benefits to the maritime community and marine radio industry, including rationalisation of seafarer training and certification in the UK. It will also allow resources to be better used and aid consistency in decision taking through single Agency participation in specific on-setting work at European level."

Parliamentary Under-secretary of State for Transport Glerda Jackson said, slightly more succinctly: "This transfer represents a rationalisation of the functions carried out by the two Agencies, resulting in a 'one-stop shop' for manufacturers of radio equipment and mariners wishing to become qualified in seafaring competencies."

The MSA will also take over the power to revoke an Authority to Operate held by an individual. The RA will continue to be responsible for licensing of maritime radio use under the Wireless Telegraphy Act 1949, the enforcement of licence conditions, and investigation of reports of radio interference.

**DIFFERENTIAL THERMOSTAT KIT** Perfect for heat recovery, solar systems, boiler efficiency etc. Two sensors will operate a relay when a temp difference (adjustable) is detected. All components and pcb. £29 ref LOT83

**MAGNETIC RUBBER TAPE** Selfadhesive 10 metre reel, 8mm wide perfect for all sorts of applications! £15 ref LOT87

**MAINS POWER SAVER** UK made plug in unit, fitted in seconds, can reduce your energy consumption by 15%. Works with fridges, soldering irons, conventional bulbs etc. Max 2A rating. £9 each ref LOT71, pack of 10 £69 ref LOT72

**YUASHA SEALED LEAD ACID** Batteries, ex equipment but ok bargain price just £5.99 each ref YA1. 100 or more £3.50 each.

#### DC TO DC CONVERTERS

DRM58 input 10-40vdc output 5v 8A £15 DRM128 input 17-40vdc output 12v 8A £18 DRM158 input 20-40vdc output 15v 8A £18 DRM248 input 29-40vdc output 24v 8A £12 DRS123 input 17-40vdc output 12v 3A £10 DRS153 input 20-40vdc output 15v 3A £20 DRS243 input 29-40vdc output 24v 3A £8

**HITACHI LM225X LCD SCREENS** 270x150mm, standard 12 way connector, 640x200 dots, tec spec sheet, £15 each ref LM2

**VARIABLE CAPACITORS** Dual gang, 60x33x45mm, reduction gearing, unknown capacity but probably good quality (military spec) general purpose radio tuner. £9 ref VC1

**ELECTRONIC FLASH PCB** Small pcb fitted with components including a flash tube. Just connect 12vdc and it flashes, variable speed potentiometer. £6 ref FLS1

**THIEF PROOF PEN!** Amazing new ball point pen fitted with a combination lock on the end that only you know! £2.49 ref TP2

**JUMBO BI COLOUR LEDS PCB** with 15 fitted also 5 giant seven segment displays (55mm) £8 ref JUM1

**HOME DECK CLEARANCE** These units must be cleared! leads, a n infra red remote qwerty keyboard and receiver, a standard UHF modulator, a standard 1200/75 BT approved modem and loads of chips, capacitors, diodes, resistors etc all for just £10 ref BAR33.

**6.8MW HELIUM NEON LASERS** New units. £65 ref LOT33

**COINSLIT TOKENS** You may have a use for these? mixed bag of 100 tokens £5 ref LOT20.

**PORTABLE X RAY MACHINE PLANS** Easy to construct plans on a simple and cheap way to build a home X-ray machine! Effective device, X-ray sealed assemblies, can be used for experimental purposes. Not a toy or for minors! £6/set. Ref FXP1.

**TELEKINETIC ENHANCER PLANS** Mystify and amaze your friends by creating motion with no known apparent means or cause. Uses no electrical or mechanical connections, no special gimmicks yet produces positive motion and effect. Excellent for science projects, magic shows, party demonstrations or serious research & development of this strange and amazing psychic phenomenon. £4/set Ref F/TK1.

**ELECTRONIC HYPNOSIS PLANS & DATA** This data shows several ways to put subjects under your control. Included is a full volume reference text and several construction plans that when assembled can produce highly effective stimuli. This material must be used cautiously. It is for use as entertainment at parties etc only, by those experienced in its use. £15/set Ref F/EH2.

**GRAVITY GENERATOR PLANS** This unique plan demonstrates a simple electrical phenomena that produces an anti-gravity effect. You can actually build a small mock spaceship out of simple materials and without any visible means- cause it to levitate. £10/set Ref F/GRA1.

**WORLDS SMALLEST TESLA COIL/LIGHTNING DISPLAY GLOBE PLANS** Produces up to 750,000 volts of discharge, experiment with extraordinary HV effects. "Plasma in a jar", St. Elmo's fire, Corona, excellent science project or conversation piece. £5/set Ref F/BTC1/LG5.

**COPPER VAPOUR LASER PLANS** Produces 100mw of visible green light. High coherency and spectral quality similar to Argon laser but easier and less costly to build yet far more efficient. This particular design was developed at the Atomic Energy Commission of NEGEV in Israel. £10/set Ref F/CLV1.

**VOICE SCRAMBLER PLANS** Miniature solid state system turns speech sound into indecipherable noise that cannot be understood without a second matching unit. Use on telephone to prevent third party listening and bugging. £6/set Ref F/VSS.

**PULSED TV JOKER PLANS** Little hand held device utilises pulse techniques that will completely disrupt TV picture and sound works on FM too! DISCRETION ADVISED. £9/set Ref F/TJ5.

**BODYHEAT TELESCOPE PLANS** Highly directional long range device uses recent technology to detect the presence of living bodies, warm and hot spots, heat leaks etc. Intended for security, law enforcement, research and development, etc. Excellent security device or very interesting science project. £8/set Ref F/BHT1.

**BURNING, CUTTING CO2 LASER PLANS** Projects an invisible beam of heat capable of burning and melting materials over a considerable distance. This laser is one of the most efficient, converting 10% input power into useful output. Not only is this device a workhorse in welding, cutting and heat processing materials but it is also a likely candidate as an effective directed energy beam weapon against missiles, aircraft, ground-to-ground, etc. Particle beams may very well utilize a laser of this type to blast a channel in the atmosphere for a high energy stream of neutrons or other particles. The device is easily applicable to burning and etching wood, cutting, plastics, textiles etc £12/set Ref F/LC7.

**MYSTERY ANTI GRAVITY DEVICE PLANS** Uses simple concept. Objects float in air and move to the touch. Defies gravity, amazing gift, conversation piece, magic trick or science project. £6/set Ref F/ANT1K.

**FRUIT POWERED CLOCK** Just add a fresh orange, tomato, banana or any other fruit plug in the probes and the clock works! £9.95 ref SC154

**DYNAMO FLASHLIGHT** Interesting concept, no batteries needed just squeeze the trigger for instant light apparently even works under water in an emergency although we haven't tried it yet! £6.99 ref SC152

**ULTRASONIC BLASTER PLANS** Laboratory source of sonic shock waves. Blow holes in metal, produce 'cold' steam, atomize liquids. Many cleaning uses for PC boards, jewellery, coins, small parts etc. £6/set Ref F/ULB1.

**ULTRA HIGH GAIN AMP/STETHOSCOPIC MIKE/SOUND**

**AND VIBRATION DETECTOR PLANS** Ultrasensitive device enables one to hear a whole new world of sounds. Listen through walls, windows, floors etc. Many applications shown, from law enforcement, nature listening, medical heartbeat, to mechanical devices. £6/set Ref F/HGA7

### WOLVERHAMPTON ELECTRONICS STORE NOW OPEN IN WORCESTER ST TEL 01902 22039

**ANTI DOG FORCE FIELD PLANS** Highly effective circuit produces time variable pulses of acoustical energy that dogs cannot tolerate £6/set Ref F/DOG2

**LASER BOUNCE LISTENER SYSTEM PLANS** Allows you to hear sounds from a premises without gaining access. £12/set Ref F/LLIST1

**LASER LIGHT SHOW PLANS** Do it yourself plans show three methods. £6 Ref F/LLS1

**PHASOR BLAST WAVE PISTOL SERIES PLANS** Handheld, has large transducer and battery capacity with external controls. £6/set Ref F/PS4

**INFINITY TRANSMITTER PLANS** Telephone line grabber/room monitor. The ultimate in home/office security and safety! simple to use! Call your home or office phone, push a secret tone on your telephone to access either: A) On premises sound and voices or B) Existing conversation with break-in capability for emergency messages. £7 Ref F/TELEGRAB

**BUG DETECTOR PLANS** Is that someone getting the goods on you? Easy to construct device locates any hidden source of radio energy! Sniffs out and finds bugs and other sources of bothersome interference. Detects low, high and UHF frequencies. £5/set Ref F/BD1.

**ELECTROMAGNETIC GUN PLANS** Projects a metal object a considerable distance-requires adult supervision £5 ref F/EML2.

**ELECTRIC MAN PLANS, SHOCK PEOPLE WITH THE TOUCH OF YOUR HAND!** £5/set Ref F/EMA1.

**PARABOLIC DISH MICROPHONE PLANS** Listen to distant sounds and voices, open windows, sound sources in 'hard to get' or hostile premises. Uses satellite technology to gather distant sounds and focus them to our ultra sensitive electronics. Plans also show an optional wireless link system. £8/set ref F/PM5

**2 FOR 1 MULTIFUNCTIONAL HIGH FREQUENCY AND HIGH DC VOLTAGE, SOLID STATE TESLA COIL AND VARIABLE 100,000 VDC OUTPUT GENERATOR PLANS** Operates on 9-12vdc, many possible experiments. £10 Ref F/HVM7/TCL4.

**MEGA LED DISPLAYS** PCB fitted with 5 seven segment displays each measuring 55 x 38mm. £5 ref LED5.

**MOD TRANSMITTING VALVES 6J180E** £80 ref LOT112

**SWITCHED MODE PSU'S** 244 watt, +5 32A, +12 6A, -5 0.2A, -12 0.2A. There is also an optional 3.3v 25A rail available. 120/240V I/P. Cased, 175x90x145mm. IEC inlet Suitable for PC use (6 d/drive connectors 1 m/board). £15 ref LOT135

**HYDROGEN FUEL CELL PLANS** There is a lot of interest in using Hydrogen as the fuel of the future. Hydrogen is easy to produce using chemicals and surplus solar generated electricity. It is also easy to store with little or no loss. Hydrogen fuel cells are designed to store hydrogen and weight for weight will hold twice as much energy as a full petrol tank. Our plans give you loads of information on Hydrogen production, storage and practical plans to build your own hydrogen fuel cell! you will need access to a well equipped workshop for this but full construction details and drawings are included. Fuel cell plans £9 ref HY1

**VIDEO PROCESSOR UNITS?/6v 10AH BATT/24V 8A TX** Not too sure what the function of these units is but they certainly make good strippers! Measures 390X320X120mm, on the front are controls for scan speed, scan delay, scan mode, loads of connections on the rear. Inside 2 x 6v 10AH sealed lead acid batts, pcb's and a 8A? 24v toroidal transformer (mains in), sold as seen, may have one or two broken knobs etc due to poor storage. £15.99 ref VP2

**RETRO NIGHT SIGHT** Recognition of a standing man at 300m in 1/4 moonlight, hermetically sealed, runs on 2 AA batteries, 80mm F1.5 lens, 20mw infrared laser included. £325 ref RETRON.

**MAKE YOUR OWN CHEWING GUM KIT** Everything you need to make real chewing gum, even the bowl and tree sap from the Sapodilla tree £7.99 ref SC190

**MINI FM TRANSMITTER KIT** Very high gain preamp, supplied complete with FET electret microphone. Designed to cover 88-108 Mhz but easily changed to cover 63-130 Mhz. Works with a common 9v (PP3) battery, 0.2W RF. £9 Ref 1001.

**3-30V POWER SUPPLY KIT** Variable, stabilized power supply for lab use. Short circuit protected, suitable for professional or amateur use 24v 3A transformer is needed to complete the kit. £14 Ref 1007.

**1 WATT FM TRANSMITTER KIT** Supplied with piezo electric mic. 8-30vdc. At 25-30v you will get nearly 2 watts! £15 ref 1009.

**FM/AM SCANNER KIT** Well not quite, you have to turn the knob your self but you will hear things on this radio that you would not hear on an ordinary radio (even TV). Covers 50-160mhz on both AM and FM. Built in 5 watt amplifier, inc speaker. £18 ref 1013.

**3 CHANNEL SOUND TO LIGHT KIT** Wireless system, mains operated, separate sensitivity adjustment for each channel, 1,200 w

### BULL ELECTRICAL

250 PORTLAND ROAD, HOVE, SUSSEX.  
BN3 5QT. (ESTABLISHED 50 YEARS).

MAIL ORDER TERMS: CASH, PO OR CHEQUE  
WITH ORDER PLUS £3.50 P&P PLUS VAT.

24 HOUR SERVICE £4.50 PLUS VAT.  
OVERSEAS ORDERS AT COST PLUS £3.50  
(ACCESS, VISA, SWITCH, AMERICAN EXPRESS)

phone orders : 01273 203500

FAX 01273 323077  
E-mail bull@pavilion.co.uk

power handling, microphone included. £17 Ref 1014.

**4 WATT FM TRANSMITTER KIT** Small but powerful FM transmitter, 3RF stages, microphone and audio preamp included. £24 Ref 1028.

**STROBE LIGHT KIT** Adjustable from 1-60 hz (a lot faster than conventional strobes). Mains operated. £17 Ref 1037.

**COMBINATION LOCK KIT** 9key, programmable, complete with keypad, will switch 2A mains 9v dc operation. £13 ref 1114.

**PHONE BUG DETECTOR KIT** This device will warn you if somebody is eavesdropping on your line. £9 ref 1130.

**ROBOT VOICE KIT** Interesting circuit that distorts your voice! adjustable, answer the phone with a different voice! 12vdc £9 ref 1131

**TELEPHONE BUG KIT** Small bug powered by the phone line, starts transmitting as soon as the phone is picked up! £12 Ref 1135.

**3 CHANNEL LIGHT CHASER KIT** 800 watts per channel, speed and direction controls supplied with 12 LEDs (you can fit tracks instead to make kit mains, not supplied) 9-12vdc £17 ref 1026.

**12V FLOURESCENT LAMP DRIVER KIT** Light up 4 foot tubes from your car battery! 9v 2a transformer also required. £8 ref 1069.

**HELPING HANDS** Perfect for those fiddly jobs that need six hands, 6 ball and socket joints, magnifier. £7.99 ref YO57A

**VOX SWITCH KIT** Sound activated switch ideal for making bugging tape recorders etc, adjustable sensitivity. £10 ref 1073.

**PREAMP MIXER KIT** 3 input mono mixer, sep bass and treble controls plus individual level controls. 18vdc, input sens 100mA. £15 ref 1052.

**SOUND EFFECTS GENERATOR KIT** Produces sounds ranging from bird chips to sirens. Complete with speaker, add sound effects to your projects for just £9 ref 1045.

**15 WATT FM TRANSMITTER (BUILT)** 4 stage high power, preamp required 12-18vdc, can use ground plane, yagi or open dipole. £69 ref 1021.

**HUMIDITY METER KIT** Builds into a precision LCD humidity meter, 9 lc design, pcb, lcd display and all components included. £29

**PC TIMER KIT** Four channel output controlled by your PC, will switch high current mains with relays (supplied). Software supplied so you can program the channels to do what you want whenever you want. Minimum system configuration is 286, VGA, 4.1, 640k, serial port, hard drive with min 100k free. £24.99

**MAGNETIC MARBLES** They have been around for a number of years but still give rise to curiosity and amazement. A pack of 12 is just £3.99 ref G/IR20

**NICKEL PLATING KIT** Professional electroplating kit that will transform rusting parts into showpieces in 3 hours! Will plate onto steel, iron, bronze, gunmetal copper, welded silver soldered or brazed joints. Kit includes enough to plate 1,000 sq inches. You will also need a 12v supply, a container and 2 12v light bulbs. £45 ref NIK39

**Miniature adjustable timers, 4 pole c/o output 3A 240v, HY1230S, 12VDC adjustable from 0-30 secs. £4.99**

**HY1260M, 12VDC adjustable from 0-60 mins. £4.99**

**HY2405S, 240v adjustable from 0-5 secs. £4.99**

**HY24060m, 240v adjustable from 0-60 mins. £4.99**

**BUGGING TAPE RECORDER** Small voice activated recorder, uses micro cassette complete with headphones. £28.99 ref MAR29P1

**POWER SUPPLY** fully cased with mains and o/p leads 17v DC 900mA output. Bargain price £5.99 ref MAG6P9

**COMPOSITE VIDEO KIT**. Converts composite video into separate H sync, V sync, and video. 12v DC. £12.00 REF: MAG8P2.

**FUTURE PC POWER SUPPLIES** These are 295x135x60mm, 4 drive connectors 1 mother board connector. 150watt, 12v fan, iec inlet and on/off switch. £12 Ref EF6

**VENUS FLY TRAP KIT** Grow your own carnivorous plant with this simple kit £3 ref EF34.

**6"x12" AMORPHOUS SOLAR PANEL** 12v 155x310mm 130mA. Bargain price just £5.99 ea REF MAG6P12

**FIBRE OPTIC CABLE BUMPER PACK** 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG13P1

**ROCK LIGHTS** Unusual things these, two pieces of rock that glow when rubbed together! believed to cause rain! £3 a pair Ref EF29.

**3' by 1' AMORPHOUS SOLAR PANELS** 14.5v, 700mA 10 watts, aluminium frame, screw terminals, £55 ref MAG45.

**ELECTRONIC ACCUPUNCTURE KIT** Builds into an electronic version instead of needles! good to experiment with. £9 ref 7P30

**SHOCKING COIL KIT** Build this little battery operated device into all sorts of things, also gets worms out of the ground! £9 ref 7P36.

**HIGH POWER CATAPULTS** Hinged arm brace for stability, tempered steel yoke, super strength latex power bands. Departure speed of ammunition is in excess of 200 miles per hour! Range of over 200 metres! £8.99 ref R/9.

**COMPAQ POWER SUPPLIES WITH 12V DC FANS** Ex equipment psu's, some ok some not but worth it for the fan alone! probably about 300 watt PC unit with IEC input. £3.50 each ref CQ1

**BALLON MANUFACTURING KIT** British made, small biob blows into a large, longlasting balloon, hours of fun! £3.99 ref G/IE99R

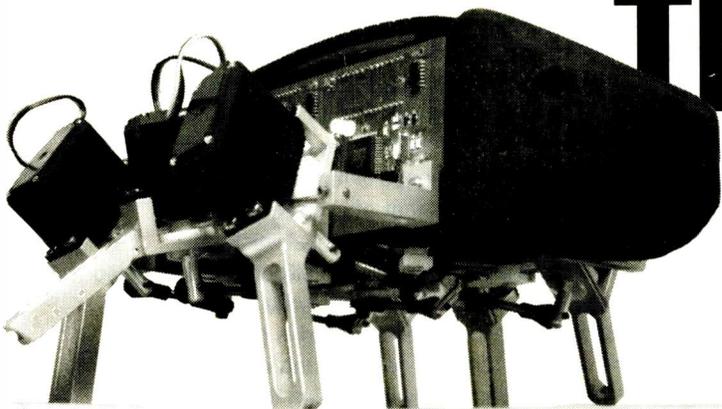
**9-0-9V 4A TRANSFORMERS**, chassis mount. £7 ref LOT19A.

**MEGA LED DISPLAYS** Build your self a clock or something with these mega 7 seg displays 55mm high, 38mm wide. 5 on a pcb for just £4.99 ref LOT16 or a bumper pack of 50 displays for just £29 ref LOT17.

**SOLID STATE RELAYS**  
CMP-DC-200P 3-32vdc operation, 0-200vdc 1A £2.50  
SMT20000/3 3-24vdc operation, 28-280vac 3A £4.50

**FREE COLOUR CATALOGUE  
WITH EVERY ORDER**

**WE BUY SURPLUS STOCK  
FOR CASH  
SURPLUS STOCK LINE 0802 660335**



# The Secret

**Robots are playing an increasingly pivotal part in modern life. Now some people fear that they will become a 'new species' that will take us over. Douglas Clarkson examines the evidence.**

# of the Machines

**A**rtificial intelligence is a rapidly expanding component of our society. As an integral component of economic competitiveness, market economies prosper by utilisation, for example, of industrial robots in car assembly lines. There are so many issues raised, for example, by Professor Kevin Warwick's book *March of the Machines* that it is difficult to know where to begin in sampling its many messages. Also, the work of Professor Warwick's group at Reading University tends to handle topics in a constructive way - finding ways and means to develop a specialist wheelchair for the disabled. There are indications, however, within the world military sector, of massive investment and development of 'intelligent systems' to wage war. This means that by no means all R & D is communicated to the public at large.

Professor Warwick's book is deliberately slanted to be read by someone with no background in science, so its technical and scientific content is deliberately limited. This can be something of a disappointment for those able to find their way around publications with more technical content.

Professor Warwick, shown with one of the 'Seven Dwarfs' in figure 1, has in a way singled out identity in a particular aspect - autonomous units, each with an apparent identity of its own - in order to isolate and demonstrate the potential for machine independence and development. Books like *March of the Machines* are more perhaps designed to stimulate a debate than provide definitive predictions about the future. The book airs several key questions - none more important than an understanding of the Nature of Self.

## The nature of Self

A central question in the study of machine intelligence relates to the nature of human consciousness. There are expressions of belief that the human brain is no more than a complex telephone exchange which is connected across various interfaces to a higher energy or non physical spiritual force. There is also the viewpoint that 'neurons are us' - we are no more and no less than our vast tangled web of brain cells. This is the viewpoint of 'strong' Artificial Intelligence, which maintains that, if the human identity is no more than a complex collection of miniature electrical circuits, then it should eventually be able to copy this and replicate human faculties. Also, according to this theory, even circuits of intermediate

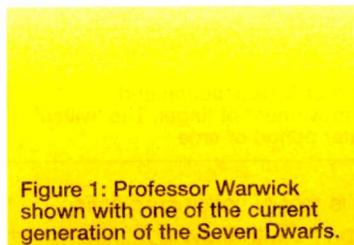
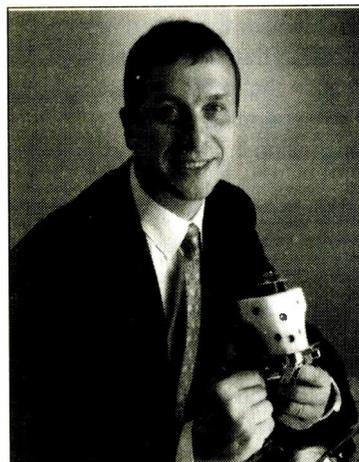


Figure 1: Professor Warwick shown with one of the current generation of the Seven Dwarfs.



complexity would have some degree of human type characteristics.

According to the belief in the higher spiritual force theory of consciousness, or 'magic' theory, it will never be possible to develop a 'self aware' robotic machine because the element of higher human development - will and consciousness - cannot be replicated in purely physical form. It is in the progression of machine 'cleverness', however, that many in this field anticipate an apparent attribute or mimic of machine self awareness. It will, however, be a clever deception.

## The mind of the mathematician

The Artificial Intelligence community is too busy designing, programming and training AI systems to spend much of their time engaging in philosophical thought of the nature of awareness and consciousness. But they do prompt mathematicians like Roger Penrose to put a shot across the bows of the barge of 'strong AI' - that bastion of belief that considers that consciousness is no more than the activation of vast arrays of neural connections in our brain. Twinned with this belief is the assumption that if a connected system can be made to process algorithms as complex as those taking place in the human brain, then it too will be conscious. Penrose's book, the *Emperor's New Mind* is effectively a move back to the common sense approach that consciousness is something quite separate and different from simulated sensory spikes in silicon. In tracing through observations across diverse fields of mathematics, physics, neurophysiology and computing, Professor Penrose presents some interesting observations.

One of these is that in identification of the 'road map' of sensory mappings in the brain, where, for example, the area is activated that causes the right arm to move, this will be done without the wish to move the left arm being aroused. In one conscious patient, the right arm in fact tried to stop such 'involuntary' motion taking place.

While the site selected was the origin of nerve pathways to control the arm, it was not the centre which controlled the 'will' to undertake such activity.

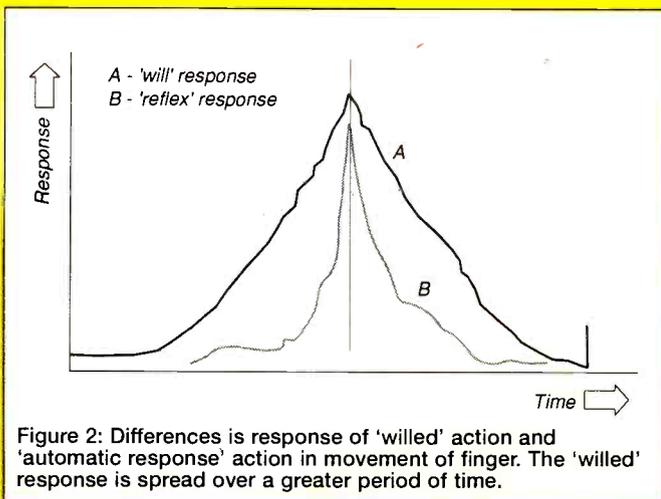


Figure 2: Differences in response of 'willed' action and 'automatic response' action in movement of finger. The 'willed' response is spread over a greater period of time.

Another subtle observation is that of anticipated action - such as wiggling a finger compared with moving a finger in response to a buzzer or a light signal. The differences in response are indicated in figure 2, where the 'willed' action takes place over a longer time period than the 'response' action. This is perhaps an indication that more interesting differences could be detected by separating actions originating in 'will' and those originating in 'reflex' and 'response'?

One very interesting observation of general interest is the phenomenon of 'blindsight'. Where the retinal function is intact but damage occurs to the visual cortex so that vision is lost over part of the visual field, some sensory awareness can in fact be retained since visual data is also routed to other centres in the brain. This was proved by a patient with this problem correctly 'guessing' simple geometrical shapes presented in the visual field that was 'missing'. This suggests therefore, that the brain is undertaking some sort of image assessment and characterisation that is not directly related to seeing objects.

Leastways, Professor Penrose gives us plenty to think about. It is an indication that the pendulum is moving steadily away from a Newtonian model of the universe and with it strong artificial intelligence concepts of the nature of human consciousness. Professor Penrose, however, has not actually stepped outside the stockade of 20th century physics, though he has climbed its highest tower and gazed into new territories yet to be discovered.

### The march of popular science

The area of machine consciousness and emerging theories of cosmology is very much the core material of an expanding core of books appearing under 'Popular Science'. One interesting contribution is *'Who's Afraid of Schrodinger's Cat'* by Ian Marshall and Darah Zohar, which acts like a road map of old, transitional and new theories. *The Life of the Cosmos* by Lee Smolin provides a perspective on Newtonian Science and

emerging views of cosmology and related matters. *Goodbye Descartes* by Keith Devlin continues in the same vein. In a reinforcement of an earlier book, Hubert Dreyfus has recently published *What Computers Still Can't Do* to remind us that computers in the 1990s are fundamentally not really any smarter than they were in the 1970s. Are these titles evidence that thinking on artificial intelligence is really moving away from equating all human faculties to that of connected neural circuits? Most book publishers at least must think so.

The heightened debate on machine intelligence comes also at an interesting phase in science which, while fascinated as ever with the diversity of the physical world is giving some space to more esoteric topics. The Big Bang is one thing and the first three minutes was a very interesting time, but now the attention of physicists is being directed on conditions before the Big Bang. Why did it take place? This takes science into a plane of thought rather than into a profile of measuring observables. Once science sets forward questions to be asked, it tends to be persistent and not let go of them. In looking for new answers, physicists have been fundamentally influenced by their discoveries in quantum physics.

### Concepts of Self Awareness

There are, however, some problems in basic understanding of sensory awareness. It is one thing to understand how the eye - retina - visual cortex can process a series of nerve impulses, quite another to understand how this is transformed to something that we can see. Seeing is just not a process of receiving a processed series of nerve signals - it is about an awareness of seeing. Likewise with hearing - yes, we can understand how the cochlear microphonic signal is created. The question is really: how are these signals translated into an awareness of hearing? It is this awareness of the senses - awareness of being - that remains a stubborn question and is really at the core of machine 'awareness' studies.

To thus make references to machines becoming self-aware touches on some very deep philosophical issues that certainly deserve to be addressed diligently. It is quite convenient to dismiss the whole argument and say that human beings have no real awareness of themselves and that what the human brain can do machines will one day do better.

There is also a paradox in being self-aware. The possession of self-awareness may provide, potentially, awareness of a more expansive world beyond our own immediate awareness. Thus while we are aware of ourselves, and go about our business, there is also the interaction, albeit at a subconscious level, with more expansive dimensions. So the question of self awareness on a non physical level has massive implications for future theories of Everything.

The question, however, is how can scientific diligence be extended to areas that as yet have no formal acknowledgement. We must leave that, however, to new generations of scientists to grapple with. It is certainly a paradox, however, that we may know more of the existence of black holes in distant spiral galaxies billions of light years distant than we do of our own inherent nature - self-mind-brain nature.

### The drive for self-awareness

It should be borne in mind, however, that homo sapiens has primarily through genetic development acquired a highly developed sensory processing system to allow him to cope and survive in his environment. As the prime rivals and threats to his existence possessed roughly equivalent systems, but were perhaps stronger, faster or had bigger

teeth, his compliment of senses was adequate for the job. It has been argued that this trend has resulted from the need to be successful, to stand a greater chance of surviving.

Another viewpoint on this process is the interpretation that one of the prime drives of evolution appears to be the creation of species that are increasingly self aware. This is a fact noted in evolution that brain sizes have increased across numerous species including our own. One attribute of mankind's handiwork has been to seek to manifest a degree of sophistication and complexity in his technological creations. There is now even the theory that the physical constants of the universe have been so devised that life forms - such as us - can exist within it. The Anthropic Cosmological Principle by John Barrow and Frank Tipler is a book very much for the physicist and which provides a conducted tour of physical laws and relationships to provide some perspective on what they all add up to in this context.

### The Higher Self model

When commentators reference the 'magic' theory, this is usually without a great degree of specificity of detail. It is described almost as a factor X which may be present in some way but, its attributes are not distinct. This does not help us try to work out in some way how consciousness may operate. By trawling through mainstream esoteric philosophies, it is possible to be slightly more specific about what this could entail.

This particular model, highlighted in figure 3, is a condensation of various esoteric traditions, some quite ancient, some more relatively recent which try to place the real human identity in some perspective.

The physical body is well known to us. According to the 'magic' theory, this is considered to be directly linked to the

etheric body, which due to its vibrational characteristics is generally invisible to us. There is also a body elemental, a structure closely linked to the needs of the physical body. This aspect has also been linked in some instances to the emotional makeup.

There are other vibrational states above the etheric which are similarly invisible. Energy is applied to the etheric body at various points of contact - the chakras - with the principle ones identified on the crown of the head, the brow, the throat, the heart, the solar plexus, the spleen and the base of the spine.

Various classification schemes may include additional centres. In this context, the physical body is very much a system sustained by energy systems which for most individuals are apparently undetectable.

A key aspect of the 'magic' theory interpretation is the interaction between the brain and etheric body and higher components. Thus an expression of will which originates above the etheric, for example, to move a finger is communicated through the etheric interface to the brain which in turn duly activates the neurons in the brain to move the finger. This level of control requires the correct part of the brain to be stimulated to undertake the required action.

Scientists have been able to use techniques such as PET (Positron Emission Tomography) and MRI (Magnetic Resonance Imaging) to identify brain activity associated with a range of processes such as reading aloud or squeezing a rubber ball. In this aspect, however, there are two paths of information. One is to cause the stimulation to take place and the other is the sensory feedback resulting from the stimulus. It is quite simple, to stimulate muscles by activating elements of the cerebral cortex. This is in fact the way in which a 'road map' of the brain's mapping system is determined. This excitation, however, does not activate the will to initiate the various motor responses - only the action.

It would be quite interesting, therefore to seek to map the points of contact of the will within the brain.

### Human Sensory Extensions

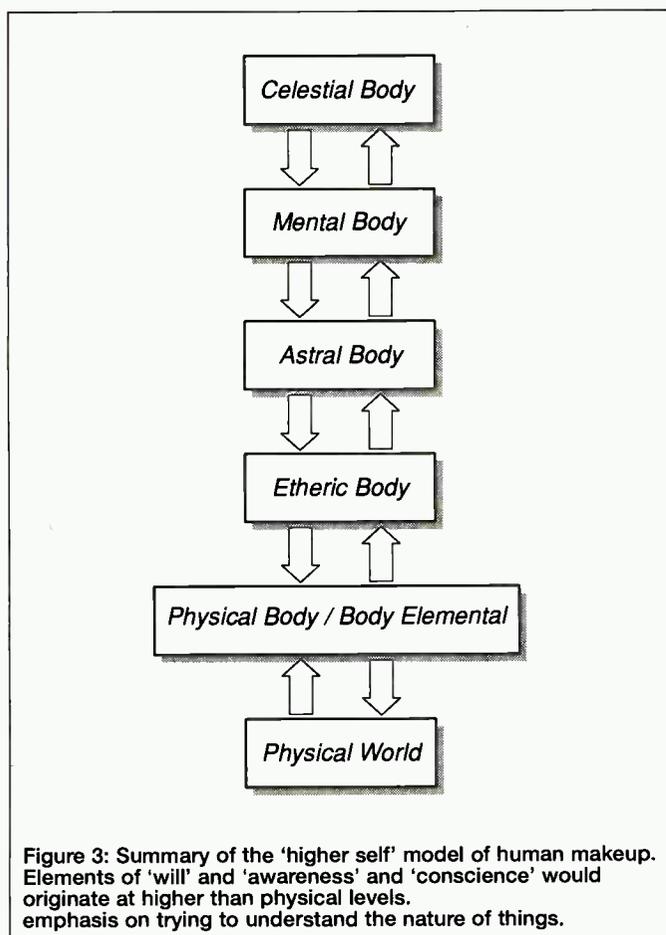
A favourite topic of science fiction writers is the concept of machines more directly participating in our neural or sensory processes. One of the most direct approaches to this is that of the cochlear implant, where external sounds are detected by conventional microphone and processed and fed along the pathway of the Organ of Corti within the cochlea where electrodes make contact with nerve fibres which in turn are connected to auditory centres in the brain. There is in fact, no direct connection between the outside world and the inner ear. This is achieved by inductive coupling.

This development is therefore very much showing the way forward. While various groups are working on the artificial retina, this is still several years away at best.

### The Robots at Reading

The optimising of neural network parameters can be directly considered as a learning process. Robots developed at Reading, however, have generally a low number of effective neurons - the latest generation of the Seven Dwarfs with the equivalent of 500.

The topical third generation of Seven Dwarfs robots at Reading University, shown in a group in figure 4, have been established with the following attributes:



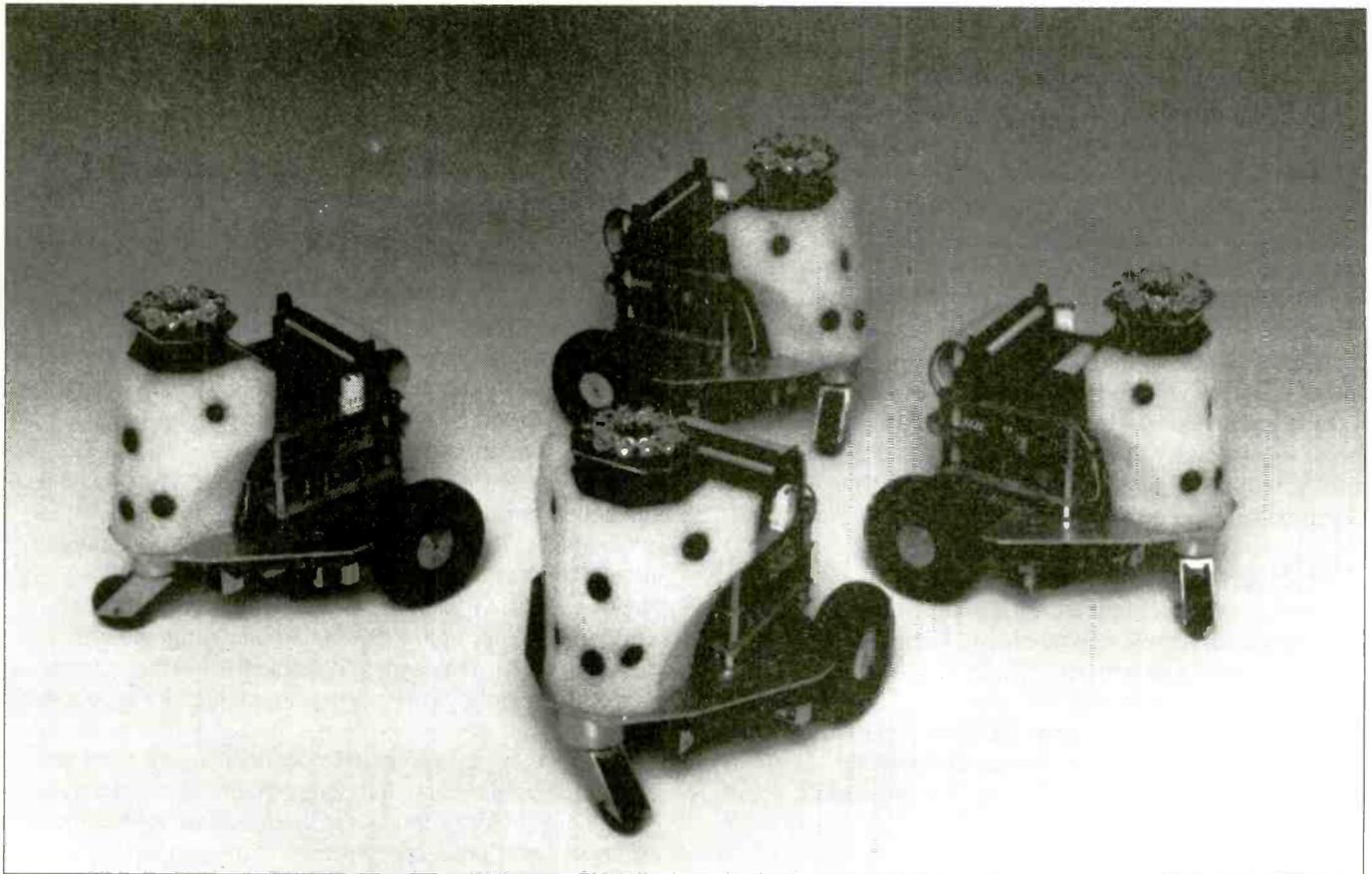


Figure 4: Group of current generation of the Seven Dwarfs (the third).

- a) avoid obstacles as determined by two front sensing ultra sound detectors
- b) dock in a recharge bay when power is required
- c) opt to be a 'leader' robot if no other robots near
- d) follow the 'leader' signal of greatest strength if not already a 'leader'

In their design, the left and right rear wheels can move independently. On top of each unit is located a mini array of infra red transmitters with infra detectors on the front portion of the unit. Each robot is provided with its own carrier frequency on which is superimposed pulses of information. A left and right side ultrasonic detector is used to provide two independent object locating signals.

An early version of Bashful is shown in figure 5.

The relevance of this set of robots is that their sensory systems, number of neural network processing elements and desired behaviour are all in balance so that they form a system that trains towards a 'smart' conclusion.

Elma is a six legged walking robot which has evolved from the previous design of Walter. Elma has sensors on her legs which allows her to detect the weight distribution along her frame. These signals are in turn routed to her processing brain which contains around 100 neurons and which maintains her stability. Elma is much more stable in walking than apparently Walter ever was. At present Elma is controlled by radio link with directions being sent to her for example to make for a given location but to avoid certain areas of the immediate area.

At present the self learning modes of neural network training is being used to train Elma to walk to that she can negotiate difficult surfaces. It is anticipated that the command system will be fully incorporated within future versions of Elma. Thus wherever Elma goes, she learns

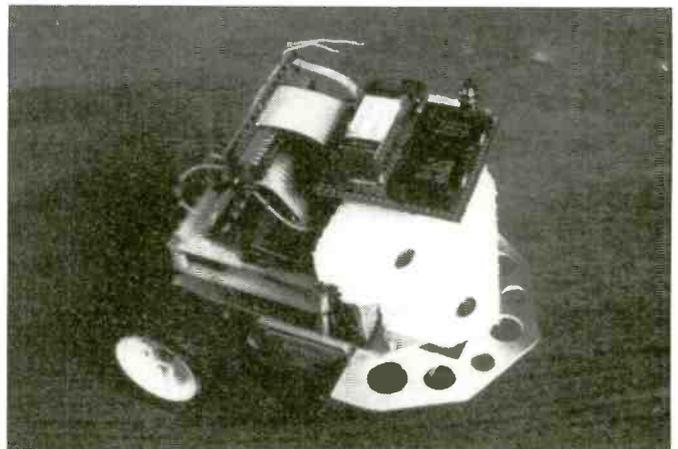


Figure 5: Close up of Bashful when he was first given a new 'neural' brain that could be simply plugged in.

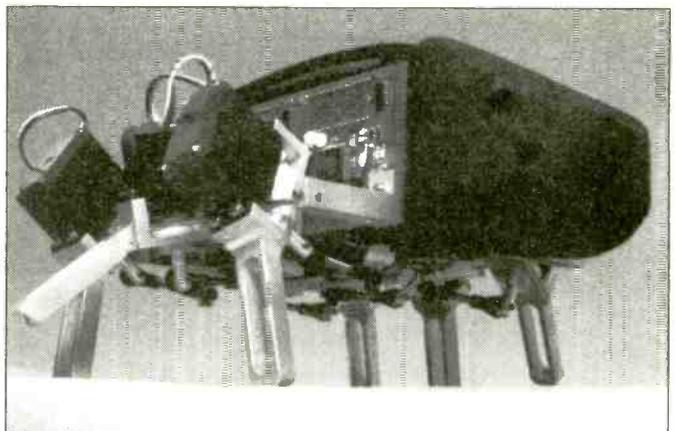


Figure 6: View of Elma, which is at present controlled remotely but which learns through training of neural network circuits to walk over difficult terrain.

Surplus always wanted for cash!

# THE ORIGINAL SURPLUS WONDERLAND!

THIS MONTH'S SELECTION FROM OUR VAST EVER CHANGING STOCKS

Surplus always wanted for cash!

## LOW COST PC's -

### SPECIAL BUY 'AT 286'

40Mb HD + 3Mb Ram



LIMITED QUANTITY only of these 12MHz HI GRADE 286 systems Made in the USA to an industrial specification, the system was designed for total reliability. The compact case houses the motherboard, PSU and EGA video card with single 5 1/4" 1.2 Mb floppy disk drive & integral 40Mb hard disk drive to the front. Real time clock with battery backup is provided as standard. Supplied in good used condition complete with enhanced keyboard, 640K + 2Mb RAM, DOS 4.01 and 90 DAY Full Guarantee. Ready to Run!  
Order as HIGRADE 286 **ONLY £129.00 (E)**

Optional Fitted extras: VGA graphics card £29.00  
1.4Mb 3 1/2" floppy disk drive (instead of 1.2 Mb) £19.95  
Wordperfect 6.0 for Dos - when 3 1/2" FDD option ordered £22.50  
NE2000 Ethernet (thick, thin or twisted) network card £29.00

## LOW COST 486DX-33 SYSTEM

Limited quantity of this 2nd year, superb small size desktop unit. Fully featured with standard SMM connectors 30 x 72 pin. Supplied with keyboard, 4 Mb of RAM, SVGA monitor output, 256K cache and integral 120 Mb IDE drive with single 1.44 Mb 3.5" floppy disk drive. Fully tested and guaranteed. Fully expandable  
Only **£399.00 (E)**  
Many other options available - call for details.

## FLOPPY DISK DRIVES 3 1/2" - 8"

5 1/4" or 3 1/2" from only £18.95!

Massive purchases of standard 5 1/4" and 3 1/2" drives enables us to present prime product at industry beating low prices! All units (unless stated) are BRAND NEW or removed from often brand new equipment and are fully tested, aligned and shipped to you with a 90 day guarantee and operate from standard voltages and are of standard size. All are IBM-PC compatible (if 3 1/2" supported on your PC).

3 1/2" Panasonic JU363/4 720K or equivalent RFE £24.95(B)  
3 1/2" Mitsubishi MF355C-L 1.4 Meg. Laptops only £25.95(B)  
3 1/2" Mitsubishi MF355C-D 1.4 Meg. Non laptop £18.95(B)  
5 1/4" Teac FD-55GFR 1.2 Meg (for IBM pc's) RFE £18.95(B)  
5 1/4" Teac FD-55F-03-U 720K 40/80 (for BBC's etc) RFE £29.95(B)  
5 1/4" BRAND NEW Mitsubishi MF501B 360K £22.95(B)  
Table top case with integral PSU for HH 5 1/4" Floppy or HD £195.00(E)  
8" Shugart 800/801 8" SS refurbished & tested £25.00(E)  
8" Shugart 810 8" SS HH Brand New £195.00(E)  
8" Shugart 851 8" double sided refurbished & tested £250.00(E)  
Mitsubishi M2894-63 8" double sided NEW £275.00(E)  
Mitsubishi M2896-63-02U 8" DS slimline NEW £285.00(E)  
Dual 8" cased drives with integral power supply 2 Mb £499.00(E)

## HARD DISK DRIVES

End of line purchase scoop! Brand new NEC D2246 8" 85 Mbyte drive with industry standard SMD interface, replaces Fujitsu equivalent model. Full manual. Only £299.00 or 2 for £525.00 (E)

3 1/2" FUJII FK-309-26 20mb MFM I/F RFE £59.95(B)  
3 1/2" CONNER CP3024 20 mb IDE I/F (or equiv) RFE £59.95(B)  
3 1/2" CONNER CP3044 40mb IDE I/F (or equiv) RFE £69.00(B)  
3 1/2" RODIME R03057S 45mb SCSI I/F (Mac & Acorn) £69.00(B)  
3 1/2" WESTERN DIGITAL 850mb IDE I/F Brand New £185.00(B)  
5 1/4" MINISCARTE 3425 20mb MFM I/F (or equiv) RFE £49.95(B)  
5 1/4" SEAGATE ST-238R 30 mb RLL I/F Refurb £69.95(B)  
5 1/4" CDC 94205-51 40mb HH MFM I/F RFE tested £69.95(B)  
5 1/4" HP 9754B 850 Mb SCSI RFE tested £89.00(B)  
5 1/4" HP C3010 2 Gbyte SCSI differential RFE tested £195.00(B)  
8" FUJITSU M2322K 160Mb SMD I/F RFE tested £195.00(E)  
Hard disc controllers for MFM, IDE, SCSI, RLL etc. from £16.95

## THE AMAZING TELEBOX

Converts your colour monitor into a QUALITY COLOUR TV!



TV SOUND & VIDEO TUNER  
CABLE COMPATIBLE!

The TELEBOX is an attractive fully cased mains powered unit, containing all electronics ready to plug into a host of video monitors made by makers such as MICROVITEC, ATARI, SANYO, SONY, COMMODORE, PHILIPS, TATUNG, AMSTRAD etc. The composite video output will also plug directly into most video recorders, allowing reception of TV channels not normally receivable on most television receivers\* (TELEBOX MB). Push button controls on the front panel allow reception of 8 fully tuneable off air UHF colour television channels. TELEBOX MB covers virtually all television frequencies VHF and UHF including the HYPERBAND as used by most cable TV operators. A composite video output is located on the rear panel for direct connection to most makes of monitor or desktop computer video systems. For complete compatibility - even for monitors without sound - an integral 4 watt audio amplifier and low level Hi Fi audio output are provided as standard.

TELEBOX ST for composite video input type monitors £36.95  
TELEBOX STL as ST but fitted with integral speaker £39.50  
TELEBOX MB Multiband VHF/UHF/Cable/Hyperband tuner £69.95  
For overseas PAL versions state 5 or 6 mHz sound specification.  
\*For cable / hyperband reception Telebox MB should be connected to a cable type service. Shipping cost on all Telebox's is (B)

## DC POWER SUPPLIES

Virtually every type of power supply you can imagine. Over 10,000 Power Supplies Ex Stock  
Call for info / list.

## IC's - TRANSISTORS - DIODES

OBSOLETE - SHORT SUPPLY - BULK

6,000,000 items EX STOCK

For MAJOR SAVINGS - CALL FOR SEMICONDUCTOR HOTLIST

## VIDEO MONITOR SPECIALS

One of the highest specification monitors you will ever see - At this price - Don't miss it!!

Mitsubishi FA3415ETKL 14" SVGA Multisync colour monitor with fine 0.28 dot pitch tube and resolution of 1024 x 768. A variety of inputs allows connection to a host of computers including IBM PC's in CGA, EGA, VGA & SVGA modes. BBC, COMMODORE (including Amiga 1200), ARCHIMEDES and APPLE. Many features: Etched faceplate, text switching and LOW RADIATION MPR specification. Fully guaranteed, supplied in EXCEL- LENT little used condition.  
Tilt & Swivel Base £4.75  
Only **£119 (E)** Order as MITS-SVGA  
VGA cable for IBM PC included.  
External cables for other types of computers CALL

As New - Used on film set for 1 week only!  
15" 0.28 SVGA 1024 x 768 res. colour monitors.  
Swivel & tilt etc. Full 90 day guarantee. £145.00 (E)

Just In - Microvitec 20" VGA (800 x 600 res.) colour monitors. Good SH condition - from £299 - CALL for Info

PHILIPS HCS35 (same style as CM8833) attractively styled 14" colour monitor with both RGB and standard composite 15.625 KHz video inputs via SCART socket and separate phono jacks. Integral audio power amp and speaker for all audio visual uses. Will connect direct to Amiga and Atari BBC computers. Ideal for all video monitoring / security applications with direct connection to most colour cameras. High quality with many features such as front concealed fan controls, VCR correction button etc. Good used condition - fully tested - guaranteed  
Dimensions: W14" x H12 3/4" x 15 1/2" D  
Only **£95 (E)**

PHILIPS HCS31 Ultra compact 9" colour video monitor with standard composite 15.625 KHz video input via SCART socket. Ideal for all monitoring / security applications. High quality, ex-equipment fully tested & guaranteed (possible minor screen burns). In attractive square black plastic case measuring W10" x H10" x 13 1/2" D. 240 V AC mains powered.  
Only **£79.00 (D)**

KME 10" 15M10009 high definition colour monitors with 0.28" dot pitch. Superb clarity and modern styling. Operates from any 15.625 khz sync RGB video source, with RGB analog and composite sync such as Atari, Commodore Amiga, Acorn Archimedes & BBC. Measures only 13 1/2" x 12" x 11". Good used condition.  
Only **£125 (E)**

## 20" 22" and 26" AV SPECIALS

Superbly made UK manufacture. PIL all solid state colour monitors, complete with composite video & optional sound input. Attractive teak style case. Perfect for Schools, Shops, Disco, Clubs, etc. In EXCELLENT little used condition with full 90 day guarantee.

20"....£135 22"....£155 26"....£185 (F)

## SPECIAL INTEREST ITEMS

MITS. FA3445ETKL 14" Industrial spec SVGA monitors £245  
2Kw to 400 Kw - 400 Hz 3 phase power sources - ex stock £90A  
IBM 8230 Type 1, Token ring base unit driver £950  
IBM 53F5501 Token Ring ICS 20 port lobe modules £750  
IBM MAU Token ring distribution panel 8228-23-5050N £95  
AIM 501 Low distortion Oscillator 9Hz to 330KHz, IEEE £550  
Trend DSA 274 Data Analyser with G703(2M) 64 I/O £60A  
Marconi 6310 Programmable 2 to 22 GHz sweep generator £6500  
HP1650B Logic Analyser £3750  
HP3781A Pattern generator & HP3782A Error Detector £90A  
HP APOLLO RX700 system units £950  
HP6621A Dual Programmable GPIB PSU 0-7 V 160 watts £1800  
HP3081A Industria workstation c/w Barcode swipe reader £675  
HP6264 Rack mount variable 0-20V @ 20A metered PSU £675  
HP541212A DC to 22 GHz 40 channel test set £650  
HP7580A A1 8 pen HPGL high speed drum plotter £1850  
EG+G Brookdeal 95035C Precision lock in amp £650  
View Eng. Mod 1200 computerised inspection system £90A  
Ling Dynamics 2Kw programmable vibration test system £90A  
Computer controlled 1056 x 560 mm X Y table & controller £1425  
Kethley 590 CV capacitor / voltage analyser £90A  
Racal ICR40 dual 40 channel voice recorder system £3750  
Fiskers 4K5VA 3 ph On Line UPS - New batts Dec.1995 £9500  
ICI R5030UV34 Cleanline ultrasonic cleaning system £90A  
Mann Tally MT645 High speed line printer £2200  
Intel SBC 486/133SE Multibus 486 system, 8Mb Ram £1200  
Zeta 3220-05 A0 4 pen HPGL fast drum plotters £1150  
Nikon HFX-11 (Ephiphot) exposure control unit £1450  
Motorola VME Bus Boards & Components List. SAE / CALL £90A  
Trilo 0-18 vdc linear, metered 30 amp bench PSU. New £550  
Fujitsu M3041R 600 LPM band printer £1950  
Fujitsu M3041D 600 LPM printer with network interface £1250  
Perkin Elmer 2998 Infrared spectrophotometer £90A  
VG Electronics 1035 TELETEXT Decoding Marger Meter £3750  
Andrews LARGE 3.1 m Satellite Dish & mount (For Voyager) £950  
Sekonic SD 150H 18 channel digital Hybrid chart recorder £1995  
TAYLOR HOBSON Tallysur amplifier / recorder £750  
System Video 1152 PAL waveform monitor £485  
Test Lab - 2 mtr square quietised acoustic test cabinets £300  
Kenwood 9601 PAL Vectorscope - NEW £650  
Please call for further details on the above items

## 19" RACK CABINETS

Superb quality 6 foot 40U  
Virtually New, Ultra Smart  
Less than Half Price!

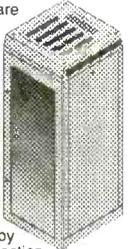


Top quality 19" rack cabinets made in UK by Optima Enclosures Ltd. Units feature designer, smoked acrylic lockable front door, full height lockable half louvered back door and louvered removable side panels. Fully adjustable internal fixing struts, ready punched for any configuration of equipment mounting plus ready mounted integral 12 way 13 amp socket switched mains distribution strip make these racks some of the most versatile we

have ever sold. Racks may be stacked side by side and therefore require only two side panels to stand singly or in multiple bays. Overall dimensions are: 77 1/2" H x 32 1/2" D x 22" W. Order as:  
OPT Rack 1 Complete with removable side panels. £335.00 (G)  
OPT Rack 2 Rack, Less side panels £225.00 (G)

## 32U - High Quality - All steel RakCab

Made by Eurocraft Enclosures Ltd to the highest possible spec, rack features all steel construction with removable side, front and back doors. Front and back doors are hinged for easy access and all are lockable with five secure 5 lever barrel locks. The front door is constructed of double walled steel with a 'designer style' smoked acrylic front panel to enable status indicators to be seen through the panel, yet remain unobtrusive. Internally the rack features fully slotted reinforced vertical fixing members to take the heaviest of 19" rack equipment. The two movable vertical fixing struts (extras available) are pre punched for standard 'cage nuts'. A mains distribution panel internally mounted to the bottom rear, provides 8 IEC 3 pin Euro sockets and 1 x 13 amp 3 pin switched utility socket. Overall ventilation is provided by fully louvered back door and double skinned top section with top and side louvres. The top panel may be removed for fitting of integral fans to the sub plate etc. Other features include: fitted castors and floor levelers, pre-punched utility panel at lower rear for cable / connector access etc. Supplied in excellent, slightly used condition with keys. Colour Royal blue. External dimensions mm=1625H x 635D x 603W. (64" H x 25" D x 23 3/4" W)  
Sold at LESS than a third of makers price !!



A superb buy at only **£195.00 (G)**

Over 1000 racks - 19" 22" & 24" wide  
3 to 44 U high. Available from stock !!  
Call with your requirements.

## TOUCH SCREEN SYSTEM

The ultimate in 'Touch Screen Technology' made by the experts - MicroTouch - but sold at a price below cost !! System consists of a flat translucent glass laminated panel measuring 29.5 x 23.5 cm connected to an electronic controller PCB. The controller produces a standard serial RS232 or TTL output which continuously gives simple serial data containing positional X & Y co-ordinates as to where a finger is touching the panel - as the finger moves, the data instantly changes. The X & Y information is given at an incredible matrix resolution of 1024 x 1024 positions over the entire screen size !! A host of available translation software enables direct connection to a PC for a myriad of applications including: control panels, pointing devices, POS systems, controllers for the disabled or computer un-trained etc. Imagine using your finger with 'Windows', instead of a mouse !! (a driver is indeed available !!) The applications for this amazing product are only limited by your imagination!! Complete system including Controller, Power Supply and Data supplied at an incredible price of only: **£145.00 (B)**  
Full MICROTOUCH software support pack and manuals for IBM compatible PC's £29.95 RFE - Tested

## LOW COST RAM & CPU'S

INTEL 'ABOVE' Memory Expansion Board. Full length PC-XT and PC-AT compatible card with 2 Mbytes of memory on board. Card is fully selectable for Expanded or Extended (286 processor and above) memory. Full data and driver disks supplied. RFE. Fully tested and guaranteed. Windows compatible. £59.95(A1)  
Half length 8 bit memory upgrade cards for PC AT XT expands memory either 256k or 512k in 64k steps. May also be used to fill in RAM above 640k DOS limit. Complete with data.  
Order as: XT RAM UG. 256k. £34.95 or 512k £39.95 (A1)

SIMM SPECIALS  
1 MB x 9 SIMM 9 chip 120ns Only £16.50 (A1)  
1 MB x 9 SIMM 3 chip 80 ns £21.50 or 70ns £22.95 (A1)  
1 MB x 9 SIMM 9 chip 80 ns £21.50 or 70ns £23.75 (A1)  
4 MB 70 ns 72 pin SIMM - with parity. Only £55.00 (A1)  
INTEL 486-DX33 CPU £55.00. INTEL 486-DX66 CPU £69.00 (A1)  
FULL RANGE OF CO-PROCESSOR'S EX STOCK - CALL FOR LIST

## FANS & BLOWERS

EPSON D0412 40x40x20 mm 12v DC £7.95 10 / £65  
PAPST TYPE 612 60x60x25 mm 12v DC £8.95 10 / £75  
MITSUBISHI MMF-D6D12D 60x60x25 mm 12v DC £4.95 10 / £42  
MITSUBISHI MMF-08C12D 80x80x25 mm 12v DC £5.25 10 / £49  
MITSUBISHI MMF-09B12D 92x92x25 mm 12v DC £5.95 10 / £53  
PANSKAKE 12-3.5 92x92x19 mm 12v DC £7.95 10 / £69  
EX-EQUIP AC fans. ALL TESTED 120 x 120 x 38 mm specify 110 or 240 v. £6.95. 80 x 80 x 38 mm - specify 110 or 240 v. £5.95  
IMHOF B26 1900 rack mnt 30 x 19" Blower 110/240v NEW £79.95  
Shipping on all fans (A). Blowers (B). \$5,000 Fans Ex Stock CALL

Issue 13 of Display News now available - send large SAE - PACKED with bargains!



ALL MAIL & OFFICES  
Open Mon-Fri 9.00-5.30  
Dept ET. 32 Biggin Way  
Upper Norwood  
LONDON SE19 3XF

LONDON SHOP  
Open Mon - Sat 9:00 - 5:30  
215 Whitehorse Lane  
South Norwood  
On 68A Bus Route  
N. Thornton Heath &  
Selhurst Park SR Rail Stations

NEW DISTEL©  
The Original  
FREE On line Database  
Info on 20,000+ stock items!  
RETURNING SOON!

ALL ENQUIRIES  
**0181 679 4414**  
FAX 0181 679 1927



All prices for UK Mainland. UK customers add 17.5% VAT to TOTAL order amount. Minimum order £10. Bona Fide account orders accepted from Government, Schools, Universities and Local Authorities - minimum account order £50. Cheques over £100 are subject to 10 working days clearance. Carriage charges (A)=£3.00, (A1)=£4.00, (B)=£5.00, (C)=£6.50, (D)=£12.00, (E)=£15.00, (F)=£18.00, (G)=CALL. Allow approx 6 days for shipping - faster CALL. Scotland surcharge CALL. All goods supplied to our Standard Conditions of Sale and unless stated guaranteed for 90 days. All guarantees on a return to base basis. All rights reserved to change prices / specifications without prior notice. Orders subject to stock. Discounts for volume. Top CASH prices paid for surplus goods. All trademarks etc acknowledged. © Display Electronics 1996. E & O E. 06/6

how to walk better and is more prepared for awkward terrain that may be encountered in the future.

Elma, shown in figure 6, and also on the front cover of Professor Warwick's book, could have practical applications in working in dangerous environments - such as decommissioning nuclear power stations, mapping minefields and autonomous vehicles for space exploration, for example on the surface of Mars. European Space Agency, please take note. In a mechanical sense, Elma is considerably more complex than the Seven Dwarfs. The relevance of a device such as Elma is that it learns to cope with problems of the real world, by adapting its neural network to cope with real problems.

## Neural networks and learning

It is the 'self learning' mode of neural network interaction that has principally been developed at Reading. Figure 7 indicates a typical neural network, with a row of inputs feeding forward through intermediate lines to a line of outputs. A training set of data is required to establish the function of the network. With initially random weights added, in the example of one of Professor Warwick's robots, the robot will move about, encounter other robots and other objects. Each of the lines indicated represents a specific value of weighting - with 50 defines in this particular example.

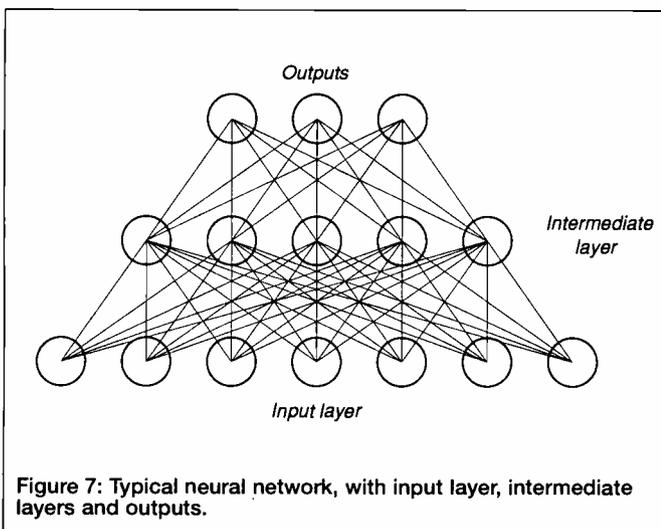


Figure 7: Typical neural network, with input layer, intermediate layers and outputs.

In time through a series of interactions with its environment, the robot will learn not to bump into things. The parameters of the weightings will tend to stabilise, for a particular robot and environment, at a given value. If after a process of learning, all the weightings are reset to the same initial set of random values, and the robot begins to learn all over again, then the final set of weightings will be comparable but not identical since the weightings will reflect exactly what happened to the robot on its way. It is also possible to reset one weighting to a random value and then observe the robot make mistakes as it relearns a more appropriate value of the weighting.

Of course, it is possible to load a set of learned parameters from one robot, transfer these to an identical but untrained robot and the new robot will behave as if it had been trained. By networking robots either in physical close proximity or, for example, across the Internet, it is possible to collate and speed up the learning process. This training across the Internet has in fact been demonstrated successfully.

## Raising the AI Profile

The work at Reading has in some ways been centred on developing autonomous devices - self powered through batteries. This has allowed observation of learning modes of such devices and with also the added bonus that such devices are fun to watch and excellent for demonstrations. To the public, one inspection of the robots at close hand is worth hours of lectures on the technology of such devices. One of the achievements at Reading has been to make such technology much more visible and allow it to be captured by today's 'sound byte' media brigade, hungry, as ever, for unusual images.

In conventional approaches to design and construction of electronic systems, the unit is designed, tested and usually after a few minor modifications put into use. In the way that neural networks are developing, more complex development systems are able to adapt their network design to cope with improved power of problem-solving within a given framework. There is not only an ability to solve problems within a given framework, but there is scope to improve the power of the problem solving algorithm. This can involve optimising neural network topologies. This level of self driven enhancement within a framework of increasing complexity of function is seen also as a component of the ability of machine smartness and effectiveness to be enhanced.

So far at Reading we have the aspect of small autonomous objects responding to a very basic subset of environmental requirements and directives, really demonstrating potential usefulness rather than actual usefulness itself.

## Elements of Control

In this sense, robots will remain extensions of our will. If some deranged individual develops a highly developed technology which is designed to inflict death and destruction on fellow human beings using robot technology, then this is not because the systems that wreak the havoc are self-aware and know what they are doing. As any software designer knows, however, the more complex systems become, the more liable they are to develop or manifest errors. So there is also the finite possibility that a system developed with positive intent could fail or become unsafe simply through error in its design at some level.

There is also a paradox here. If systems become self adapting and modify their neural network topology to increase complexity and general processing ability, then can such changes be validated as they take place to ensure system integrity? In this sense, the more it modifies its design to do things in a more efficient way, the more there is a potential risk of error.

## AI Propaganda

There is also a discrete psychological approach to the development of robotic technology. This tends to demonstrate that after all, *homo sapiens* is nothing startling. Only a few generations of applied technology will produce machines that are much better at everything we have been trying to do.

A sober warning from Professor Warwick is that before long we will lose control of our robot inventions and they will become our masters. All things are possible. If you look carefully, however, at the vast legislative bureaucracy of the European Union, taking extreme care to define the limits of milk content in 'ice cream' then it would be unlikely that the EU would readily sanction the development and release of super robots that would dominate us.

**THERE IS ONE DANGER YOU CAN'T SEE, HEAR, SMELL OR FEEL- ITS RADIATION. THERE ARE OVER 10,000 SHIPMENTS OF RADIOACTIVE MATERIAL IN THE UK EVERY YEAR BY ROAD AND RAIL! WOULD ANYBODY TELL YOU OF A RADIATION LEAK?**  
**NEW GEIGER COUNTER IN STOCK** Hand held unit with LCD screen, auto ranging, low battery alarm, audible click output. New and guaranteed. £129 ref GE1

**RUSSIAN BORDER GUARD BINOCULARS £1799** Probably the best binoculars in the world ring for colour brochure.

**RUSSIAN MULTIBAND WORLD COMMUNICATIONS RECEIVER** Exceptional coverage of 9 wave bands, (5 short, 1 LW, 1FM, 1MW) internal ferrite and external telescopic aerials, mains/battery. £45 ref VEGA

**NEW LASER POINTERS** 4.5mw, 75 metre range, hand held unit runs on two AA batteries (supplied) 670nm £29 ref DEC49

**HOW TO PRODUCE 35 BOTTLES OF WHISKY FROM A SACK OF POTATOES** Comprehensive 270 page book covers all aspects of spirit production from everyday materials. Includes construction details of simple stills etc. £12 ref MS3

**NEW HIGH POWER MINI BUG** With a range of up to 800 metres and a 3 days use from a PP3 this is our top selling bug! less than 1" square and a 10m voice pickup range £28 Ref LOT102.

**BUILD YOUR OWN WINDFARM FROM SCRAP** New publication gives step by step guide to building wind generators and propellers. Armed with this publication and a good local scrap yard could make you self sufficient in electricity! £12 ref LOT81

**PC KEYBOARDS** PS2 connector, top quality suitable for all 286/386/486 etc £10 ref PCKB 10 for £65

**NEW LOW COST VEHICLE TRACKING TRANSMITTER KIT £29** range 1.5-5 miles, 5,000 hours on AA batteries, transmits info on car direction, left and right turns, start and stop information. Works with any good FM radio. £29 ref LOT101a

**HIGH SECURITY ELECTRIC DOOR LOCKS** Complete brand new Italian lock and latch assembly with both Yale type lock (keys inc) and 12v operated deadlock £10 ref LOT99

**\*NEW HIGH POWER WIRELESS VIDEO AND AUDIO BUG KIT 1/2 MILE RANGE** Transmits video and audio signals from a miniature CCTV camera (included) to any standard television! Supplied with telescopic aerial. £169

**CCTV PAN AND TILT KIT** Motorize your CCTV camera with this simple 12vdc kit. 2 hermetically sealed DC linear servo motors 5mm threaded output 5secs stop to stop, can be stopped anywhere, 10mm travel, powerful. £12 ref LOT125

**GPS SATELLITE NAVIGATION SYSTEM** Made by Garmin, the GPS38 is hand held, pocket sized, 255g, position, altitude, graphic compass, map builder, nitro filled. **Bargain price** just £179 ref GPS1.

**CCTV CAMERA MODULES** 46X70X29mm, 30 grams, 12v 100mA auto electronic shutter, 3.6mm F2 lens, CCIR, 512x492 pixels, video output is tv p-p (75 ohm). Works directly into a scart or video input on a tv or video. IR sensitive. £79.95 ref EF137.

**IR LAMP KIT** Suitable for the above camera, enables the camera to be used in total darkness! £6 ref EF138

**INFRA RED POWERBEAM** Handheld battery powered lamp, 4 inch reflector, gives out powerful pure infrared light! perfect for CCTV use, night sights etc. £29 ref PB1.

**SUPER WIDEBAND RADAR DETECTOR** Detects both radar and laser, X, K and KA bands, speed cameras, and all known speed detection systems. 360 degree coverage, front & rear waveguides, 1.1"x2.7"x4.6" fits on sun visor or dash £149 ref

## CHIEFTAN TANK DOUBLE LASERS 9 WATT+3 WATT+LASER OPTICS

Could be adapted for laser listener, long range communications etc. Double beam units designed to fit in the gun barrel of a tank, each unit has two semi conductor lasers and motor drive units for alignment. 7 mile range, no circuit diagrams due to MOD, new price £50,000? us? £199. Each unit has two gallium Arsenide injection lasers, 1 x 9 watt, 1 x 3 watt, 900nm wavelength, 28vdc, 600hz pulse frequency. The units also contain an electronic receiver to detect reflected signals from targets. £199 for one. Ref LOT4.

**EASY DIY/PROFESSIONAL TWO WAY MIRROR KIT** Includes special adhesive film to make two way mirror(s) up to 60"x20". (glass not included) includes full instructions. £12 ref TW1.

**NEW LOW PRICED COMPUTER/WORKSHOP/HI-FI RCB UNITS** Complete protection from faulty equipment for everybody! Inline unit fits in standard IEC lead (extends it by 750mm), fitted in less than 10 seconds, reset/test button, 10A rating. £6.99 each ref LOT5. Or a pack of 10 at £49.90 ref LOT6. If you want a box of 100 you can have one for £250!

**TWO CHANNEL FULL FUNCTION B GRADE RADIO CONTROLLED CARS** From World famous manufacturer these are returns so they will need attention (usually physical damage) cheap way of buying TX and RX plus servos etc for new projects etc. £12 each sold as seen ref LOT2.

**MAGNETIC CREDIT CARD READERS AND ENCODING MANUAL** £9.95 Cased with filelays, designed to read standard credit cards! complete with control electronics PCB and manual covering everything you could want to know about whats hidden in that magnetic strip on your card! just £9.95 ref BAR31

**WANT TO MAKE SOME MONEY? STUCK FOR AN IDEA?** We have collated 140 business manuals that give you information on setting up different businesses, you peruse these at your leisure using the text editor on your PC. Also included is the certificate enabling you to reproduce (and sell) the manuals as much as you like! £14 ref EP74

**RUSSIAN 900X MAGNIFICATION ZOOM MICROSCOPE** metal construction, built in light, mirror etc. Russian shrimp farm, group viewing screen, lots of accessories. £29 ref ANAYLT

**AA NICAD PACK** Pack of 4 tagged AA nicads £2.99 ref BAR34

**RUSSIAN NIGHTSIGHTS** Model TZS4 with infra red illuminator, views up to 75 metres in full darkness in infrared mode, 150m range, 45mm lens, 13 deg angle of view, focussing range 1.5m to infinity. 2 AA batteries required. 950g weight. £199 ref BAR61. 1 years warranty

**LIQUID CRYSTAL DISPLAYS Bargain prices,** 16 character 2 line, 99x24mm £2.99 ref SM1623A

20 character 2 line, 83x19mm £3.99 ref SM2024A

16 character 4 line, 62x25mm £5.99 ref SMC1640A

**TAL-1, 110MM NEWTONIAN REFLECTOR TELESCOPE** Russian. Superb astronomical scope, everything you need for some serious star gazing! up to 169x magnification. Send or fax for further information. 20kg, 885x800x1650mm ref TAL-1. £249

**YOUR HOME COULD BE SELF SUFFICIENT IN ELECTRICITY** Comprehensive plans with loads of info on designing systems, panels, control electronics etc £7 ref PV1

## COLOUR CCTV VIDEO CAMERAS, BRAND NEW AND, CASED, FROM £99.

**PERFECT FOR SURVEILLANCE, INTERNET, VIDEOCONFERENCING, SECURITY, DOMESTIC VIDEO**

**Works with most modern video's, TV's, Composite monitors, video grabber cards etc**

**Pal, 1v P-P, composite, 75ohm, 1/3" CCD, 4mm F2.8, 500x582, 12vdc, mounting bracket, auto shutter, 100x50x180mm, 3 months warranty, 1 off price £119 ref XEF150, 10 or more £99 ea 100+ £89**

**MICRO RADIO** It's tiny, just 3/8" thick, auto tuning, complete with headphones. FM £9.99 ref EP35

**25 SQUARE FOOT SOLAR ENERGY BANK KIT** 100 6"x6" 6v Amorphous 100mA panels, 100 diodes, connection details etc to build a 25 square foot solar cell for just £99 ref EF112.

**CONVERT YOUR TV INTO A VGA MONITOR FOR £25!** Converts a colour TV into a basic VGA screen. Complete with built in psu, lead and s/ware. Ideal for laptops or a cheap upgrade. Supplied in kit form for home assembly. **SALE PRICE £25 REF SA34**

**\*15 WATT FM TRANSMITTER** Already assembled but some RF knowledge will be useful for setting up. Preamp req'd, 4 stage 80-108mhz, 12-18vdc, can use ground plane, yagi or dipole £69 ref 1021

**\*4 WATT FM TRANSMITTER KIT** Small but powerful FM transmitter kit. 3RF stages, mic & audio preamp included £24 ref 1028

**YUASHA SEALED LEAD ACID BATTERIES** 12v 15AH at £18 ref LOT8 and below spec 6v 10AH at £5 a pair

**ELECTRIC CAR WINDOW DE-CERS** Complete with cable, plug etc **SALE PRICE JUST £4.99 REF SA28**

**AUTO SUNCHARGER** 155x300mm solar panel with diode and 3 metre lead fitted with a cigar plug. 12v 2watt. £12.99 REF AUG10P3.

**SOLAR POWER LAB SPECIAL** You get 2 6"x6" 6v 130mA cells, 4 LED's, wire, buzzer, switch + 1 relay or motor. £7.99 REF SA27

**12V DC MOTOR SPEED CONTROL KIT** Complete with PCB etc. Up to 30A. A heat sink may be required. £19.00 **REF: MAG17**

**SOLAR NICAD CHARGERS** 4 x AA size £9.99 ref 6P476, 2 x C size £9.99 ref 6P477

**MEGA POWER BINOCULARS** Made by Helios, 20 x magnification, precision ground fully coated optics, 60mm objectives, shock resistant caged prism, case and neck strap. £89 ref HPH1

**GIANT HOT AIR BALLOON KIT** Build a 4.5m circumference, fully functioning balloon, can be launched with home made burner etc Reusable (until you loose it!) £12 50 ref HA1

**AIR RIFLES. 22** As used by the Chinese army for training purposes. As used is a lot about! £39.95 Ref EF78. 500 pellets £4 50 ref EF80.

**\*NEW MEGA POWER VIDEO AND AUDIO SENDER UNIT.** Transmits both audio and video signals from either a video camera, video recorder, TV or Computer etc to any standard TV set in a 500m range! (tune TV to channel 31) 12v DC

op Price is £65 **REF: MAG15** 12v psu is £5 extra **REF: MAG5P2**

**\*MINIATURE RADIO TRANSCIEVERS** A pair of walkie talkies

with a range up to 2 km in open country. Units measure 22x52x155mm Including cases and earpieces. 2xPP3 req'd. £37.00 pr. **REF: MAG30**

**\*FM TRANSMITTER KIT** housed in a standard working 13A adapter! the bug runs directly off the mains so lasts forever! why pay £700? or price is £18 **REF. EF62** (kit) Transmits to any FM radio. Built and tested version now available of the above unit at £45 ref EXM34

**\*FM BUG BUILT AND TESTED** superior design to kit. Supplied to detective agencies. 9v battery req'd. £14 **REF MAG14**

**GAT AIR PISTOL PACK** Complete with pistol, darts and pellets £14.95 **REF EF82B** extra pellets (500) £4 50 **REF EF80**

**HEAT PUMPS** These are mains operated air to air units that consist of a aluminium plate (cooling side) and a radiator (warming side) connected together with a compressor. The plate if inserted into water will freeze it. Probably about 3-400 watts so could produce 1kw in ideal conditions. £30 ref HP1

**3 FOOT SOLAR PANEL** Amorphous silicon, 3' x 1' housed in an aluminium frame, 13v 700mA output £55 ref MAG45

**SOLAR/WIND REGULATOR** Prevents batteries from over charging. On reaching capacity the regulator diverts excess power into heat avoiding damage. Max power is 60 watts. £27.99 ref SCA11-05

**FANCY A FLUTTER? SEND OUR NEW PUBLICATION?** Covers all aspects of horse and dog betting, systems etc and gives you a betting system that should make your betting far more profitable! £6 a copy ref BET1

**FIBRE OPTIC CABLE BUMPER PACK** 10 metres for £4.99 ref MAG5P13 ideal for experimenters! 30 m for £12.99 ref MAG13P1

**4X28 TELESCOPIC SIGHTS** Suitable for all air rifles, ground lenses, good light gathering properties. £24.95 ref R/7

**GYROSCOPES** Remember these? well we have found a company that still manufactures these popular scientific toys, perfect gift or for educational use etc. £6 ref EP70

**NICAD CHARGERS AND BATTERIES** Standard universal mains operated charger, takes 4 batts + 1 PP3, £10 ref PO11D. Nicads- AA size (4 pack) £4 ref 4P44, C size (2 pack) £4 ref 4P73, D size (4 pack) £9 ref 9P12.

**RECHARGE ORDINARY BATTERIES UP TO 10 TIMES!** With the Battery Wizard! Uses the latest pulse wave charge system to charge all popular brands of ordinary batteries AAA, AA, C, D. four at a time! Led system shows when batteries are charged, automatically rejects unsuitable cells, complete with mains adaptor BS approved. Price is £21.95 ref EP31.

**PHOTOGRAPHIC RADAR TRAPS CAN COST YOU YOUR LICENCE!** The new multiband 2000 radar detector can prevent even the most responsible of drivers from losing their licence! Adjustable audible alarm with 8 flashing leds gives instant warning of radar zones. Detects X, K, and Ka bands, 3 mile range, 'over the hill' 'around bends' and 'rear trap facilities' micro size just 4.25"x2.5"x75". Can pay for itself in just one day! £89 ref EP3.

**3" DISCS** As used on older Amstrad machines, Spectrum plus 3's etc £3 each ref BAR400.

**STEREO MICROSCOPES BACK IN STOCK** Russian, 200x complete with lenses, lights, filters etc very comprehensive microscope that would normally be around the £700 mark, our price is just £299 (full money back guarantee) full details in catalogue.

**SECOND GENERATION NIGHT SIGHTS FROM £748** RETRON Russian night sight, 1.8x, infra red lamp, 10m-inf, standard M42 lens, 1.1kg. £349 ref RET1

**LOW COST CORDESS MIC** 500' range, 90 - 105mhz, 115g, 193 x 26 x 39mm, 9v PP3 battery required. £17 ref MAG15P1

**HI POWER SURVEILLANCE TELESCOPE** Continuous zoom control from 20 times to an amazing 60 times magnification. 60mm fully coated objective lens for maximum light transmission, complete with tripod featuring micro elevation control. £75 ref ZT1

**JUMBO LED PACK** 15 10mm bicolor leds, plus 5 giant (55mm) seven segment displays all on a pcb £8 ref JUM1. Pack of 30 55mm seven seg displays on pcbs is £19 ref LED4, pack of 50 £31 ref LED50

**12VDC 40MM FANS MADE BY PANAFLO, NEW. £4. REF FAN12**

**HELP WANTED WITH MOTORS** We have thousands to clear at rock bottom prices! bumper pack of 20 motors (our choice) is just £19.95! Some of these will be 5" or maybe larger!

**HELP WANTED WITH MULTI RAIL POWER SUPPLIES** Again we have thousands available, most with fans, mostly cased, sold as seen, condition may vary, some working some not. Pack of 10 is £19.95

**HELP WANTED WITH TELEPHONE COIN BOXES** Need we say, thousands available! these are units designed to convert an ordinary phone into a coinbox phone. They have damaged cases but the electronics and coinslots are ok. Speech clip on the board talks to you as you program it! Pack of 10 is £19.95

**HELP WANTED WITH EXTERNAL MICRO TAPE STREAMERS** 10,000 in stock, space needed! brand new cased units with loads of interesting bits (motor, tape heads, PCB etc etc. Very smart plastic case useful for projects etc. Pack of 20 is £19.95 ref MD2

**HELP WANTED WITH YUASHA 12V 6.5AH SEALED LEAD ACID BATTERIES** About 10 pallets full just inside warehouse no 2! pack of 5 for just £19.95 also some below spec 6v 10Ah at £19.95 for a pack of 8

**Check out our WEB SITE**  
full colour interactive  
1997 catalogue

<http://www.pavilion.co.uk/bull-electrical>

**FREE COLOUR CATALOGUE WITH EVERY ORDER**

**\*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK**

**WE BUY SURPLUS STOCK FOR CASH**

**SURPLUS STOCK LINE 0802 660335**

**FREE 10% DISCOUNT VOUCHER**  
CUT OUT AND INCLUDE THIS CORNER WITH YOUR ORDER AND DEDUCT 10% FROM ALL THE ITEMS IN THIS ADVERT!

ETI

**BULL ELECTRICAL**  
250 PORTLAND ROAD, HOVE, SUSSEX.  
BN3 5QT. (ESTABLISHED 50 YEARS).  
MAIL ORDER TERMS: CASH, PO OR CHEQUE  
WITH ORDER PLUS £3.50 P&P PLUS VAT.  
24 HOUR SERVICE £4.50 PLUS VAT.  
OVERSEAS ORDERS AT COST PLUS £3.50  
'phone orders: 01273 203500  
(ACCESS, VISA, SWITCH, AMERICAN EXPRESS)  
FAX 01273 323077  
E-mail [bull@pavilion.co.uk](mailto:bull@pavilion.co.uk)

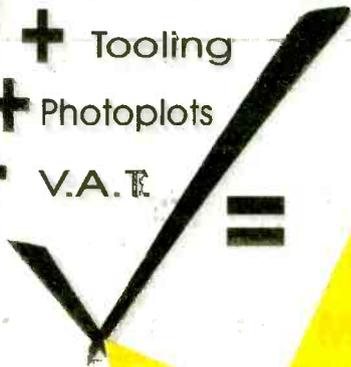
**BRAND NEW!**

# PCB-POOL®



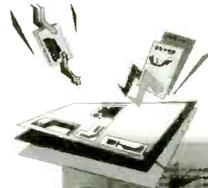
**TRIED & TRUSTED STRAIGHT FROM GERMANY**

**1 Eurocard**  
+ Tooling  
+ Photoplots  
+ V.A.T.

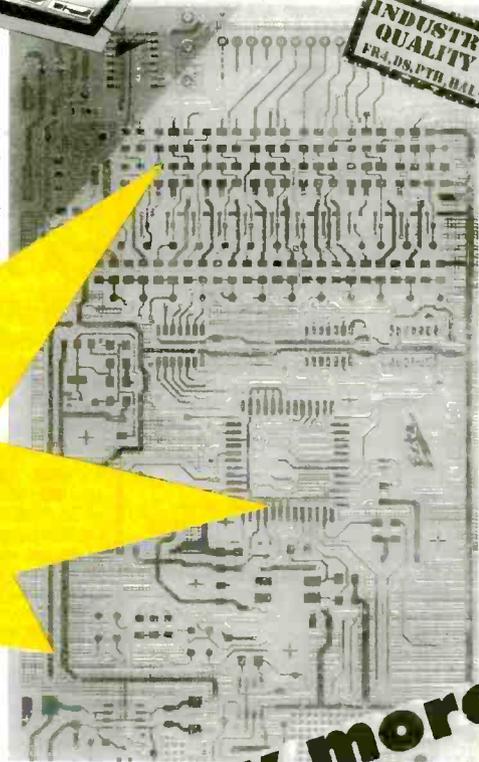


CONTOUR?  
**ANY!**

ANY FORMAT, ANY OUTLINE  
NO PREMIUM!



**INDUSTRY QUALITY**  
FR4, OS, PTFE, HAL



MULTILAYER?  
**NO PROBLEM!**

ASK FOR DETAILS!

**£ 49**

**FREE**

ON YOUR FIRST ORDER  
(only as long as stock lasts)



ill. similar

NO. OF DRILLS?  
**NO LIMITS!**

NO INCREASE IN COSTS FOR  
INCREASE IN DRILLS!

**pay more?  
NO!**

**ALL IN ONE PRICE**

Incl.  
Tooling  
Photoplots  
V.A.T.

**SERIE XXS**

**10board POOL**



only £ 25 /per PCB  
V.A.T. included

**20board POOL**



only £ 19 /per PCB  
V.A.T. included

**30board POOL**



only £ 16 /per PCB  
V.A.T. included

**40board POOL**



only £ 14 /per PCB  
V.A.T. included

**50board POOL**



only £ 12 /per PCB  
V.A.T. included

**Eurocard + Soldermask + Position print**



Beta LAYOUT Ltd.  
IRELAND  
PCB-Brokerage  
6 College Grove  
Ennis - Co. Clare

My adress/Fax number

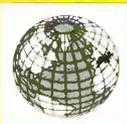
[Empty text box for address/fax number]

**Fax/send back**

- Send/ fax me the PCB-POOL® participation requirements.
- Please send me the PREVUE-DISC free of charge.

**get connected**

**INFO: ☎ ++353 (0) 65 66500 FAX 66514**



**FAX**  
on Demand  
**66515**

**EURO**  
File-Transfer  
**66520**

**analog**  
BBS  
**66516**

**isdn**  
BBS  
**66518**



German Office  
Beta LAYOUT GmbH  
PCB-Brokerage  
Feldstraße 2  
65326 Aarbergen

pcbpool@betalayout.ie  
http://www.pcb-pool.com

## Security

Although it was not a key remit of Professor Warwick's book, the greatest threat to the efficiency of such systems in present circumstances is to break their security and subvert their software. As disaffected groups feel resentful of the increased level of bureaucratic control of social and economic infrastructure, key computer systems may become even more a 'soft' target and one that, mistakenly, such groups could accept as justifiable. It would appear also more satisfying to subvert such systems than to destroy them.

## The Really Useful Robot

It is perhaps useful to guess what a Really Useful Robot Company could develop in the future. It would be possible to program in some directives to autonomous machines. For free moving units, these could be described as:-

- do not run out of power
- do not get lost
- do not run into objects
- always take note of external commands
- undertake tasks efficiently
- fail safely in event of malfunction
- do not present a risk to other objects
- keep a log of everything that has taken place

At a level below this is the computational power to address all these issues. Such systems are becoming smarter, as increasing processing power becomes available. In terms of the effects of such systems on our society, the fact they may or may not be self aware is irrelevant. The coming reality that machines are going to get relatively smarter and smarter.

## Sensory superiority

On the sensory side, with modern technology, a vast array of additional attributes can be bundled into a robot. Thus we can add equipment to detect and resolve in different parts of the electromagnetic spectrum outside the relatively narrow band of 380 nm to 720 nm. We can add x-ray spectrometer, gamma ray spectrometer, ultra violet detectors, infra red detectors. We can even add sensors via Doppler technology to determine if objects are coming towards us or going away from us. Also, as technology becomes more compact and efficient, it becomes even easier to extend the sensory armament.

Thus robots can be developed with significantly enhanced sensory systems. It is recognised, however, that the human retina/visual cortex is vastly superior in the processing of visual information compared to any machine. In its limited set of sensory inputs, the human 'machine' does exceptionally well.

## Machine Profiles

While it may not be possible for a machine to experience self-awareness, it is entirely possible to provide it with sophisticated algorithms for it to operate within well defined guidelines. The general structure of an autonomous system are outlined in figure 8.

It is clear that the system would in fact be a mix of digital systems and also probably neural network components. The digital systems would provide the goal directive and components to tell how the system should respond in given circumstances. The system would require to verify its function so that it could report faults or move itself into a safe mode if required. It would require levels of security to sanction receipt of data from various sources and also security to transfer data to specific remote

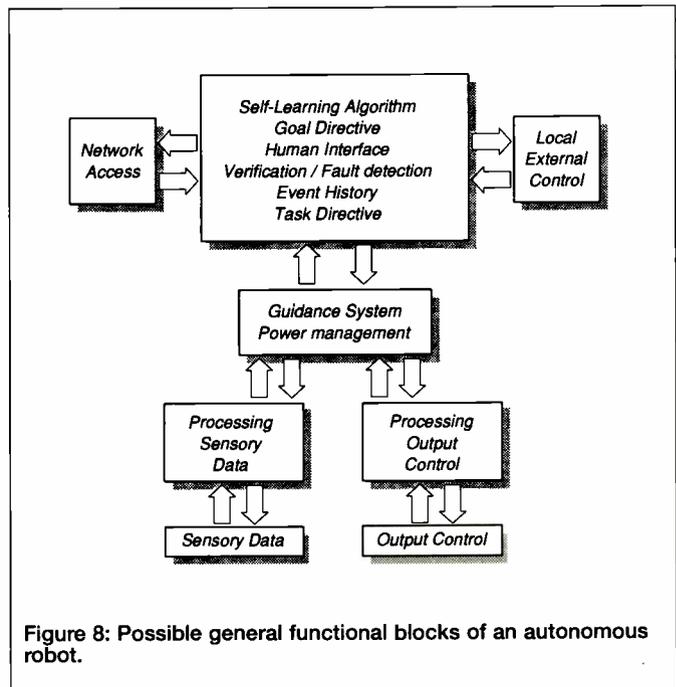


Figure 8: Possible general functional blocks of an autonomous robot.

systems. An event history could be either transmitted continuously or stored on line in order to be able to monitor system integrity or locate faults in event of failure.

Examples have been cited of robots talking to each other over the Internet. The security aspects of this would have to be looked at much more closely if it ever became commonplace. With modern processing speeds of 200 MHz, the potential data handling of such systems would be significant indeed. Technological advances with equivalent speeds of say 2000 MHz systems say in 10 years time gives even more scope to develop useful functionality.

It must be recognised, however, that the fundamental breakthrough with neural networks came about when it was realised how they could be trained. This was barely some ten years ago. While all the time incremental progress is being made in this discipline, it is quite conceivable that there are several major breakthroughs still to be experienced in this field which will allow the structuring and effective training of vastly more complex networks.

It must certainly mean that in a physical environment, smart machines will be doing physical things. To a very large extent robotic systems are already building the next generation of robots. Processes of chip manufacture and development are now so demanding that the most delicate stages of manufacture and design were long ago taken over by automated methods.

## A safer society

There is no doubt that our dependence on machines will increase. So far, however (and hopefully) all these systems are very much under the control of their masters. It is our collective responsibility to ensure that this remains so. It is the complexity of our society that is pushing for increased computerisation. In the example of control of aircraft in national airspace, the trend is increasingly to hand more and more over to computers to monitor and direct flight paths. As we make such systems work harder, process more data, make more calculations per second, access data archives which expand rapidly, yes we are giving these systems a more important role in our society. This is primarily, however, because society is itself changing rapidly and these systems are being introduced to respond to this rapid technological change.

In fact key areas for additional implementation of computer/robotic technology are very clearly in evidence. They have a critical role in managing inherently unsafe systems such as a transportation systems, nuclear power plants and many procedures processing dangerous chemicals. One argument could say that without the appropriate use of such technology the future would be a more dangerous and unsafe one.

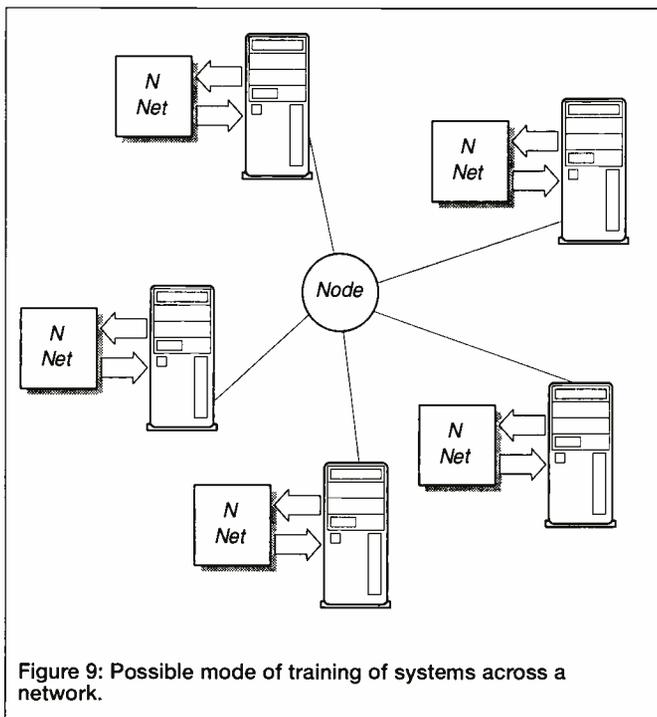


Figure 9: Possible mode of training of systems across a network.

### Distributed Training of Machines

The collection of Reading robots presents an example where the small robots are moving about, learning about their environment and refining the training of their neural networks. With the high connectivity of computers today, it is relatively easy to anticipate how systems as networks can learn collectively.

Consider neural networks linked across numerous computers and which have access to a large flow of training data for the local neural networks, as shown in figure 9.

If all of these systems have an optimising algorithm where each system can receive its own training data set locally and also link to the network structure and input/output of other PCs, then the level of training of the PCs begins to increase as weighting factors are developed for the individual PCs and with dialogue from other systems. In this scenario it is imagined that

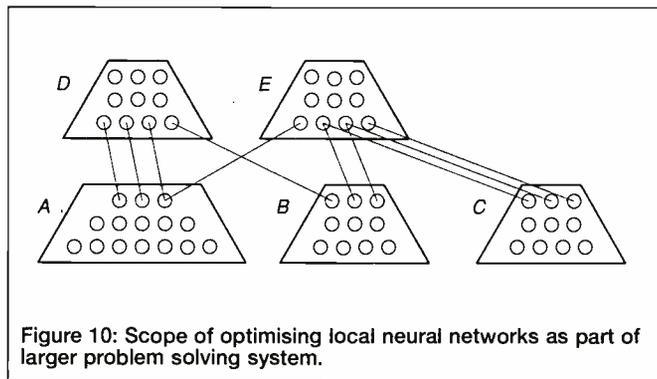


Figure 10: Scope of optimising local neural networks as part of larger problem solving system.

all these systems are configured exactly the same in their neural network configuration. The network of PC's can be considered to be increasing in smartness over the network.

As part of the 'connected' nature of the system, it would be possible for validation of the effectiveness of each local system to be checked against a reference benchmark in order to rank the systems and allow the systems to select in some way the best training data set available across the network.

If however, things are taken a stage further where each local system is given an individual autonomous task where it can optimise the internal connected structure for effective functioning. In this scenario, each local neural network has well defined input/outputs relating to physical parameters. If these are cascaded together across another layer of processing in another layer of local neural networks, as shown in figure 10, again where inputs and outputs are independently defined and have real significance, then training of these local systems can be undertaken.

An so as a thought experiment in neural network development, these systems can be considered to optimise their own internal design to solve the particular problem assigned to them - assuming the physical problem assigned to them can be split up into such local processing modules. By linking these systems in a network, they can be informed of the states of processing in the other systems. One layer would be trained at a time before the next layer was trained from the outputs of the first section. If this model is established in principle, then it is simply a case of expanding it up according to the resources of hardware and software available. This is shown as a two dimensional problem, but it could equally well be developed in three dimensions.

Systems could therefore evolve where each 'box' represents an autonomous 'smart system'. Also, the network connectivity could be superseded by an optimising 'supervisory' system to monitor the functionality of the system and make adjustments to optimise performance.

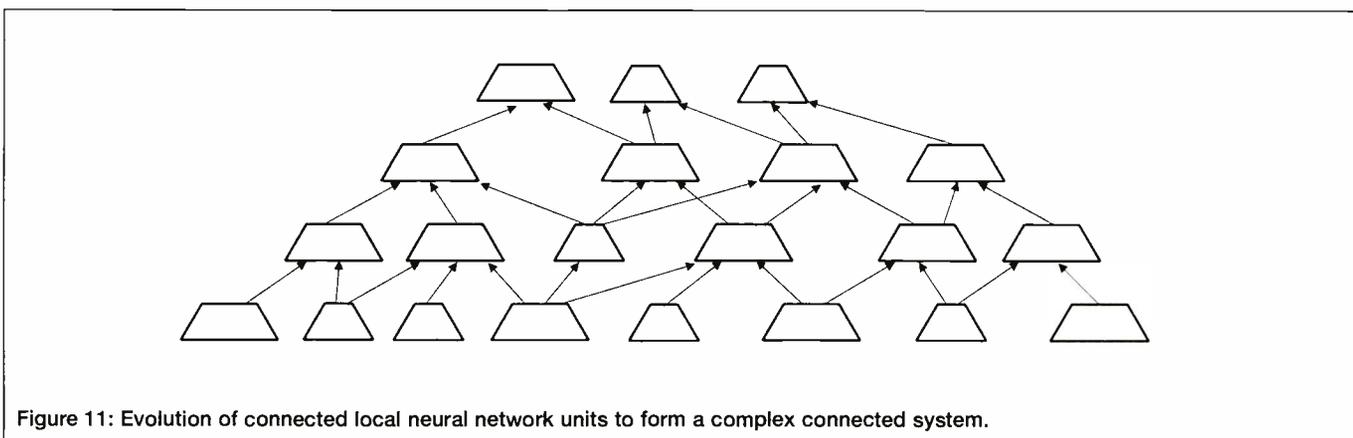


Figure 11: Evolution of connected local neural network units to form a complex connected system.

If a system such as this is to evolve 'organically', then it may require to be associated with a component of trial and error, where some configurations are abandoned while others are retained as they add efficiency to the solution. This would be a role, therefore for some aspect of genetic algorithms in the optimisation of such a system. A complex network could be developed in this way would approach the complexity of the structure of figure 11 where each cell is a relatively complex local neural network implementation. Once 'cell' could for example be a complex spoken language/command interface. Another could be a system for recognition of images.

Such a system, however, is not just a neural network. It is more like some system that has a natural property to make sense out of data, to order it by means of complex training techniques which are in the domain of conventional digital programming. This level of design requires wholly new design structures compared with conventional digital processing scenarios. No doubt this is the scenario which many in this field are seeking ways to implement. It is perhaps not the element of sheer computing power that is the daunting factor - it is the model of connectivity which is the key.

All the hard programming is in the optimising of the network and in the training. Once the network is trained, the inputs are presented and relatively simple programming feeds forward the results. At this stage, operating the network, is a relatively mechanical process. The result of the training procedures and any elements of system configuration would have been achieved

through highly advanced programming. Even if this process is driven to some sort of logical conclusion, where millions of neurons are trained together in a vast association of elements, all interconnected appropriately either with weightings in software or in on chip representations, does this represent machine self awareness? Probably not.

It would, however, represent a distillation of a vast amount of data and experience of the physical world. Such a system could be made to appear uncannily like a human being in various of its responses since this is an area in which training of some patterns of human behaviour would be relatively easy.

Does this also mean that much of the 'intelligence' of the brain is very much its sheer physical organisation. Once everything is set up, using it is very much like clockwork, as inputs feed forward through complex neuronal interconnections. After all, when we go for a walk, this is done without any conscious effort of what we are doing - it is all pre-connected. The human brain, however, is very adaptable. It learns new skills. It links to new memories. If part of it become damaged, it seeks out other functional pathways. We have yet to fully understand how it achieves this.

### **Socio-economic implications**

Today manufacturers scour the world for sources of cheap labour. Plants are established, for example, in China, not with highly developed state of the art automated technology but where products are largely built by hand. The economics of this are still attractive, and the capital investment costs will be lower compared with setting up a highly automated production line. But with increasingly cost effective automation, there will be less demand, anywhere, for manufacturing labour. This could set in train global changes of a very unpleasant type - much more threatening to the status quo than the scenario of berserk robots. In this scenario, low skill/low labour cost economies will be particularly vulnerable to such technological change.

It is not in question that more 'smart' machines will play an increasingly important role in the future as techniques of production change the balance of people and technology. Whole new product ranges, however, will probably emerge to counter balance this trend. There are issues of safety as more and more critical systems are controlled by high technology. There are employment issues as long term established industries fade rapidly away as technological change catches up with them. It is a measure of our loss of control of technology that we are adapting our social structure to cope with technological change rather than controlling technology to serve our social needs.

### **The new applications**

Government agencies are very interested in advances in technology to intercept and monitor all manner of modern communications. Machines could, for example, be trained to be efficient at intercepting and assessing voice and data communications and especially Internet sites which may be undesirable.

It is therefore necessary to be constructive in how this technology will be used. David Brown, in his book *Cybertrends*, maps out some potential pitfalls and ways forward for the future.

Perhaps, more importantly, it is the debate over how such technology will be used that is of more relevance.

### **Summary**

The media interest in the Reading Robots has arisen not because the technology of the Seven Dwarfs was complex or in any way revolutionary, but because they provided a means of communicating to the onlooker the potential of robotic technology for the future.

At the same time, mixed in with this message was the implied reality that one day such robots will surpass us in 'intelligence'.

While it is accepted that robots are set on an evolutionary path of their own and this will affect the nature of our society in fundamental ways, there is plenty of current and indeed increasing scientific opinion which indicates that the 'thinking' or 'conscious' machine will never materialise. The leading edge of scientific thinking is chasing much bigger issues than the cognitive potential of silicon.

In conclusion as a contrast, perhaps it is relevant, however, to contemplate the calmness reflected in some of the larger granite carvings of Ancient Egypt, where material progress was very basic and there was greater emphasis on trying to understand the bigger picture of things.

### **References**

- March of the Machines: why the new race of robots will rule the world*, Kevin Warwick, 1997, Century.
- The Emperor's New Mind*, Roger Penrose, Vintage, 1990.
- Who's afraid of Schrodinger's cat?*, Ian Marshall and Darah Zohar, Bloomsbury, 1997
- Cybertrends*, David Brown, Viking, 1997
- The Anthropic Cosmological Principle*, John D Barrow and Frank Tipler, Oxford Paperbacks, 1996
- Goodbye Descartes*, Kevin Devlin, John Wiley, 1997.

## From the Microcontroller Professionals:

### Program PIC Microcontrollers:

**We now have 3 programmers for PIC's !**

**Original** - This is our original programmer for 16C5X, 16C55X, 16C6X, 16C7x, 16C8x, 16F8X devices.

**Price : £40 for the kit, or £50 ready built.**

**Serial** - This programmer programs the newest PIC devices in a single 40 pin multi-width ZIF socket. Will program: 16C55X, 16C6X, 16C7X, 16C8x, 16F8X, 12C508, 12C509, PIC 14000. Also In-Circuit programming.

**Price : £40 for the kit, or £50 ready built.**

**Introductory** - This programmer is intended for the smaller user, or newcomer to PIC's. Will program 8 pin and 18 pin devices : 16C55X, 16C61, 16C62X, 16C71, 16C71X, 16C8X, 16F8X, 12C508, and 12C509.

**Price £22 for the kit (not available ready built).**

Note : All our programmers operate on a PC, using a standard RS232 serial interface (COM1, 2, 3, or 4).

No hard to handle parallel cable swapping !

All programmers are supplied with full instructions, Windows programming software, MPASM, MPSIM and PICDE - the Windows based PIC assembler environment. (offers all features of PICDESIM below without the simulator).

### PIC BASIC

**FED's PIC BASIC products - straightforward, capable, powerful, rapid development.**

In a Windows Development Environment our modules need no assembler or UV eraser to program your PIC's, and operate from a serial link to your PC.

The 16C74 module features - 8k EEPROM, up to 2000 lines of BASIC, 27 lines of programmable I/O, 8 A/D inputs, Interrupt driven serial RS232 interface, Peripheral I<sup>2</sup>C bus interface, LCD display driver routines, up to 178 bytes for variables and stack, extendible with optional external ram and all the standard 16C74 features.

**Compiler** - The FED PIC BASIC compiler for the 16C74. It produces hex code to program your 16C74 directly with no need for external EEPROM. Compatible with the EEPROM versions of PIC 16C74 BASIC modules - develop on an EEPROM based module then compile and program your PIC chips directly.

16C57 Module Kit (8k EEPROM, 4MHz) £27.00, Pre-built £33.00  
 16C57 Module Kit (8k EEPROM, 10MHz) £31.00, Pre-built £37.00  
 16C74 Module Kit (8k EEPROM, 4MHz) £35.00, Pre-built £42.00  
 16C74 Module Kit (8k EEPROM, 20MHz) £40.00, Pre-built £46.00  
 16C84 chip programmed with BASIC - £25.00  
 Compiler - £60.00, or £50.00 when ordered with a module



### Forest Electronic Developments

10 Holmhurst Avenue, Christchurch,  
 Dorset, BH23 5PQ. <http://www.lakewood.win-uk.net/fed.htm>  
 01425-270191 (Voice/Fax)

Prices are inclusive, please add £3.00 for P&P and handling to each order.

Cheques/POs payable to Forest Electronic Developments, or phone with credit card details. Serial Cables - £7.50.



### Windows Based PIC Development: PICDESIM - the Windows based development environment.

PICDESIM allows you to develop your PIC projects in one Windows program.

Incorporate multiple files, view help file information directly from the code, edit within the project, build, and track errors directly in the source, then simulate.

Simulator allows addressed, conditional and timed breakpoints, follow your code in the source editor window, set a breakpoint directly in the code. Run your program, or single step, or step over subroutines. Track variable values and trace them for display on the Trace Analyser. Input stimuli include clocks, direct values and asynchronous serial data. Profile your program - examine frequently called routines which are timed and use the information to optimise out bottle necks.

Trace Analyser allows any register or port value to be examined in analogue (graphical), waveform, or numeric values, check your program directly against your predicted waveforms.

Runs up to 50 times faster than MPSIM !

**NEW !** - 32 bit version allows full use of Windows '95 and Windows NT 4.0 facilities.

**Cost £30.00, or £25.00 for existing and new purchasers of any of our programmers. Please specify Windows 3.1, or Windows '95 (32 bit) versions of PICDESIM.**

### PIC's

PIC16C74/JW Erasable 20MHz	£24.00	PIC16C556 (14 bit versn 16C56)	£4.50
PIC16C74-04POTP	4MHz £8.00	PIC16C74-20P OTP	20MHz £11.00
PIC16C57-04POTP	4MHz £5.00	PIC16C57-10P OTP	10MHz £6.00
PIC16C84-04P	4MHz £6.00	PIC16C84-10P	10MHz £8.00
PIC16F84-04P	4MHz £7.00	PIC12C508-04P OTP	4MHz £2.20
PIC14000-04P OTP	4MHz £10.00	PIC14000/JW Erasable	£23.00
PIC12C508-04P OTP	4MHz £2.70		

Ask about other chips!

### PIC Training

**Our new training course introduces PIC's painlessly with a practical emphasis.**

Our training package includes

- Full introductory manual to the PIC series including use of assembler, peripherals and interrupts for the 12 bit and 14 bit controllers.
- Video introducing the PIC, and showing use of PICDESIM
- Development board with PIC16F84, and all components required to develop 3 practical projects, including LED driving, handling delays and serial communications to a PC.
- PICDESIM - the Windows based Simulator (see left)
- Microchip MPSIM and MPASM programs

Training Course £80.00

Training Course with pre-built Introductory PIC programmer £99.00

### Development Boards

**Development boards allow simple prototyping of projects.**

Our 18 pin development board includes a simple serial interface to a PC, 18 pin socket for any 18 pin device, 4MHz resonator and power regulator components. All instructions components, and circuits supplied. Includes a 16F84 - 10MHz version of 16C84 with an additional 32 bytes of RAM for programs.

Development board with all components for serial interface, power supply, oscillator and 16F84 device £20.00.

### Coming soon...

Look out over the next few months as we expand our PIC BASIC range and extend our microcontroller support to another major manufacturer.

# Digital Voice Modulator

**Based on the HT-8950 voice modulator chip, Robert Penfold's 'voice-box' can add pitch-shift and vibrato to voice signals, with a 'robot voice' for would-be metal men!**

**T**his simple project is based on a single integrated circuit, but it provides a number of interesting voice effects that are generated using some basic digital signal processing. The pitch of the input signal can be shifted up or down, and in each case three levels of shift are available. A robot voice effect can also be produced, but this effect is quite strong and it can sometimes be difficult to understand what is being said. It is still a useful facility though, and will appeal to those who do not like to do things by halves. Frequency modulation (vibrato) can be added to both the pitch and robot effects. The audio quality is not in the hi-fi category since the system has only eight-bit resolution and uses a sampling rate of 8 kHz. The quality is adequate for a speech signal, though, and this project is only intended for "fun" applications such as producing sound effects for amateur dramatics productions.

The unit is economic to run as it is powered from a couple of HP7 size batteries that have an extremely long operating life. Inputs are provided at line and microphone levels, and the unit should work well with any low impedance dynamic or electret microphone. Outputs at line and microphone levels are available from separate sockets, and adding the unit into practically any set-up should therefore be very straightforward. The desired effect is selected using three pushbutton switches. One of these toggles the vibrato, and the other two cycle through the available effects in opposite directions. A front panel LED acts as a simple audio level indicator and makes it easier to obtain a suitable drive level, especially when using the unit with a microphone.

## Ups and downs

There are two basic approaches to providing a shift in the pitch of an audio signal. One method involves using the heterodyne principle to raise or lower the pitch of every frequency component by an amount that is controlled by an oscillator. This method is rather like generating a single sideband radio signal and deliberately demodulating it using the wrong carrier frequency. However, this method does not necessarily involve the use of high frequencies, and the desired effect can be produced using balance mixers, high quality audio filters, and phasing techniques. Although this system provides a very



"clean" output signal it has a slight drawback in that it alters the harmonic relationship of the components in the processed signal.

For example, an input signal at 1 kHz might contain harmonics at 2 kHz, 3 kHz, 4 kHz, etc. If these are all raised in frequency by 500 Hz, the fundamental frequency would become 1.5 kHz but the first harmonic would be at 2.5 kHz. In other words, the first harmonic would no longer be at twice the fundamental frequency, and the other harmonics would be even further adrift from their correct frequencies. This would not be of importance in all applications, but it gives some "heavy metal" sounds when applied to a singing voice! Another problem with the heterodyne method is that it can only provide a very limited amount of downwards shift. This is simply because a large shift results in the lowest input frequencies being taken below 0Hz, which is obviously not possible. In reality the signal just becomes scrambled.

The second method involves recording the signal and then playing it back at the wrong speed. A higher playback speed proportionately increases the pitch of all the components in the signal, and a lower playback speed proportionately reduces the frequency of all the components. An advantage of this method is that it leaves the harmonic relationship of the individual frequency components intact. The main drawback is that it is very difficult to obtain a really "clean" output signal from a system that works in real-time. In a real-time system the input signal has to be recorded for a short period and then played back at a different speed. If the playback speed is faster than the recording speed, the playback time is shorter than the recording time. This leaves the problem of how to fill in the gaps in the output signal. A reduction in pitch gives the opposite problem with the output signal having a longer duration than the input signal. This means that some of the input signal has to be cut out in order to keep the duration of the output signal equal to that of the input signal. No matter how cleverly the sets of output samples are spliced together you can always "hear the join."

## HT-8950

The chip used in this project is the HT-8950 voice modulator which is contained in a standard 18-pin DIL encapsulation (figure 1). While this device is not exactly dirt cheap, it costs very little when you consider the amount of circuitry it contains. As can be seen from the simplified block diagram of figure 2, it contains analogue to digital and digital to analogue converters as well as static RAM, an input amplifier, and a substantial amount of control logic.

The input amplifier is actually an operational amplifier that has a built-in bias circuit, and can be used in the inverting mode. This feeds into a comparator that forms part of the analogue to digital converter. The data sheet for the HT-8950 does not specify which type of conversion is used, but it is presumably a successive approximation converter. A block of static RAM is used to temporarily store the samples produced by the converter, and

then they are output to the digital to analogue converter via a data latch. Of course, the samples are clocked out to the digital to analogue converter at a higher or lower rate than they were recorded, so that the required change in pitch is obtained.

A timebase generator is included in the chip together with all the necessary control logic. An oscillator can be used to frequency modulate the timebase circuit during playback so that the vibrato effect is generated. The mode of operation is governed by seven inputs to the control logic circuit. These really break down into two groups of inputs, and one of these groups (S0, S1, and S2) is intended to provide electronic control of the chip. In this case we require manual control and it is therefore the other four inputs that are used. These inputs are at pins 15 to 18, and they have internal pull-up resistors. In use they are connected to ground via pushbutton switches. Operating the switch connected to pin 15 toggles the vibrato effect on and off. The switches connected to pins 16 and 17 enable the chip to be cycled up or down through the available modes, and the list provided below shows the order that is used. The chip defaults to the robot mode at switch-on incidentally.

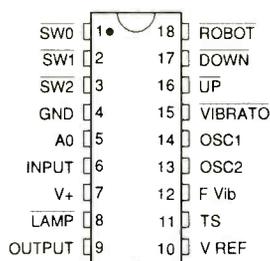


Figure 1: Pin assignments for the HT-8950 voice modulator chip

Up 2  
Up 1.6  
Up 1.33  
Normal  
Down 0.88  
Down 0.8  
Down 0.66  
Robot

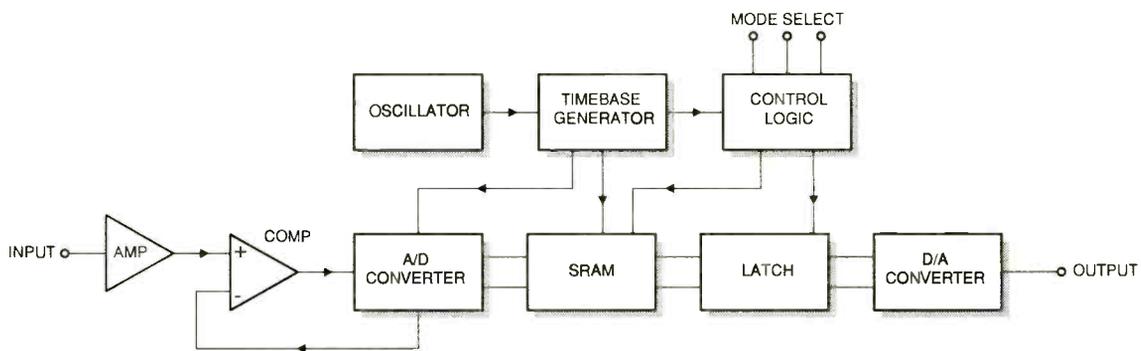


Figure 2: the block diagram for the HT-8950

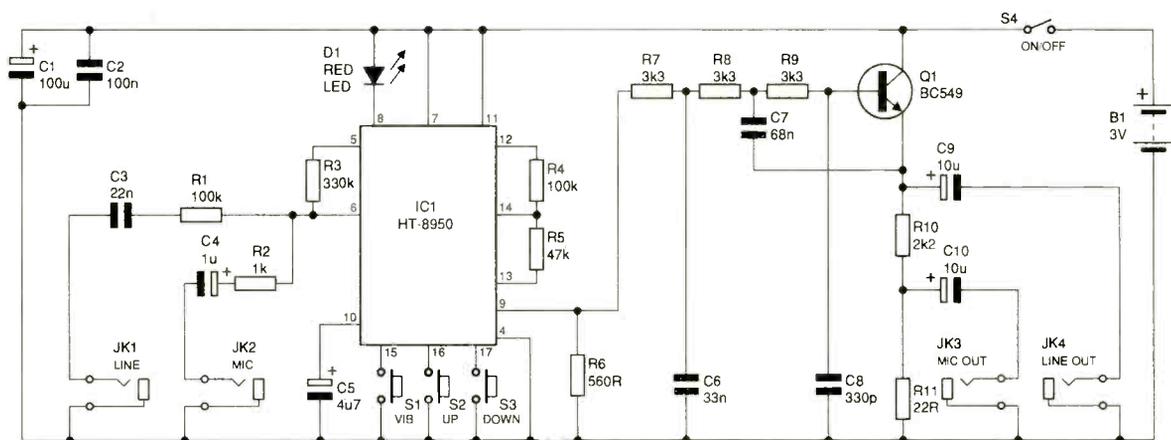
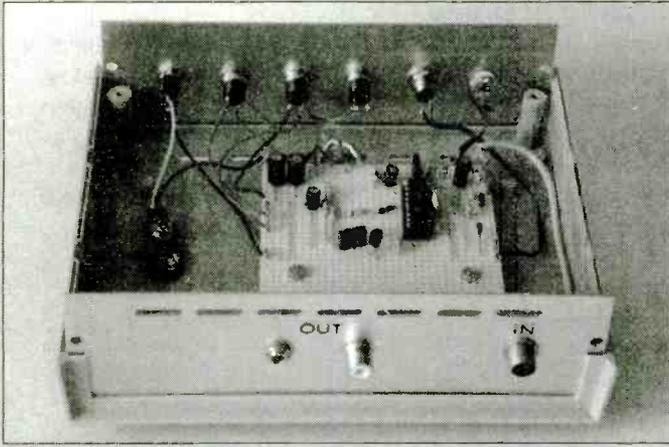


Figure 3: the full circuit diagram for the digital voice modulator



To get to the Up 1.33 mode after switching on you would therefore either press the "down" switch three times, or the "up" switch five times. Operating the switch connected to pin 18 enables the chip to be instantly switched into the robot mode, but this facility is not normally required.

### Circuit operation

The full circuit diagram for the digital voice modulator is shown in figure 3. In order to provide inputs for both microphone and line levels the operational amplifier at the input of IC1 is used as a summing mode mixer. Resistor R3 is the feedback resistor and R1 plus R2 are the input resistors. The relatively high value of R1 results in a voltage gain of only 3.3 at the line input, but with an input impedance of 100k. The input amplifier mainly acts as a buffer stage for input signals at line level. R2 has a much lower value, which produces an input impedance of only about 1 k, but this is well suited to a low impedance dynamic or electret microphone. The voltage gain at this input is much higher at about 330, but this higher gain is needed due to the low output level from a low impedance microphone. Even with this much higher level of gain the microphone may have to be used quite close to the user's

mouth. Capacitor C5 is the decoupling capacitor for the internal bias circuit for the input amplifier.

Resistors R4 and R5 are part of the built-in oscillator circuits. R4 controls the vibrato frequency, and the specified value gives an operating frequency of about 8 Hz. R5 is part of the main timebase generator circuit. Switches S1 to S3 are the mode control switches. A switch on pin 18 to provide a shortcut to the robot mode has not been included, but it could easily be added if desired. The digital to analogue converter is a type that provides an output current rather than a voltage, but load resistor R6 effectively converts the output stage to normal voltage operation. The audio output signal from pin 9 is a digitised type which requires the usual lowpass filtering to remove the high frequency components. Q1 is used as an emitter follower buffer stage in a third order lowpass filter that has a cut-off frequency of about 3.5 kHz. This bandwidth is adequate for a voice signal, and is approaching the absolute maximum bandwidth supported by the sampling frequency of 8 kHz. Resistors R10 and R11 form the emitter load for Q1, and they also act as an attenuator which provides the microphone level output. This output is at about -40 decibels compared to the line output level, which should be high enough to fully drive any microphone input, but low enough to avoid overloading.

The total current consumption of the circuit is approximately 2 mA, but it increases to about two or three times this level when audio level indicator D1 is operating brightly. Each set of two HP7 batteries should last about 500 to 1000 hours. Note that the maximum operating voltage for the HT-8950 is just 4 volts, and that the absolute maximum supply rating is just 5.5 volts. Do not use a supply potential of more than 3 volts as this could cause a malfunction, and could even damage the HT-8950.

### Construction

Figure 4 shows the component layout for the stripboard panel, which measures 32 holes by 24 copper strips. This is not a standard size in which stripboard is sold, and a larger piece will therefore have to be trimmed to size using a hacksaw. Then drill

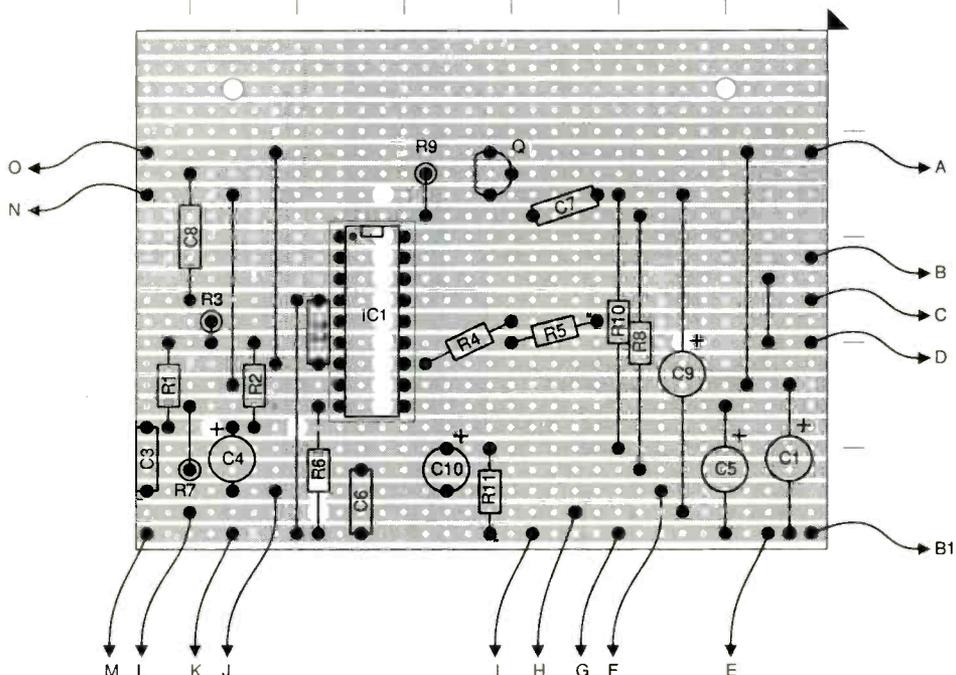


Figure 4: the component layout for the stripboard panel

the two 3.3 millimetre diameter mounting holes which will accept either metric M3 or 6BA mounting bolts. Next the breaks in the copper strips are made using either the special tool, or a hand-held twist drill bit of about 5 millimetres in diameter will do the job quite well.

The board is then ready for the components and link-wires to be added. The HT-8950 is a CMOS device and it therefore requires the standard anti-static handling precautions. As this chip is not particularly cheap it is a good idea to follow these precautions "to the letter." The most important one is to use a holder, and not to fit IC1 into the holder until the board and all the hard wiring have been completed. Until you are ready to fit IC1 into its holder it should be left in its anti-static packaging. When fitting it in place try not to touch the pins any more than is really necessary, and you should obviously keep well away from any known sources static charges.

Apart from IC1, the exact order in which the components and link-wires are fitted to the board is not too important, but it is best to work methodically rather than just fitting components at random. One or two of the link-wires are fairly long, and in order to avoid accidental short circuits they must either be kept quite taut or they must be insulated with PVC sleeving. Fit single-sided solder pins to the board at the points where connections to the off-board components such as the switches and sockets will be made. One millimetre diameter pins are needed for normal 0.1 inch matrix stripboard.

The prototype is housed in a plastic and metal instrument case which measures about 170 millimetres wide, but this is substantially larger than is really necessary. In most respects the general layout of the unit is not too critical, but the leads which connect the input sockets to the component panel must either be very short or screened cable must be used. Even when using a slightly oversized case it can be difficult to find space for everything on the front panel. It is probably better to move some or all of the sockets to the rear panel rather than cram everything on to an overcrowded front panel.

Details of the hard wiring are provided in figure 5, which should be used in conjunction with figure 4 (eg point "A" in figure 4 connects to point "A" in figure 5). I used 3.5 millimetre jack sockets for JK2 and JK3 and phono sockets for JK1 and JK4, but you can obviously use any audio connectors that match the equipment you will use with the voice modulator. A plastic holder is used for the two HP7 batteries and the connections to the holder are made by way of an ordinary PP3 style battery clip. LED indicator D1 is not driven at a particularly high average current and it is therefore advisable to use a high efficiency type. The cathode (k) terminal is usually indicated by having that lead shorter than the anode lead.

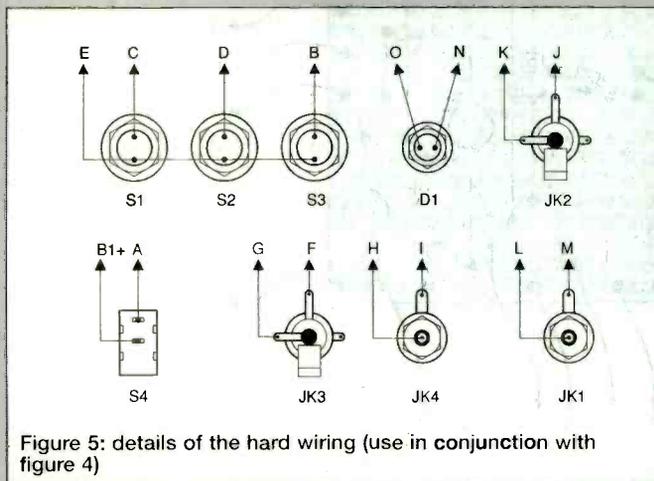
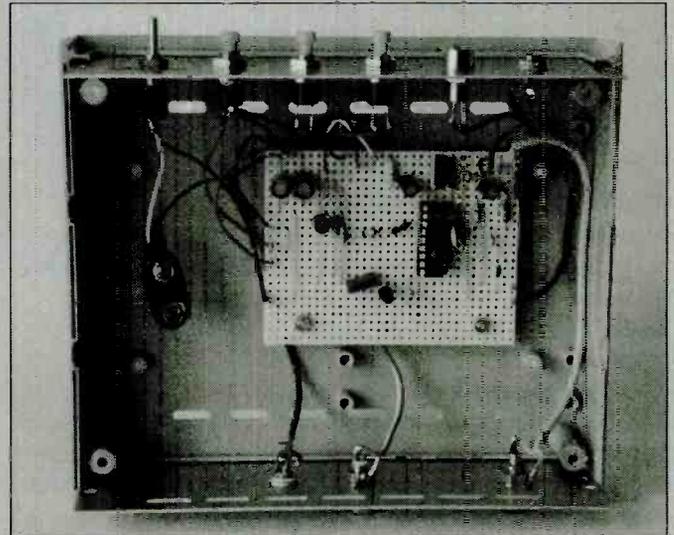


Figure 5: details of the hard wiring (use in conjunction with figure 4)

## Testing and use

Mistakes are relatively easy to make when using stripboard, so it is a good idea to thoroughly check the finished unit before connecting the battery and trying it out. A good way of giving the unit an initial check is to monitor the line output using a crystal earpiece, with the input signal being provided by a microphone. At switch-on you should obtain the robot effect, and with or without the added vibrato, as you talk into the



## PARTS LIST for the Digital Voice Modulator

### Resistors

(All 0.25W 5 percent carbon film)

R1,4	100k
R2	1k
R3	330k
R5	47k
R6	560R
R7,8,9	3K3
R10	2k2
R11	22R

### Capacitors

C1	100u 10V radial elect
C2	100n ceramic
C3	22n polyester
C4	1u 50V radial elect
C5	4u7 50V radial elect
C6	33n polyester
C7	68n polyester
C8	330p ceramic plate
C9,10	10u 25V radial elect

### Semiconductors

IC1	HT-8950
Q1	BC549
D1	Red panel LED

### Miscellaneous

JK1,4	Standard jack or phono socket
JK2,3	3.5mm jack socket
S1,2,3	Push to make, non-locking pushbutton switch
S4	SPST min toggle switch
B1	3 volt (2 x HP7 size cells in holder)

Small metal or plastic case, 18-pin DIL holder, 0.1 inch pitch stripboard measuring 32 holes by 24 copper strips, PP3 type battery connector, wire, solder, etc.



ELECTRONIC COMPONENTS

Station Road, Cullercoats, Tyne & Wear, NE30 4PQ

Tel: (0191) 251 4363

Fax: (0191) 252 2296

Email: sales@esr.co.uk

http://www.esr.co.uk

See Next / Last Months Ad. for COMPONENT ACCESSORIES

Table of electronic components including 4000 Series, 74HC Series, 74LS Series, Linear ICs, Diodes, Bridge Rectifiers, Transistors, A/D Converters, Microcontrollers, Voltage Regulators, Potentiometers, Resistors, and Ceramic Mini Discs. Includes part numbers, descriptions, and prices.

SAMEDAY DESPATCH Quality Components No Minimum Order Value

ORDERING INFORMATION - Carriage £1.25+Vat, Prices Exclude Vat (17.5%), Add Carriage & Vat to all orders. Payment with Order. PO/Cheques payable to ESR Electronic Components. ALL Credit Card Orders Accepted. NO Credit Card Surcharges. Trade discount for Schools & Colleges.



**8 CAVANS WAY,  
BINLEY INDUSTRIAL ESTATE,  
COVENTRY CV3 2SF**  
Tel: 01203 650702  
Fax: 01203 650773  
Mobile: 0860 400683

(Premises situated close to Eastern-by-pass in Coventry with easy access to M1, M6, M40, M42, M45 and M69)

### OSCILLOSCOPES

Beckman 9020 - 20MHz - Dual Channel	£150
Cossor 3102 - 60MHz Dual Channel	£250
Gould 1602 - 20 MHz D.S.O. with printer (cursors)	£1150
Gould OS 245A/250/255/300/300/335/14000	from £125
Hamlet 20320/25 - 20MHz - Dual Channel	from £150
Hewlett Packard 180A/180C/181A/182C	from £200
Hewlett Packard 1740A, 1741A, 17744A, 100MHz dual ch	from £350
Hewlett Packard 54100D - 1GHz Digitizing	£2995
Hewlett Packard 54501A - 100MHz - Digitizing 4 channel	£1750
Hewlett Packard 54602A - 150MHz - 4 channel	£1750
Hitachi V650F - 60 MHz Dual Channel	£350
Hitachi VC6265 - 100 MHz Digital Storage (AS NEW) GPIB	£2250
Hitachi V152FV302B/V302F/V353F/V550B/V650F	from £125
Intron 2020 - 20 MHz Digital Storage (NEW)	£650
Iwatsu SS 5710/SS 5702 - 20MHz	from £125
Kikusui COS 6100 - 100MHz - 5 Channel, 12 Trace	£475
Kikusui 5100 - 100MHz - Dual Channel	£350
Meguro - MSO 1270A - 20 MHz Digital Storage (NEW)	£650
National VP5703A - 100MHz - Digital Storage	£750
Nicolet 310 - L.F. D.S.O with twin Disc Drive	£550
Nicolet 3091 - L.F. D.S.O.	£900
Panasonic VP5741A - 100 MHz D.S.O. with Digital readout - waveform analysis - TV Signal Analysis Function - G.P.I.B.	£1995
Philips PM 3211/PM 3212/PM 3214/PM 3217/PM 3234/PM 3240/PM 3243/PM 3244/PM 3261/PM 3262/PM 3263/PM 3540	from £125
Philips PM 3295A - 400MHz Dual Channel	£1750
Scopex 14D-15 - 15MHz - Dual Channel	£100
Tektronix 434 - 25MHz - 2 Channel, Analogue Storage	£250
Tektronix 454 - 150MHz - 2 Channel	£400
Tektronix 468 - 100MHz - D.S.O.	£750
Tektronix 2213 - 60MHz Dual Channel	£425
Tektronix 2215 60MHz dual trace	£450
Tektronix 2235 - 100MHz-Dual trace	£800
Tektronix 2236 - 100MHz Dual Channel with Counter/Timer	£995
Tektronix 2335 Dual trace 100MHz (portable)	£750
Tektronix 2445 150 MHz - 4 Channel	£1250
Tektronix 2445A - 150MHz - 4 Channel	£1650
Tektronix 2465 - 350MHz - 4 channels	£2300
Tektronix 2225 - 50MHz dual ch	£450
Tektronix 455 - 50MHz Dual Channel	£350
Tektronix 464/466 - 100MHz An storage	from £350
Tektronix 465/465B - 100MHz dual ch	from £350
Tektronix 475/475A - 200MHz/250MHz Dual Channel	from £475
Tektronix 485 - 350MHz - 2 channel	£900
Tektronix 5403 - 60MHz - 2 or 4 Channel	from £250
Tektronix 7313, 7603, 7613, 7623, 7633, 100MHz 4 ch	from £300
Tektronix 7704 - 250MHz 4 ch	from £650
Tektronix 7904 - 500MHz	from £850
Tektronix 7934 - 500MHz with storage	from £1000
Trio CS-1022 - 20MHz - Dual Channel	£125

Other scopes available too

### SPECIAL OFFER

HITACHI V212 - 20 MHZ DUAL TRACE	£180
HITACHI V222 - 20 MHZ DUAL TRACE + ALTERNATE MAGNIFY	£200

### SPECTRUM ANALYSERS

Advantest 4131 - 10KHz - 3.5GHz (G.P.I.B)	£5000
Ando AC8211 - Spectrum Analyser 1-7GHz	£3000
Eaton/Alltech 757 - 10KHz - 22 GHz	£2750
Hewlett Packard 3580A - -5Hz-50KHz	£995
Hewlett Packard 3709B - Constellation Analyser with 15709A High Impedance Interface (As New)	£5750
Hewlett Packard 182T with 8559A (10MHz - 21GHz)	£3750
Hewlett Packard 35601A - Spectrum Analyser Interface	£1000
Hewlett Packard 3585A - 40MHz Spectrum Analyser	£5000
Hewlett Packard 141T + 8552B + 8555A - (10MHz - 18GHz)	£1600
Hewlett Packard 3562A Dual Channel Dynamic Sig. Analyser	£7500
Hewlett Packard 895A - Network Analyser 500KHz - 1300MHz	£3250
Hewlett Packard 853A + 8558B - 0.1 to 1500MHz	£3250
Hewlett Packard 182T + 8558B - 0.1 to 1500MHz	£2750
Hewlett Packard 8565A - 0.01-22GHz	£3750
Hewlett Packard 8754A - Network Analyser 4-1300MHz	£2500
Marconi 2370 - 110MHz	£995
Marconi 2371 - 30KHz - 200MHz	£1250
Meguro MSA 4901 - 1-300 GHz (AS NEW)	£1995
Meguro MSA 4912 - 1-1 GHz (AS NEW)	£3000
Poirad 641-1 - 10MHz - 18GHz	£1500
Rohde & Schwarz - SWOB S Polyskop 0.1 - 1300MHz	£2500
Takeda Riken 4132 - 1.0GHz Spectrum Analyser	£2750
Tektronix 7L18 with 7603 mainframe (1.5-60GHz with external mixers)	£2000

### MISCELLANEOUS

Adret 740A - 100KHz-1120MHz Synthesised Signal Generator	£2000
ANRITSU ME 462B DF/3 Transmission Analyser	£3000
Danbridge JP30A - 30KV Insulation Tester	£1500
Anritsu MG642A Pulse Pattern Generator	£1500
Dranetz 626 - AC/DC - Multifunction Analyser	£850
EIP 331 - Frequency counter 18GHz	£700
Farnell AP70-30 Power Supply (0.70V/30A) Auto Ranging	£750
Farnell TSV 70 MkII Power Supply (70V-5A or 35V-10A)	£200
Farnell DSG-1 - Synthesised Signal Generator	£125
Flure 5100A - Calibrator	£2500
Flure 5101B - Calibrator with Tape Deck	£4000
Flure 5100B - Calibrator	£3500
Guidline 9152 - T12 Battery Standard Cell	£550
Heiden 1107 - 30V-10A Programmable Power Supply (IEEE)	£650
Hewlett Packard 331A - Distortion Analyser	£300
Hewlett Packard 333A - Distortion Analyser	£300
Hewlett Packard 335A - Synthesised Signal Generator (10Hz-21MHz)	£1000
Hewlett Packard 3437A System voltmeter	£350
Hewlett Packard 3456A Digital voltmeter	£850
Hewlett Packard 3438A Digital multimeter	£200
Hewlett Packard 3711A/3712A/3791B/3793B Microwave Link Analyser	£2250
Hewlett Packard 3776A - PCM Terminal Test Set	£POA
Hewlett Packard 3325A - 21MHz Synthesiser/Function Gen	£1500
Hewlett Packard 3488A - HP - 1B Switch control unit (various Plug-ins available)	£650
Hewlett Packard 334A - Distortion Analyser	£300
Hewlett Packard 3455A - Distortion Measuring Set	£1500
Hewlett Packard 3455A - 6 1/2 Digit M/Meter (Autocal)	£750
Hewlett Packard 3478A - Multimeter (5 1/2 Digit) + HP-1B	£550
Hewlett Packard 3776A - PCM Terminal Test Set	£P.O.A.
Hewlett Packard 3779A/3779C - Primary Mux Analyser	from £600
Hewlett Packard 436A + Sensor	from £1000
Hewlett Packard 4275A - LCR Meter (Multi-Frequency)	£3900
Hewlett Packard 4338A - Millionmeter (As New)	£2500

Hewlett Packard 4342A - 'Q' Meter	£995
Hewlett Packard 4952A - Protocol Analyser (with interfaces)	£2500
Hewlett Packard 4953A - Protocol Analyser	£2750
Hewlett Packard 432A - Power Meter (with 478A Sensor)	£275
Hewlett Packard 435A or B Power Meter (with 8481A/8484A)	from £750
Hewlett Packard 4271B - L.C.R. Meter (Digital)	£900
Hewlett Packard 4279A - 1MHz, C-V Meter	£6500
Hewlett Packard 4948A - (TIMS) Transmission impairment M/Set	£2000
Hewlett Packard 4972A - Lan Protocol Analyser	£2000
Hewlett Packard 5420A Digital Signal Analyser	£350
Hewlett Packard 5335A - 200MHz High Performance Systems Counter	£600
Hewlett Packard 5183 - Waveform Recorder	£250
Hewlett Packard 5183 - Waveform Recorder	£2250
Hewlett Packard 5238A Frequency Counter 100MHz	£250
Hewlett Packard 5370A - 100MHz Universal Timer/Counter	£450
Hewlett Packard 5385A Frequency Counter - 1GHz - (HP1B) with OPTS 001/003/004/005	£995
Hewlett Packard 6034 - 60v-10a System Power Supply	£1500
Hewlett Packard 6253A Power Supply 20V-3A Twin	£200
Hewlett Packard 6181C D.C. current source	£150
Hewlett Packard 6255A Power Supply 40V - 1.5A Twin	£200
Hewlett Packard 6266B Power Supply 40V-5A	£220
Hewlett Packard 6271B Power Supply 60V-3A	£225
Hewlett Packard 6034A - 0-60V-10A System P.S.U.	£1500
Hewlett Packard 7475A - 6 Pen Plotter	£250
Hewlett Packard 7550A - 8 Pen Plotter A3/A4	£450

### HEWLETT PACKARD 6261B

Power Supply 20v-50A £450 Discount for Quantities

Hewlett Packard 8349B - Microwave Broad Band Amplifier	£3500
Hewlett Packard 83555A - Millimeter - Wave Source Module 33-50GHz	£4250
Hewlett Packard 8015A - 50MHz Pulse Generator	£750
Hewlett Packard 8403A - Modulator	£500
Hewlett Packard 8405A - Vector Voltmeter	£500
Hewlett Packard 8165A - 50 MHz Programmable Signal Source	£1650
Hewlett Packard 8350B - Sweep Oscillator Mainframe (various Plug-Ins available) extra	£2650
Hewlett Packard 8152A - Optical Average Power Meter	£1250
Hewlett Packard 8158B - Optical Attenuator (OPTS 002 + 011)	£1100
Hewlett Packard 83554A - Wave Source Module 26.5 to 40 GHz	£3500
Hewlett Packard 8620C Sweep oscillator mainframe	£400
Hewlett Packard 8684A 5.4GHz to 12.5GHz Sig-Gen	£2750
Hewlett Packard 8620C Sweep oscillator mainframe	from £250
Hewlett Packard 8750A Storage normaliser	£375
Hewlett Packard 8903A - Audio Analyser (20Hz - 100KHz)	£2600
Hewlett Packard 8958A - Cellular Radio Interface	£4000
Hewlett Packard 8901A - Modulation Analyser	£3400
Hewlett Packard P382A Variable Attenuator	£250
Hewlett Packard 1630D - Logic Analyser (43 Channels)	£650
Hewlett Packard 16500A - Fitted with 16510A/16515A/16530A/16531A - Logic Analyser	£4000
Hewlett Packard 11729B - Carrier Noise Test Set	£2000
Krohn-Hite 2200 Lin/Log Sweep Generator	£995
Krohn-Hite 4024A Oscillator	£250
Krohn-Hite 5200 Sweep, Function Generator	£350
Krohn-Hite 6500 Phase Meter	£250
Marconi 2019 - 80KHz-1040MHz Synthesised Sig. Gen	£1850
Marconi 2019A - 80KHz-1040MHz - Synthesised Signal Generator	£1950
Marconi 2022A - 10KHz-1GHz AM/FM Signal Generator	£2000
Marconi 2022A 500KHz digital frequency meter	£2000
Marconi 2610 - True RMS Voltmeter	£850
Marconi 2871 Data Comms Analyser	£2000
Philips PM 5167 10MHz function gen.	£400
Philips 5190 L.F. Synthesiser (G.P.I.B.)	£800
Philips PM5519 - TV Pattern Generator	£350
Philips PM5667 - Vectorscope	£500
Philips PM6652 - 1.5GHz Programmable High Resolution Timer/Counter	£3900
Philips PM6670 - 120MHz High Resolution Universal Counter	£350
Philips PM6673 - 120MHz High Resolution Universal Counter	£350
Prima 1000 - 6 1/2 Digit Multimeter (NEW)	£450
Racal 1992 - 1.3GHz Frequency Counter	£800
Racal Dana 9081/9082 Synth sig. gen. 520MHz	from £500
Racal Dana 9084 Synth sig. gen. 104MHz	£450
Racal Dana 9303 R/F Level Meter & Head	£650
Racal Dana 9917 UHF frequency meter 560MHz	£175
Racal Dana 9302A R/F millivoltmeter (new version)	£375
Racal Dana 9082 Synthesised am/fm sig gen (520MHz)	£500
Racal 9085 Low Distortion Oscillator	£POA
Racal 9301A - True RMS R/F Millivoltmeter	£300
Racal 9921 - 3GHz Frequency Counter	£450
Rohde & Schwarz AMF 2 - TV Demodulator	£1250
Rohde & Schwarz LFM 2 - 60 Mhz Group Delay Sweep Gen	£1600
Rohde & Schwarz SMPF 2 - 1GHz Radio Comms T/Set	£2500
Rohde & Schwarz URF 2 - Video Noise Meter	£1400
Rohde & Schwarz URE - RMS Voltmeter (10Hz-25MHz)	£500
Rohde & Schwarz URU - Scud Radio Code Test Set	£300
Rohde & Schwarz SUP 2 Noise Generator	£300
Rohde & Schwarz UPGS - Psophometer	£150
Rohde & Schwarz SMDU - 15Hz to 525MHz Signal Gen (FM & AM)	£500
Schaffner NSG 203A Line Voltage Variation Simulator	£950
Schaffner NSG 221A Interference Simulator	£250
Schaffner NSG 223 Interference Generator	£850
Schaffner WSG 431 Electrostatic Discharge Simulator	£1250
Schlumberger 4923 Radio Code Test Set	£950
Schlumberger 4031 - 1GHz Radio Comms Test Set	£7000
Schlumberger 2720 1250 MHz Frequency Counter	£500
Schlumberger 7060/7065/7075 Multimeters	from £350
Solartron 1250 - Freq. Response Analyser	£2500
Stanford Research DS 340 - 15 MHz Synthesized Function (NEW) and arbitrary waveform generator	£1200
Systron Donner 6030 - Microwave Frequency Counter (26.5 GHz)	£2500
Tequipment CT71 Curve Tracer	£250
Tektronix TM5003 + AFG 5101 Arbitrary Function Gen	£1750
Tektronix 1240 Logic Analyser	£750
Tektronix DAS9100 - Series Logic Analyser	£500
Tektronix - Plug-ins - many available such as SC504, SW503, SG502, PG508, FG504, FG503, TG501, TR503 + many more	£POA
Tektronix 577 Curve Tracer	£1150
Tektronix AM503 + TM501 + P6302 - Current Probe Amplifier	£995
Tektronix PG506 + TG501 + SG503 + TM503 - Oscilloscope Calibrator	£1995
Tektronix AA5001 + TM 5006 M/F - Programmable Distortion Analyser	£2500
Tektronix 577 - Curve Tracer	£1150
Time 9811 Programmable Resistance	£600
Time 9814 Voltage Calibrator	£750
Toellner 7720 - Programmable 10 MHz Function Gen (AS NEW)	£700
Valhalla Scientific - 2724 Programmable Resistance Standard	£P.O.A.
Wayne Kerr 3245 - Precision Inductance Analyser	£3250
Wayne Kerr 4210 - LCR Meter	£600
Wayne Kerr 4225 - LCR Bridge	£600
Wayne Kerr 6425 - Precision Component Analyser	£275
Wayne Kerr 8905 - Precision LCR Meter	£850
Wavetek 171 - Synthesised Function Generator	£250
Wavetek 72B Programmable Sig Source (0.0001Hz-13MHz)	£P.O.A.
Wavetek 184 - Sweep Generator - 5MHz	£250
Wavetek 3010 - 1 - 1GHz Signal Generator	£1250
Wiltron 6620S - Programmable Sweep Generator (3.6 - 6.5GMZ)	£650

**MANY MORE ITEMS AVAILABLE -  
SEND LARGE S.A.E. FOR LIST OF EQUIPMENT  
ALL EQUIPMENT IS USED -  
WITH 30 DAYS GUARANTEE.  
PLEASE CHECK FOR AVAILABILITY BEFORE  
ORDERING - CARRIAGE & VAT TO BE ADDED  
TO ALL GOODS**

microphone its effect on your voice should be very obvious indeed. The data sheet for the HT-8950 does not give any precise details on how this effect is produced, but it apparently uses a "chopping" technique. Together with the vibrato this produces a sort of super "Dalek" effect! Remember that in any operating mode, pressing S1 toggles the vibrato effect on and off.

By operating S1 and S3 it should be possible to cycle the unit through all the available effects. Once again, the effects are very obvious, especially when using a large shift in pitch. In general it is best to move high pitched voices downwards and low pitched voices upwards. Moving a high pitched voice higher in pitch tends to take many of the voice frequencies outside the bandwidth of the modulator, and gives an output that can be difficult to understand. Similarly, shifting a low pitched voice even lower in pitch can give very poor intelligibility, and a very odd sound!

The input stage operates as a simple summing mode mixer, and the unit will work using microphone and line input signals simultaneously. However, using more than one input signal at a time might not give very good results, and the unit works best if it is only used with voice signals, and one signal at a time.

It is interesting to use the unit on the voices of the rich and famous. Try connecting the earphone output of a radio to the line input of the modulator, and then search the bands for victims. Results can sometimes be surprising, with the voice of someone famous being turned into the voice of someone else who is famous. Shifting the voice of John Major down a couple of notches produces a very good impersonation of Sir Edward Heath! No doubt many other interesting transformations are possible.

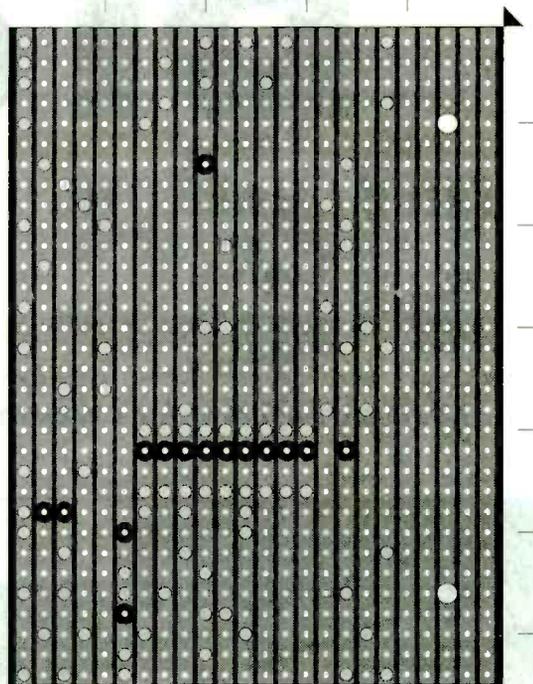


Figure 6: the stripboard reverse

**NEW SPECIAL OFFERS**

New mini waterproof TV camera 40x40x15mm requires 10 to 20 volts at 120mA with composite video output (to feed into a video or a TV with a SCART plug) it has a high resolution of 450 TV lines Vertical and 380 TV lines horizontal, electronic auto iris for nearly dark (1 LUX) to bright sunlight operation and a pinhole lens with a 92 degree field of view, it focuses down to a few CM. It is fitted with a 3 wire lead (12v in gnd and video out).  
 £93.57 + VAT = £109.95 or 10+ £89.32 + VAT = £104.95.  
 High quality stepping motor kits (all including stepping motors) "Comstep" independent control of 2 stepping motors by PC (Via the parallel port) with 2 motors and software.  
 Kit ..... £67.00 ready built ..... £99.00  
 Software support and 4 digital inputs kit ..... £27.00  
 power interface 4A kit ..... £36.00  
 power interface 8A kit ..... £46.00  
 Stepper kit 4 (manual control) includes 200 step stepping motor and control circuit ..... £23.00  
 Hand held transistor analyser it tells you which lead is the base, the collector and emitter and if it is NPN or PNP or faulty ..... £33.45  
 LEDs 3mm or 5mm red or green ..... 7p each  
 yellow ..... 11p each  
 cable ties ..... 1p each £5.95 per 1000  
 £49.50 ..... per 10,000  
 Rechargeable Batteries  
 AA (HP7) 500 mA ..... £0.99  
 AA 500mAh with solder tags ..... £1.55  
 AA 700 mA ..... £1.75  
 C (HP 11) 1.2AH ..... £2.20  
 C 2AH with solder tags ..... £3.60  
 D (HP2) 1.2AH ..... £2.60  
 D 4AH with solder tags ..... £4.95  
 PP3 8.4V 110mAh ..... £4.95  
 1/2AA with solder tags ..... £1.55  
 Sub C with solder tags ..... £2.50  
 AAA (HP16) 180mAh ..... £1.75  
 1/3 AA with tags (philips CTV) ..... £1.95  
 Standard charger charges 4 AA cells in 5 hours or 4Cs or Ds in 12-14 hours + 1xPP3 (1, 2, 3 or 4 cells may be charged at a time) ..... £5.95  
 High power charger as above but charges the Cs and Ds in 5 hours AAs Cs and Ds must be charged in 2s or 4s ..... £10.95  
 Nickel Metal Hydride AA cells high capacity with no memory. If charged at 100mA and discharged at 250mA or less 1100mAh capacity (lower capacity for high discharge rates) ..... £3.75  
 Special offers please check for availability  
 stick of 4 42 x 16mm nicad batteries 171mmx16mm dia with red & black leads 4.8v ..... £5.95  
 5 button cell 6V 280mAh battery with wires (Varta 5x250DK) ..... £2.45  
 Shaded pole motor 240Vac 5mm x 20mm shaft 90 x 60 x 55mm excluding the shaft ..... £4.95 each  
 115v ac 80v dc motor 4mm x 22mm shaft 50mm dia x 60 long body (excluding the shaft) it has replaceable thermal fuse and brushes ..... £4.95 each £3.95 100+  
 7 segment common anode led display 12mm ..... £0.45  
 LM337k TO3 case variable regulator ..... £1.95  
 GaAs FET low leakage current S8873 £12.95 each  
 ..... £9.95 10+ £7.95 100+  
 BS250 P channel mosfet £0.45, BC559 transistor ..... £3.95 per 100  
 ..... 20 for £1.00  
 BC547A transistor ..... £1.00  
 74LS05 hex inverter £10.00 per 100, used 8748 Microcontroller £3.50  
 SL952 UHF Limiting amplifier LC 16 surface mounting

package with data sheet ..... £1.95  
 D.C. DC converter Reliability model V12P5 12v in 5v 200ma out 300v input to output isolation with data £4.95 each or pack of 10 £39.50  
 Hour counter used 7 digit 240v ac 50Hz ..... £1.45  
 QWERTY keyboard 58 key good quality switches new ..... £6.00  
 Airpax A82903-C large stepping motor 14v 7.5' step 27ohm 68mm dia body 6.3mm shaft £8.95 or £200.00 for a box of 30  
 Polyester capacitors box type 22.5mm lead pitch 0.9uf 250vdc 18p each 14p 100+ 9p 1000+ 1uf 250vdc 20p each, 15p 100+, 10p 1000+ 7uf 50v bipolar electrolytic axial leads 15p each, 7.5p 100+ 0.2uf 250v polyester axial leads 15p each, 7.5p 100+ Polypropylene 1uf 400vdc (Wima MKP10) 27.5mm pitch 32x29x17mm case 75p each 60p 100+ Philips 123 series solid aluminium axial leads 33uf 10v & 2.2uf 40p each, 25p 100+ Philips 408 series long life 22uf 63v axial 30p each 15p 1000+  
 Multilayer AVX ceramic capacitors all 5mm pitch 100v 100pf, 150pf, 220pf, 10,000pf (10n) 10p each, 5p 100+, 3.5p 1000+  
 500pf compression trimmer ..... 60p  
 40 uf 370vac motor start capacitor (dielectric type containing no pcb) £5.95 or £49.50 for 10  
 Solid carbon resistors very low inductance ideal for RF circuits  
 27ohm 2W 68ohm 2W 25p each 15p each 100+ we have a range of 0.25w 0.5w 1w and 2w solid carbon resistors please send SAE for list  
 P.C. 400W PSU (Intel part 201035-001) with standard motherboard and 5 disk drive connectors, fan and mains inlet/outlet connectors on back and switch on the side (top for lower case) dims 212x49x149mm excluding switch £26.00 each  
 £138.00 for 6  
 MX180 Digital multimeter 17 ranges 1000vdc 750vac 2Mohm 200mA transistor He 9v and 1.5v battery test ..... £9.95  
 AMD 27256-3 Eproms £2.00 each, £1.25 100+  
 DIP switch 3PCO 12 pin (ERG SDC-3-023) 60p each 40p 100+  
 Disk drive boxes for 5.25 disk drive with room for a power supply light grey plastic 67x268x247mm £7.95 or £49.50 for 10  
 Hand held ultrasonic remote control ..... £3.95  
 CV2486 gas relay 30 x 10mm dia with 3 wire terminals will also work as a neon light 20p each or £7.50 per 100  
 Varsatim R300NH Streamer tape commonly used on nc machines and printing presses etc. it looks like a normal cassette with a slot cut out of the top £4.95 each (£3.75 100+)  
 Heatsink compound tube ..... 95p  
 HV3-2405-E5 5-24v 50mA regulator ic 18-264vac input 8 pin DIL package £3.49 each (100+ £2.25)  
 LM 555 timer ic 16p, 8 pin DIL socket 6p  
 All products advertised as new and unused unless otherwise stated. Wide range of CMOS TTL 74HC 74F Linear Transistors kits, rechargeable batteries capacitors tools etc. always in stock.  
 Please add £1.95 towards P&P, vat inc. in all prices

**JPG ELECTRONICS**

ETI 276-278 Chatsworth Road, Chesterfield S40 2BH  
 Access Visa Orders (01246) 211202 fax 550959  
 Callers Welcome 9.30am-5.30pm Monday-Saturday

**Surplus Electronic Components at competitive prices**

I.C.'s,  
 Transistors,  
 Diodes,  
 Regulators, etc.

Write, Fax or phone for full list:

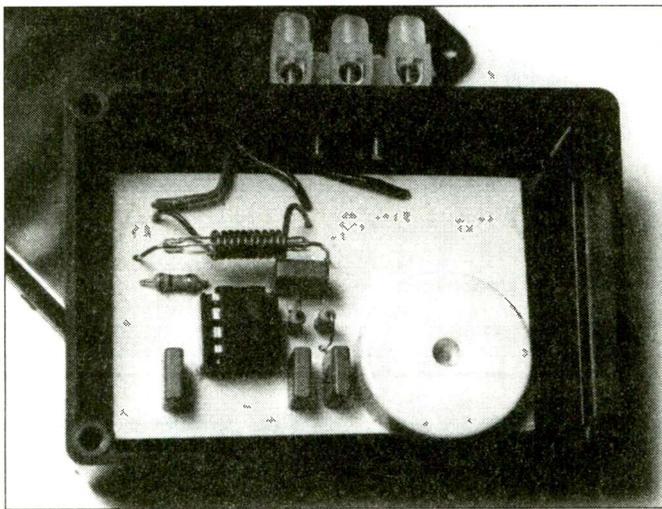
**Harrison Electronics**

Century Way, March,  
 Cambs. PE15 8QW

Tel/Fax: (01354) 651289

# Brake Light Checker

*A self-test system for caravan and trailer brake lights by Terry Balbirnie*



## Self-check

There is no such checking requirement for the brake lights. However, these are also very important - especially when the lamps on the towing vehicle cannot be seen by the driver behind. The present circuit fulfils this need by checking that the stop lights are both working. Under normal conditions of use nothing happens. However, when there is a fault, a high-pitched beeping will be given each time the brakes are applied. This will probably be unlike any other sound in the car and, being high-pitched, will be easily heard above engine and other noises. As well as failure of one or both bulbs, faults which will trigger the unit include poor connections at the towbar plug and socket, broken wires, corrosion in cables or at the lampholders and bad earthing. Note that the unit will not operate in the event of a fault which would cause the brake lights on the car itself to fail. An example of this would be the fuse feeding them having blown. Since this fuse carries an additional load of 100 percent, it is necessary to follow the manufacturer's recommendation regarding uprating it if necessary.

**T**he law requires flashing indicators on towed vehicles to have some sort of built-in check to show the driver that they are working. This often takes the form of a small dashboard light which blinks in time with the car indicators if the corresponding one on the trailer is operating. Some systems use a buzzer instead.

## How it works

The complete circuit for the Brake Light Checker circuit is shown on figure 1. The principle components are magnetic reed switch, S1, coil L1 and integrated circuit IC1. A complete description will be given presently.

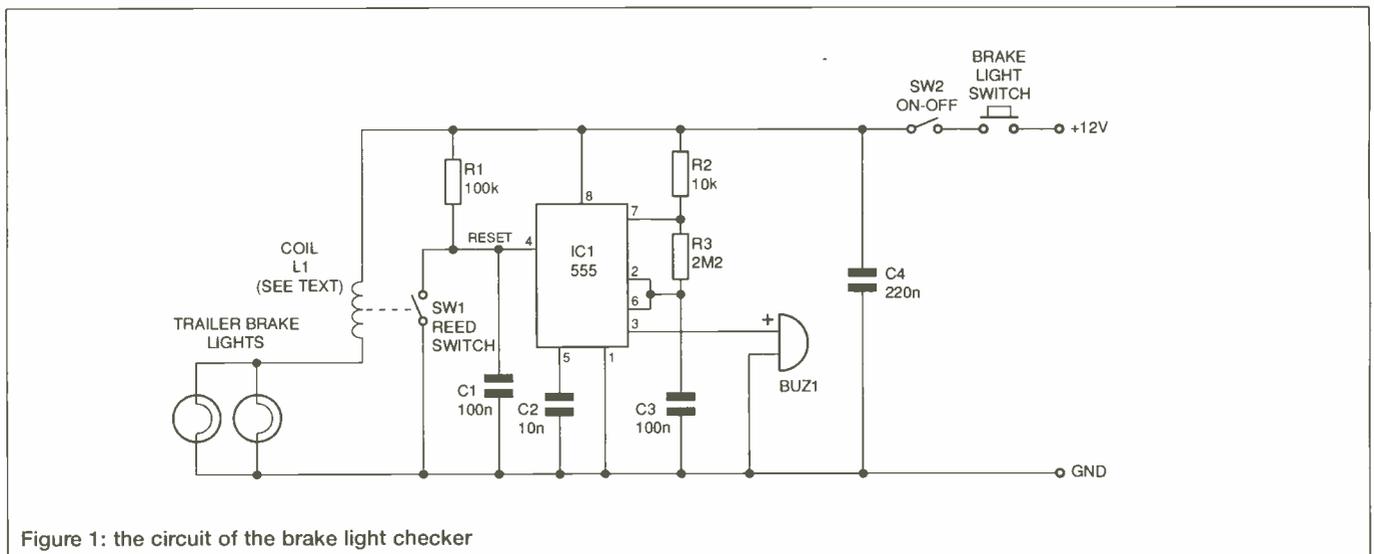


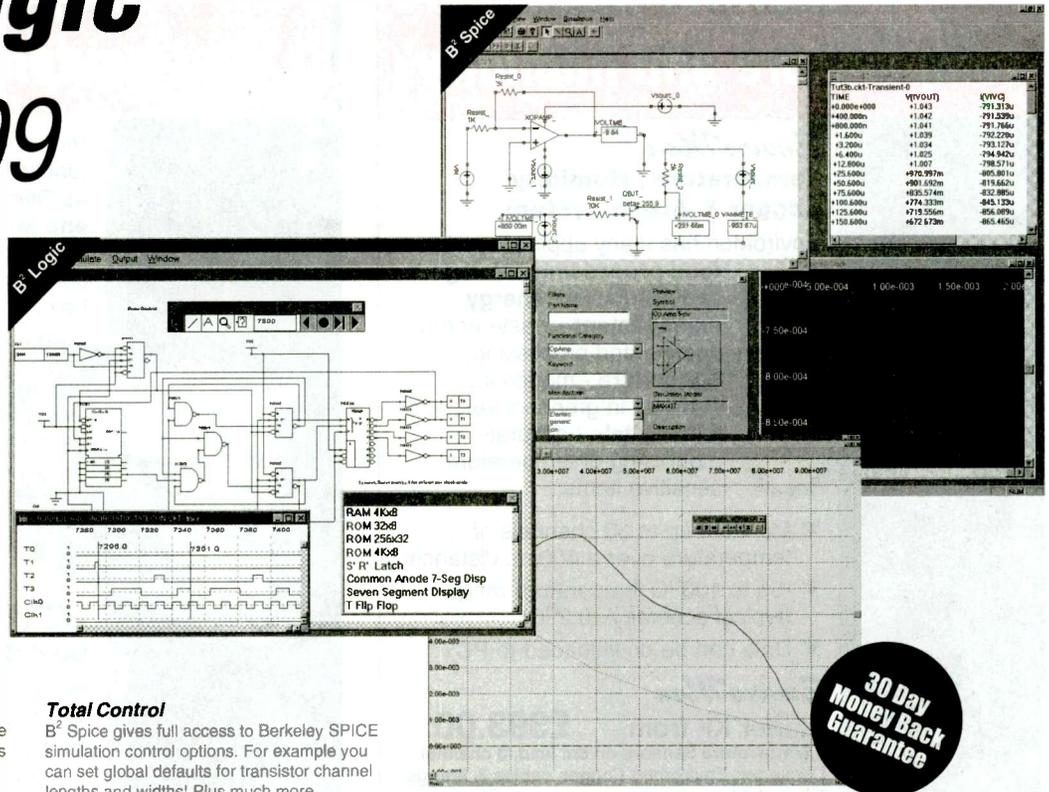
Figure 1: the circuit of the brake light checker

# B<sup>2</sup> Spice & B<sup>2</sup> Logic

## £199

## Not Just a Pretty Interface

- Design and test analogue and digital circuits quickly and easily
- Incorporates a dedicated model editing package
- Fast 32 bit SPICE 3F5 engine
- Windows 3.1/95/NT
- Mac version also available
- CD ROM or 3.5" disk



### Fully Integrated and Interactive

Build the circuit on the screen and set up the simulations by choosing options from menus and dialogues. Then run the simulation and view your results.

### Flexible Visualisation of Results

In B<sup>2</sup> Spice results can be displayed in graphs, tables or directly in voltmeters and ammeters. Change from typical to worst case analysis and include the effects of temperature on components. You can customise everything, right down to the colour of an individual trace so you see just what you need. B<sup>2</sup> Spice and B<sup>2</sup> Logic let you export data to other applications.

### Versatility

A plethora of components include resistors, capacitors, inductors, mutual inductors / transformers, controlled sources, bipolar junction transistors, zener diodes, power MESFETs, JFETs, MOSFETs, voltage regulators, operational amplifiers, opto-couplers, voltage comparators, quartz crystals, IBIS I/O buffers and switching matrix connectors and much more. All devices and model parameters can be edited to suit your needs. Implement hierarchical circuits in your designs quickly and easily.

### No Limits

With B<sup>2</sup> Spice and B<sup>2</sup> Logic there is no limit on the number of components in the circuit.

### Models

There are literally thousands of them... The complete Berkeley SPICE model library as well as commercial libraries from manufacturers such as Motorola, Texas Instruments, Burr-Brown, Maxim, National Semi, APEX Comlinear, AMP, Elantec, Linear Tech, and many more. Included with B<sup>2</sup> Spice is a full model and symbol editing package so you can create, import and edit custom models.

### Commands

B<sup>2</sup> Spice supports AC frequency sweep, DC operating point, transient analysis, fast Fourier Noise, sensitivity distortion, Tf small signal transfer.

### Simulation Options

Added facility for sub-circuits (macro-models). You can set all simulation options. Allows you to set initial conditions at all nodes. Allows you to set initial guess at nodes for simulation. Allows "not given" state for all values.

### Total Control

B<sup>2</sup> Spice gives full access to Berkeley SPICE simulation control options. For example you can set global defaults for transistor channel lengths and widths! Plus much more.

### Waveform Analysis

Display and compare multiple response curves in a single graph at the same time. B<sup>2</sup> Spice simulation results can be selectively displayed and analysed graphically and in numerical format as well as exported to other applications. All of B<sup>2</sup> Spice and B<sup>2</sup> Logic's display capabilities are completely flexible.

### Devices & Stimulus for Simulation

In B<sup>2</sup> Spice sinusoidal, constant, periodic pulse, exponential, single frequency FM, AM, DC voltage, AC voltage, VCO, Vcc, piecewise linear, exponential, polynomial / arbitrary source, voltage-controlled voltage, voltage-controlled current, current-controlled voltage, current-controlled current, Lossy and ideal transmission line, MESFET, uniform RC, current and voltage switches are all available.

### Cross Probing

Cross probing allows you to display waveform results simply by marking pins, wires and devices on the circuit drawing. Monitor results while the simulation is in progress then plot analogue results on linear or log scales.

### Graphs

In B<sup>2</sup> Spice analogue traces may be displayed as raw voltages and current values or further processed using arithmetic expressions, functions and Fast Fourier Transforms. High quality graphs let you see just what you need to, clearly and easily. You can also display multiple simulations in one graph. Multiple graphs can then be aligned and compared.

### Data Analysis

Position detection with mouse for data points. Import and export data to and from other industry standard SPICE programs. B<sup>2</sup> Spice supports Polar Smith and Nyquist charts.

### Digital Options.

B<sup>2</sup> Logic is completely flexible. Set up ROM, RAM and PLA to your own requirements. Shrink a whole circuit to a block and use it as a component in a new design. Run the simulations in real time or step by step. Customise rise and fall time of all components. Results displayed in a logic analyser or table. Select parts from all major logic families. Create your own custom libraries. Create and run pre-programmed simulations.

Design engineers need software that produces results they can rely on. Anything less is a liability. B<sup>2</sup> Spice & B<sup>2</sup> Logic will give you the accurate results you need fast.

The best way to find out if a package is really what you need is to try it, which is what we're giving you the chance to do... risk free for 30 days.

We guarantee you will be 100% satisfied with the results or your money back.

To order your copies to try for 30 days call:

## 01603 872331

<http://www.paston.co.uk/spice>  
email: [rd.research@paston.co.uk](mailto:rd.research@paston.co.uk)



**RD Research**

Research House, Norwich Road, Eastgate, Norwich, NR10 4HA  
Postage & packing £4.50. Prices quoted are ex VAT. All trademarks are acknowledged.

## 'Pico's PC Converters monitor and record temperature and humidity'.

### EnviroMon Temperature / Humidity Logger & Alarm System

EnviroMon has many applications in:  
**food processing** - storage and distribution, **energy management** - waste energy, heating and processing, **agriculture** - monitoring humidity in greenhouses, and in **hospitals** - accurate monitoring of temperature sensitive items.

- ▼ Monitors up to 30 channels of temperature over a 400 m. distance.
- ▼ -55 to 100°C temperature range (typical accuracy  $\pm 0.2^\circ\text{C}$ ).
- ▼ Data can be downloaded to PC.

**EnviroMon Starter Kit from £393.00**  
 3 temperature Sensors on 5m lead, 3 channel Converter, EnviroMon Logger, cables & fittings. Expandable at any time for around £50 / channel

### TC-08 8 channel Thermocouple to PC Converter

Simple to use thermocouple to PC interface.

- ▼ Connects to serial port - no power supply required.
- ▼ Supplied with PicoLog data logging software.
- ▼ Resolution  $0.1^\circ\text{C}$ .

**TC-08 £199.00**

Supplied with serial cable and adaptor. Calibration certificate £25.00. Thermocouple probes available.

### TH-03 3 channel Thermistor to PC Converter

- ▼ Connects to serial port - no power supply required.
- ▼ PicoLog data logging software.
- ▼ -55 to  $105^\circ\text{C}$  temperature range
- ▼ Resolution  $0.01^\circ\text{C}$ .

**TH-03 £79.00**

Supplied with serial cable and adaptor. Thermistor sensors available.

**Call for free demo disk or download our web site:**  
<http://www.picotech.com>

All prices exclusive of VAT.

Broadway House, 149-151 St Neots Rd,  
 Hardwick, Cambridge. CB3 7QJ UK  
 Tel: (0)1954 211716 Fax: (0)1954 211880  
 E-mail: post@picotech.co.uk

## 'Pico's Virtual Instrument is the most powerful, flexible test equipment in my lab.'

Pico's virtual instruments emulate the functions of traditional instruments such as **Oscilloscopes, Spectrum Analysers and Multimeters**. Controlled using the standard Windows interface, the software is easy to use with full on line help.



**NEW  
100 MS/s**

### ADC-200 Dual Channel High Speed

- ▼ 100, 50 or 20 MS/s sampling.
- ▼ 50, 25 or 10 MHz spectrum analysis.
- ▼ Advanced trigger modes - capture intermittent one-off events.
- ▼ Less than half the cost of a comparable benchtop scope.

**ADC 200-100 £549.00**  
**ADC 200-50 £499.00**  
**ADC 200-20 £359.00**

Supplied with cables and power supply.

### ADC-100 Dual Channel 12 bit resolution

The ADC-100 offers both a high sampling rate 100kS/s and a high resolution. Flexible input ranges ( $\pm 50\text{mV}$  to  $\pm 20\text{V}$ ) make the unit ideal for audio, automotive and education use.

**ADC-100**  
 with PicoScope software **£199.00**  
 with PicoScope & PicoLog software **£219.00**

### ADC-40/42 Single Channel - low cost

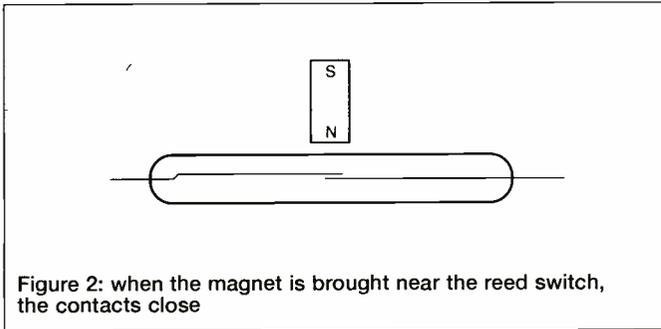
- ▼ 20 kS/s sampling.
- ▼ 10 kHz spectrum analysis.
- ▼  $\pm 5\text{V}$  input range.

**ADC-40** 8 bit resolution **£59.00**  
**ADC-42** 12 bit resolution **£85.00**

**Call for free demo disk or download our web site:**  
<http://www.picotech.com>

All prices exclusive of VAT.

Broadway House, 149-151 St Neots Rd,  
 Hardwick, Cambridge. CB3 7QJ UK  
 Tel: (0)1954 211716 Fax: (0)1954 211880  
 E-mail: post@picotech.co.uk



A reed switch consists of a short glass tube containing two flat magnetic fingers which, under normal conditions, are held slightly apart by their own springiness (see figure 2). When a magnet is brought close to the device, the fingers, or "reeds", become magnetised with opposite polarity. They therefore attract and the switch contacts on them "make". They may be used to operate some external circuit although their current-carrying capacity is quite small. Reed switches have an extremely long mechanical life (in excess of 100 million operations). Providing they carry only a small current, they will therefore have an extremely long life. Their chief drawback is that they are easily broken.

The magnet which operates the reed switch need not be a permanent one. A coil carrying a current produces a magnetic field similar to that of a bar magnet. Such a coil may be wrapped around the reed switch body and, providing it carries sufficient current, will cause it to operate. This is the principle on which the Brake Light Check circuit works. The higher the current flowing through the coil and the greater the number of turns of wire, the stronger the magnetic effect will be. The specified reed switch will operate at between 20 and 50 amp-turns. To explain this, suppose a particular specimen of switch operates at 30 amp-turns. This means that a current of 1A flowing through 30 turns of wire would cause the contacts to close. Alternatively, a current of 2A flowing through 15 turns or 3A through 10 turns would produce the same effect.

### Watt was that?

The number of turns on the coil will be chosen so that the current for one bulb is insufficient to operate the reed switch but the current for two will do so. The power rating of a standard brake light bulb is 21 watts. If this figure is divided by the nominal voltage of the car supply, ie 12V, it will give the operating current - that is, 1.75A. With both brake lights on, the current will be double this figure - 3.5A. If the reed switch operates with 30 amp-turns, the number of turns required so that the current for both bulbs will just cause the contacts to close will be 30 divided by 3.5, which gives a figure of about 9.

Since reed switches of the same type operate with different numbers of turns, it may be necessary to adjust the coil at the end of construction to make it work. With the specified switch, the correct number will lie between 6 and 15 turns. Trials suggest that these switches usually operate at the low end of the tolerance. It is suggested that 7 or 8 turns are used as a starting point. In the unlikely event of the switch operating at the high end of the tolerance, the coil will need to be re-wound with more turns. Using the specified thickness of wire (22 SWG) its resistance will be negligible and with 3.5A flowing, the voltage drop will only be about 20mV (0.02V). This is too small to have any noticeable dimming effect on the bulbs. Also, the coil will remain cool in use.

### Pulse train

Referring once again to figure 1, the warning signal is given in the following way. IC1 is an integrated circuit timer configured as an astable. Assuming on-off switch SW2 is on, a supply will be provided from the 12V car system when the brake pedal is pressed. Providing reset input pin 4 is high, a train of pulses will be produced at the output, pin 3. The pulse repetition frequency depends on the values of fixed resistors, R2 and R3 in conjunction with capacitor, C3. With the values specified, there will be several pulses produced per second. No adjustment is provided since the exact rate is not thought to be important. These pulses operate buzzer, BUZ 1, which will switch quickly on and off to give a warbling tone. Capacitor C2 is needed to provide stability in the ic.

If both trailer brake lights are on, there will be sufficient current flowing in coil L1 to close the reed switch contacts and make pin 4 low. This disables the ic and no pulses will be produced. Capacitor C1 holds pin 4 low at the instant that the brake pedal is pressed and before the reed switch contacts take over. If insufficient current flows in L1 due to a faulty bulb or for any other reason, the contacts will fail to close. C1 will then charge through resistor R1 taking only a fraction of a second to do so. The voltage at pin 4 rises and the astable operates.

Dashboard switch SW2 prevents the circuit from working when a trailer is not being towed. Without this, the buzzer would sound each time the brakes were applied since the circuit would see the lack of trailer light bulbs as a fault..

### Construction

Construction of the Brake Light Checker circuit is based on a single-sided printed circuit board (PCB) and the component overlay is shown in figure 3. Begin by soldering the ic socket in position and follow with all resistors and capacitors. Add the buzzer, observing the polarity - this is marked on the plastic body.

Prepare the reed switch by winding 7 or 8 turns of 22 SWG (0.71mm) enamelled copper wire around it. This must be done with extreme care to avoid breaking the glass. The turns should touch the body but must not be tight. The wire should be wound in one layer and occupy the central part of the reed switch as shown in the photograph. After winding the coil, grip each end lead of the reed switch close to the body using the tip of fine-nose pliers and bend the lead carefully through right-angles. Do not do this without supporting the wire at the body, since any bending pressure transmitted through the wire will crack the glass.

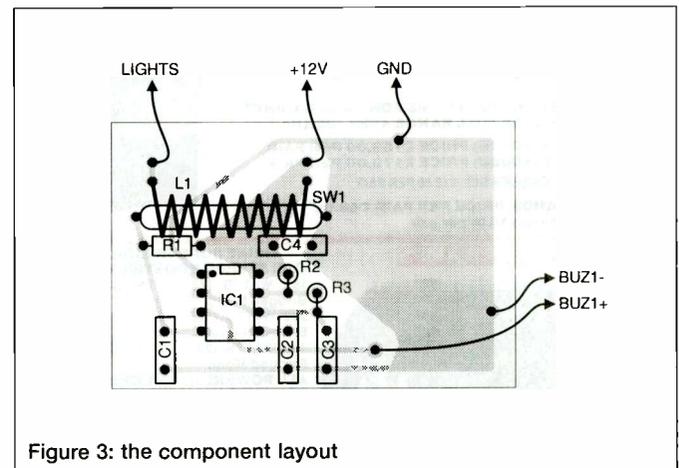


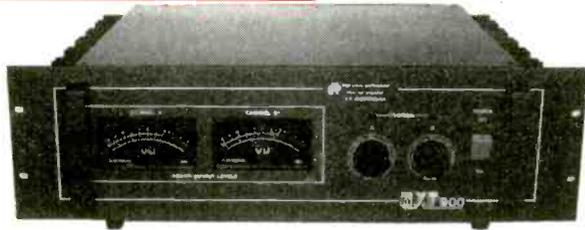
Figure 3: the component layout

**POWER AMPLIFIER MODULES-TURNABLES-DIMMERS-LOUDSPEAKERS-19 INCH STEREO RACK AMPLIFIERS**

\* PRICES INCLUDE V.A.T. \* PROMPT DELIVERY \* FRIENDLY SERVICE \* LARGE (A4) S.A.E. 60p STAMPED FOR CATALOGUE \*

**OMP MOS-FET POWER AMPLIFIERS**  
HIGH POWER, TWO CHANNEL 19 INCH RACK

**THOUSANDS PURCHASED BY PROFESSIONAL USERS**



**THE RENOWNED MXF SERIES OF POWER AMPLIFIERS**  
FOUR MODELS:- MXF200 (100W + 100W) MXF400 (200W + 200W)  
MXF600 (300W + 300W) MXF900 (450W + 450W)

ALL POWER RATINGS R.M.S. INTO 4 OHMS, BOTH CHANNELS DRIVEN

**FEATURES:** ★ Independent power supplies with two toroidal transformers ★ Twin L.E.D. Vu meters ★ Level controls ★ Illuminated on/off switch ★ XLR connectors ★ Standard 775mV inputs ★ Open and short circuit proof ★ Latest Mos-Fets for stress free power delivery into virtually any load ★ High slew rate ★ Very low distortion ★ Aluminium cases ★ MXF600 & MXF900 fan cooled with D.C. loudspeaker and thermal protection.

USED THE WORLD OVER IN CLUBS, PUBS, CINEMAS, DISCOS ETC.

**SIZES:-** MXF200 W19"xH3 1/2" (2U)xD11"  
MXF400 W19"xH5 1/4" (3U)xD12"  
MXF600 W19"xH5 1/4" (3U)xD13"  
MXF900 W19"xH5 1/4" (3U)xD14 1/2"

**PRICES:-** MXF200 £175.00 MXF400 £233.85  
MXF600 £329.00 MXF900 £449.15  
SPECIALIST CARRIER DEL. £12.50 EACH

**OMP XO3 STEREO 3-WAY ACTIVE CROSS-OVER**



Advanced 3-Way Stereo Active Cross-over, housed in a 19" x 1U case. Each channel has three level controls: bass, mid & top. The removable front fascia allows access to the programmable DIL switches to adjust the cross-over frequency: Bass-Mid 250/500/800Hz, Mid-Top 1.8/3/5KHz, all at 24dB per octave. Bass invert switches on each bass channel. Nominal 775mV Input/output. Fully compatible with OMP rack amplifier and modules.

Price £117.44 + £5.00 P&P

**STEREO DISCO MIXER SDJ3400SE ★ ECHO & SOUND EFFECTS ★**

**STEREO DISCO MIXER** with 2 x 7 band L & R graphic equalizers with bar graph LED Vu meters. **MANY OUTSTANDING FEATURES:-** Including Echo with repeat & speed control, DJ Mic with talk-over switch, 8 Channels with individual faders plus cross fade, Cue Headphone Monitor, 8 Sound Effects. Useful combination of the following inputs:- 3 turntables (mag), 3 mics, 5 Line for CD, Tape, Video etc.

Price £144.99 + £5.00 P&P



SIZE: 482 x 240 x 120mm

**PIEZO ELECTRIC TWEETERS - MOTOROLA**

Join the Piezo revolution! The low dynamic mass (no voice coil) of a Piezo tweeter produces an improved transient response with a lower distortion level than ordinary dynamic tweeters. As a crossover is not required these units can be added to existing speaker systems of up to 100 watts (more if two are put in series). FREE EXPLANATORY LEAFLETS ARE SUPPLIED WITH EACH TWEETER.

**TYPE 'A'** (KSN1038A) 3" round with protective wire mesh. Ideal for bookshelf and medium sized Hi-Fi speakers. Price £4.90 + 50p P&P.  
**TYPE 'B'** (KSN1005A) 3 1/2" super horn for general purpose speakers, disco and P.A. systems etc. Price £5.99 + 50p P&P.  
**TYPE 'C'** (KSN1016A) 2" x 5" wide dispersion horn for quality Hi-Fi systems and quality discos etc. Price £6.99 + 50p P&P.  
**TYPE 'D'** (KSN1025A) 2" x 5" wide dispersion horn. Upper frequency response retained extending down to mid-range (2KHz). Suitable for high quality Hi-Fi systems and quality discos. Price £9.99 + 50p P&P.  
**TYPE 'E'** (KSN1038A) 3 1/2" horn tweeter with attractive silver finish trim. Suitable for Hi-Fi monitor systems etc. Price £5.99 + 50p P&P.  
**LEVEL CONTROL** Combines, on a recessed mounting plate, level control and cabinet input jack socket. 85x85mm. Price £4.10 + 50p P&P.

**IBI FLIGHT CASED LOUDSPEAKERS**

A new range of quality loudspeakers, designed to take advantage of the latest speaker technology and enclosure designs. Both models utilize studio quality 12" cast aluminium loudspeakers with factory fitted grilles, wide dispersion constant directivity horns, extruded aluminium corner protection and steel ball corners, complimented with heavy duty black covering. The enclosures are fitted as standard with top hats for optional loudspeaker stands.

**POWER RATINGS QUOTED IN WATTS RMS FOR EACH CABINET**  
**FREQUENCY RESPONSE FULL RANGE 45Hz - 20KHz**

IBI FC 12-100WATTS (100dB) PRICE £159.00 PER PAIR  
IBI FC 12-200WATTS (100dB) PRICE £175.00 PER PAIR

SPECIALIST CARRIER DEL. £12.50 PER PAIR

**OPTIONAL STANDS PRICE PER PAIR £49.00**  
Delivery £6.00 per pair



**IN-CAR STEREO BOOSTER AMPS**



**PRICES:** 150W £49.99 250W £99.99  
400W £109.95 P&P £2.00 EACH

**THREE SUPERB HIGH POWER CAR STEREO BOOSTER AMPLIFIERS**  
150 WATTS (75 + 75) Stereo, 150W Bridged Mono  
250 WATTS (125 + 125) Stereo, 250W Bridged Mono  
400 WATTS (200 + 200) Stereo, 400W Bridged Mono  
**ALL POWERS INTO 4 OHMS**

**Features:** ★ Stereo, bridgable mono ★ Choice of high & low level inputs ★ L & R level controls ★ Remote on-off ★ Speaker & thermal protection.

**OMP MOS-FET POWER AMPLIFIER MODULES**

SUPPLIED READY BUILT AND TESTED.

These modules now enjoy a world-wide reputation for quality, reliability and performance at a realistic price. Four models are available to suit the needs of the professional and hobby market i.e. Industry, Leisure, Instrumental and Hi-Fi etc. When comparing prices, NOTE that all models include toroidal power supply, integral heat sink, glass fibre P.C.B. and drive circuits to power a compatible Vu meter. All models are open and short circuit proof.

**THOUSANDS OF MODULES PURCHASED BY PROFESSIONAL USERS**



**OMP/MF 100 Mos-Fet Output power 110 watts**  
R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor > 300, Slew Rate 45V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 123 x 60mm.  
PRICE £40.85 + £3.50 P&P



**OMP/MF 200 Mos-Fet Output power 200 watts**  
R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor > 300, Slew Rate 50V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 300 x 155 x 100mm.  
PRICE £64.35 + £4.00 P&P



**OMP/MF 300 Mos-Fet Output power 300 watts**  
R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor > 300, Slew Rate 60V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB. Size 330 x 175 x 100mm.  
PRICE £81.75 + £5.00 P&P



**OMP/MF 450 Mos-Fet Output power 450 watts**  
R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor > 300, Slew Rate 75V/uS, T.H.D. typical 0.001%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 385 x 210 x 105mm.  
PRICE £132.85 + £5.00 P&P



**OMP/MF 1000 Mos-Fet Output power 1000 watts**  
R.M.S. into 2 ohms, 725 watts R.M.S. into 4 ohms, frequency response 1Hz - 100KHz -3dB, Damping Factor > 300, Slew Rate 75V/uS, T.H.D. typical 0.002%, Input Sensitivity 500mV, S.N.R. -110 dB, Fan Cooled, D.C. Loudspeaker Protection, 2 Second Anti-Thump Delay. Size 422 x 300 x 125mm.  
PRICE £259.00 + £12.00 P&P

**NOTE: MOS-FET MODULES ARE AVAILABLE IN TWO VERSIONS: STANDARD - INPUT SENS 500mV, BAND WIDTH 100KHz. PEC (PROFESSIONAL EQUIPMENT COMPATIBLE) - INPUT SENS 775mV, BAND WIDTH 50KHz. ORDER STANDARD OR PEC.**

**LOUDSPEAKERS**

**LARGE SELECTION OF SPECIALIST LOUDSPEAKERS, AVAILABLE, INCLUDING CABINET FITTINGS, SPEAKER GRILLES, CROSS-OVERS AND HIGH POWER, HIGH FREQUENCY BULLETS AND HORNS, LARGE (A4) S.A.E. (60p STAMPED) FOR COMPLETE LIST.**

McKenzie and Fane Loudspeakers are also available.



**EMINENCE:- INSTRUMENTS, P.A., DISCO, ETC**

**ALL EMINENCE UNITS 8 OHMS IMPEDANCE**  
8" 100 WATT R.M.S. ME8-100 GEN. PURPOSE, LEAD GUITAR, EXCELLENT MID, DISCO. RES. FREQ. 72Hz, FREQ. RESP. TO 4KHz, SENS 97dB. PRICE £32.71 + £2.00 P&P  
10" 100 WATT R.M.S. ME10-100 GUITAR, VOCAL, KEYBOARD, DISCO, EXCELLENT MID. RES. FREQ. 71Hz, FREQ. RESP. TO 7KHz, SENS 97dB. PRICE £33.74 + £2.50 P&P  
10" 200 WATT R.M.S. ME10-200 GUITAR, KEYB'D, DISCO, VOCAL, EXCELLENT HIGH POWER MID. RES. FREQ. 65Hz, FREQ. RESP. TO 3.5KHz, SENS 99dB. PRICE £43.47 + £2.50 P&P  
12" 100 WATT R.M.S. ME12-100LE GEN. PURPOSE, LEAD GUITAR, DISCO, STAGE MONITOR. RES. FREQ. 49Hz, FREQ. RESP. TO 6KHz, SENS 100dB. PRICE £35.64 + £3.50 P&P  
12" 100 WATT R.M.S. ME12-100LT (TWIN CONE) WIDE RESPONSE, P.A., VOCAL, STAGE MONITOR. RES. FREQ. 42Hz, FREQ. RESP. TO 10KHz, SENS 98dB. PRICE £36.67 + £3.50 P&P  
12" 200 WATT R.M.S. ME12-200 GEN. PURPOSE, GUITAR, DISCO, VOCAL, EXCELLENT MID. RES. FREQ. 58Hz, FREQ. RESP. TO 6KHz, SENS 98dB. PRICE £46.71 + £3.50 P&P  
12" 300 WATT R.M.S. ME12-300GP HIGH POWER BASS, LEAD GUITAR, KEYBOARD, DISCO ETC. RES. FREQ. 47Hz, FREQ. RESP. TO 5KHz, SENS 103dB. PRICE £70.19 + £3.50 P&P  
15" 200 WATT R.M.S. ME15-200 GEN. PURPOSE BASS, INCLUDING BASS GUITAR. RES. FREQ. 46Hz, FREQ. RESP. TO 5KHz, SENS 99dB. PRICE £50.72 + £4.00 P&P  
15" 300 WATT R.M.S. ME15-300 HIGH POWER BASS, INCLUDING BASS GUITAR. RES. FREQ. 39Hz, FREQ. RESP. TO 3KHz, SENS 103dB. PRICE £73.34 + £4.00 P&P

**EARBENDERS:- HI-FI, STUDIO, IN-CAR ETC**

**ALL EARBENDER UNITS 8 OHMS** (Except EBB-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)  
**BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND**  
8" 50WATT EBB-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz, FREQ. RESP. TO 7KHz, SENS 97dB. PRICE £8.90 + £2.00 P&P  
10" 50WATT EB10-50 DUAL IMPEDANCE, TAPPED 4/8 OHM BASS, HI-FI, IN-CAR. RES. FREQ. 40Hz, FREQ. RESP. TO 5KHz, SENS 99dB. PRICE £13.65 + £2.50 P&P  
10" 100WATT EB10-100 BASS, HI-FI, STUDIO. RES. FREQ. 35Hz, FREQ. RESP. TO 3KHz, SENS 98dB. PRICE £30.39 + £3.50 P&P  
12" 100WATT EB12-100 BASS, STUDIO, HI-FI, EXCELLENT DISCO. RES. FREQ. 26Hz, FREQ. RESP. TO 3 KHz, SENS 93dB. PRICE £42.12 + £3.50 P&P  
**FULL RANGE TWIN CONE, HIGH COMPLIANCE, ROLLED SURROUND**  
5 1/2" 60WATT EB5-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 53Hz, FREQ. RESP. TO 20KHz, SENS 92dB. PRICE £9.99 + £1.50 P&P  
6 1/2" 60WATT EB6-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 38Hz, FREQ. RESP. TO 20KHz, SENS 94dB. PRICE £10.99 + 1.50 P&P  
8" 60WATT EBB-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 95dB. PRICE £12.99 + £1.50 P&P  
10" 60WATT EB10-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 35Hz, FREQ. RESP. TO 12KHz, SENS 98dB. PRICE £16.49 + £2.00 P&P

**TRANSMITTER HOBBY KITS**

**PROVEN TRANSMITTER DESIGNS INCLUDING GLASS FIBRE PRINTED CIRCUIT BOARD AND HIGH QUALITY COMPONENTS COMPLETE WITH CIRCUIT AND INSTRUCTIONS**

**3W TRANSMITTER** 80-108MHz, VARICAP CONTROLLED PROFESSIONAL PERFORMANCE, RANGE UP TO 3 MILES, SIZE 38 x 123mm, SUPPLY 12V @ 0.5AMP. PRICE £14.85 + £1.00 P&P

**FM MICRO TRANSMITTER** 100-108MHz, VARICAP TUNED, COMPLETE WITH VERY SENS FET MIC, RANGE 100-300m, SIZE 56 x 46mm, SUPPLY 9V BATTERY. PRICE £8.80 + £1.00 P&P



PHOTO: 3W FM TRANSMITTER

**B.K. ELECTRONICS**

UNITS 1 & 5 COMET WAY, SOUTHBEND ON-SEA, ESSEX, SS2 6TR

Tel. 01702 - 527572 Fax: 01702-420243

POSTAL CHARGES PER ORDER £1.00 MINIMUM. OFFICIAL ORDERS FROM SCHOOLS, COLLEGES, GOVT. BODIES, PLC. ETC. PRICES INCLUSIVE OF V.A.T. SALES COUNTER, VISA AND ACCESS ACCEPTED BY POST, PHONE OR FAX.



Cut each end of the coil wire to a length of 20mm approximately. Gently scrape off the insulation from the ends using a blunt knife blade or sandpaper. Do not use a sharp blade because the wire may be nicked and will then break at that point sooner or later. Solder the reed switch and coil wires to the PCB in the positions indicated ("C" for the ends of the coil and "RS" for those of the reed switch). Note that the reed switch should be left standing about 5mm above the panel (see photograph).

Solder 5cm pieces of stranded connecting wire to the points labelled "lights", "+12V", and "gnd". Bend the "lights" and "+12V" wires over the short pieces of track leading to the coil connections. Solder them in position so that the wire provides a re-enforcement. This will ensure that the tracks can carry the current for both bulbs without problems. Complete construction of the circuit panel by inserting IC1 into its socket taking care over the orientation.

### Adjustment and testing

The circuit panel may be housed in any small plastic box which can accommodate it. Drill a hole in the side for the wires from the PCB to pass through. Drill two small holes and mount the 3-section piece of screw terminal block on the side. Pass the wires leading from the PCB through the hole and, shortening them as necessary, connect them to the terminal block leaving some slack inside. Keep a check on which wire is which and label the terminal block accordingly.

Think about how the PCB will be secured in the box. However, do not attach it permanently yet since it may have to be removed to enable the number of turns on the coil to be adjusted. The PCB may possibly be attached using adhesive fixing pads. Alternatively, a small hole may be drilled in the large copper land area (above the buzzer position) to accept a nylon nut and bolt. If this method is to be used, a short stand-off insulator or plastic washer will be needed under the circuit panel. This will keep the soldered connections on the underside clear of the base of the box. If this is not done, the PCB could be placed under strain when fixing it down and it might crack.

### Installing

Decide on a suitable place for the unit so that the buzzer will be heard without difficulty by the driver. A 9V battery may be used to make the circuit operate and this would be helpful in finding a good site. The positive and negative battery terminals should be connected to the "+12V" and "gnd" positions respectively on the terminal block. Note that the buzzer will be a little louder when operated from the 12V supply. Check that it can still be heard with the engine running. Now decide on a suitable position on the dashboard for on-off switch, SW2. This should be a proper auto-type switch with a rating of 5A minimum.

Attention may now be given to the external details. Locate the wire leading from the car wiring harness to the brake light terminal on the drawbar socket. The conventional colour for this wire is red. Cut it at a convenient point and extend the free ends to reach the chosen position for the unit. Use proper auto-type wire of adequate rating and make the joints using "snap lock" connectors which are available from any car accessory store. Where the wires need to pass through a hole in metal, a rubber grommet must be used. The end leading to the drawbar socket should be connected to the "lights" position on the terminal block. The other end,

## PARTS LIST for the Brake Light Tester

### Resistors

R1	100k
R2	10k
R3	2M2

### Capacitors

All metallised polyester with 5mm pin spacing

C1, C3	100n
C2	10n
C4	220n

### Semiconductors

IC1	NE555N
-----	--------

### Miscellaneous

SW1	Reed switch - 20mm body length x 3.2mm diameter approx.
SW2	Auto-type on-off switch. 5A rating minimum
L1	22 swg (0.71mm) enamelled copper wire
BUZ1	Miniature piezo buzzer
	2A screw terminal block - 3 sections required.
	8-pin dill socket;
	plastic box for project; small hardware.
	Auto-type wire, snap lock connectors.

All components for the Brake Light Checker are available from Maplin.

which will be live when the brake pedal is pressed, should be connected to one of the switch terminals. The other side of the switch should be connected to the "+12V" terminal on the unit. The "gnd" connection should be taken to a convenient nearby earth point.

### Finishing off

Do not connect up the trailer yet. Switch on S2 and the ignition (if necessary). Press the brake pedal. The buzzer should sound. If it does not, there is a circuit fault and this must be investigated before proceeding.

If all is well, plug in the trailer. With both trailer lamps working the buzzer should remain silent. Remove one of the bulbs to simulate failure and operate the brakes again. The buzzer should now sound. If the buzzer fails to work with one bulb connected, it will be necessary to remove a turn or two from the coil. With care, this may be done without desoldering the reed switch. If the buzzer sounds with both bulbs working, it will be necessary to remove the reed switch from the PCB and wind a new coil with more turns on it. However, this is unlikely. Check operation with the engine running since then the current rises slightly.

Measure the position of the buzzer and drill a hole in the lid of the box to correspond. This should be a little larger than the hole in the top of the buzzer itself. Secure the PCB inside the box and check that it cannot move in service. Fit the lid. Mount the completed unit in position and check for correct operation.

### Final note

Always remember to switch on the circuit before a period of towing. This should be made part of the routine such as immediately after the plug has been inserted in the drawbar socket.

**WE HAVE THE WIDEST CHOICE OF USED OSCILLOSCOPES IN THE COUNTRY**

PHILIPS PM3266A Dual Trace 400MHz Delay Cursors	£1,750
PHILIPS PM3265 Dual Trace 350MHz Delay Cursors etc.	£1,500
H.P. 54200A Digitizing Oscilloscope 50MHz	£750
TEKTRONIX 2445 4Ch. 150MHz Delay Cursors	£1,500
TEKTRONIX TA5465 Dual Trace 100MHz Delay Cursors	£900
TEKTRONIX 475 Dual Trace 200MHz Delay Sweep	£500
TEKTRONIX 465 Dual Trace 100MHz Delay Sweep	£400
TEKTRONIX 2215 Dual Trace 60MHz Delay Sweep	£400
PHILIPS 3065 2+1Ch 100MHz Dual Trace Delay	£700
PHILIPS 3055 2+1Ch 50MHz Dual Trace Delay	£500
PHILIPS PM3217 Dual Trace 50MHz Delay Sweep	£400
GOULD OS1100S1 Dual Trace 20MHz	£200
GOULD OS300 Dual Trace 20MHz	£220
KIKUSUI 5530A Dual Trace 35MHz	£200
PHILIPS PM3206 Dual Trace 5MHz	£100
HITACHI V208 Dual Trace 50MHz Main/Battery	£400
PHILIPS PM97 Dual Trace 50MHz Scope/Meter/Dig Storage	£700
TEKTRONIX Tekmeter TKM565 True RMS MM-Autorangeing	£300
LEADER LCD100 DMM/SCOPE 200KHz Digital Storage LCD	£500
TEKTRONIX TDS340 Digital Storage 100MHz 500MegaSample	£1,400
TEKTRONIX 2230 Digital Storage 300MHz Cursors	£900
TEKTRONIX 2210 Digital Storage 50MHz Cursors	£700
TEKTRONIX 468 Dual Trace 100MHz Dig Storage	£750
HITACHI VC6041 Dual Trace 20MHz Dig Storage	£600
BECKMAN 9302 Dual Trace 20MHz Dig Storage	£450
GOULD 1425 Dual Trace 20MHz Dig Storage Cursors etc.	£400
TEKTRONIX 466 Dual Trace 100MHz Delay Analogue Storage	£450
H.P. 1741A Dual Trace 100MHz Analogue Storage	£400
TEKTRONIX 434 Dual Trace 25MHz Analogue Storage	£250

**THIS IS JUST A SAMPLE - MANY OTHERS AVAILABLE**

H.P. 8620C Sweep Osc with 8620B 2-18GHz	£1,750
H.P. 8620C Sweep Osc with 8622B 0.01-2.4GHz	£1,750
H.P. 8656A Synthesised Sig Gen 0.7-990MHz	£1,500
MARCONI 2017 FM/AM Signal Generator 10KHz-1024MHz	£1,900
MARCONI 2019A Synthesised FM/AM Sig Gen 80KHz-1040MHz	£1,800
MARCONI 2019 Syn FM/AM Sig Gen 80KHz-1040MHz	£1,600
H.P. 8640B Phase Lock Syn Sig Gen 500KHz-512MHz	£750
H.P. 8640A FM/AM Sig Gen 500KHz-1024MHz	£650
FARNELL PSG620 Syn FM/AM True Gen 10MHz-520MHz	£450
FARNELL SSG520 Syn FM/AM Sig Gen 10-520MHz	£325
FARNELL TSS20 Transmitter Test Set	£350
MARCONI TF2361 Sweep Generator 1-300MHz	£200
H.P. 8616A UHF Signal Gen 1.8-4.5GHz	£250
H.P. 8614A UHF Signal Gen 800MHz-2.4GHz	£250

**SPECTRUM ANALYSERS**

H.P. 8656A 0.01-22GHz	£3,500
AI/TECH 727 0.001-20GHz	£2,000
ANRITSU MS62B 100KHz-7GHz (Slight shadowing on storage)	£1,200
H.P. 182 with 8558B 100KHz-150MHz	£1,500
H.P. 1411 with 8557A & 8552B 10MHz-18GHz	£1,200
H.P. 1411 with 8554B & 8552B 500KHz-1250MHz	£1,500
H.P. 1411 with 8553B & 8552A 7KHz-110MHz	£900
H.P. 1407 with 8554B & 8552B 500KHz-1250MHz	£900
H.P. 1411 with 8553B & 8552A 7KHz-110MHz	£700
H.P. 1415 with 8557B & 8552A 7KHz-110MHz	£650
MARCONI TF2370 with TK2373 70KHz-1.25GHz	£1,750
MARCONI TF2370 30KHz-110MHz	£700
H.P. 3580A 5Hz-50KHz	£800
H.P. 3582A Dual Channel 25KHz	£2,000
H.P. 8443A Tracking Generator/Counter	£500
H.P. 8444A Tracking Generator	£1,000

**POWER SUPPLIES**

FARNELL AP10030 0-100V 0-30A Autorangeing	£1,800
FARNELL H00100 0-30 Volts 0-100mA	£900
FARNELL H0025 0-60 Volts 0-25 Amps	£400
FARNELL TS370M2 70V 5A/35V 10A	£200
FARNELL L30 5-30 Volts 0-5 Amps 2 Metres	£150
H.P. 8495A Vector Voltmeter 1MHz-1GHz	£160
FARNELL L12-10C 0-12 Volts 0-10 Amps	£175
THURLEY-THANDAR TSP3222 Programmable 32V 2A Twice	£500
H.P. 6516A 0-30V 0-6mA	£150
BRANDBENBUER 4727 4-20V	£200

**MANY OTHER POWER SUPPLIES AVAILABLE**

**BRUEL & KJØER EQUIPMENT AVAILABLE - PLEASE ENQUIRE**

**NEW AND HARDLY USED TEST EQUIPMENT**

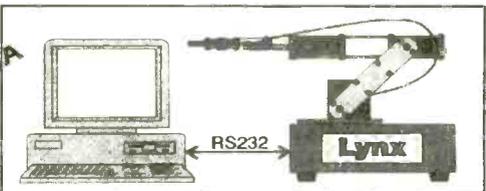
OSCILLOSCOPE Model HC3501 Dual Trace 20MHz	Used £190 Un-Used £220
PANASONIC VP8177A FM/AM Sig Gen 100KHz-110MHz	Used £450 Un-Used £750
PANASONIC VP7637A Stereo Sig Gen. Pre-Set Memory. GPIB.	Used £400 Un-Used £700
KENWOOD FL180A WOW/FLUTTER METER 0.003-10% 3KHz-15KHz	Used £100 Un-Used £125
GOODWILL GV427 Dual Channel AC Millivoltmeter 10V-300V, 10Hz-1MHz	Used £100 Un-Used £125
GOODWILL GAC808G AUDIO GENERATOR Sine Square 10Hz-1MHz	Used £60 Un-Used £80
GOODWILL GFC8010G Frequency Counter 120MHz 8 digit	Un-Used £95
POWER SUPPLY Model HSP9010 Current Limiting 0-30V 0-10 Amps	Used £235 Un-Used £275
ANALOGUE MULTIMETER Model HC260TR AC/DC Volts, DC Current 10 Amps, Continuity Buzzer, Transistor Tester etc.	Un-Used £15

Used Equipment - Guaranteed. Manuals supplied if possible.  
This is a VERY SMALL SAMPLE OF STOCK. See or telephone for lists. Please check availability before ordering. CARRIAGE all units £16. VAT to be added to Total of Goods and Carriage.

**MasterCard STEWART OF READING 110 WYKEHAM ROAD, READING, BERKS RG6 1PL BARCLAYCARD VISA**  
Tel: 01734 268041 Fax: 01734 351696 Callers Welcome 9am - 5.30pm MON-FRI

# ROBOTICS!

**NEW! from the USA**



**LYNX ARM**  
ROBOTIC ARM Kit, five axis motion with gripper. Control from any serial port. Uses R/C servos for good repeatability and accuracy. Kit includes pre-cut arm components, electronics controller board, PC software (inc source listing) and detailed construction manual. 40x30x20cm.

**STAMP BUG**  
"STAMP" based insect kit illustrates basic walking mechanisms. Twin feelers detect objects causing back-up and turn. Pre-programmed but with the option to re-programme (needs Stamp programming pack). Powerful 3 servo construction carries payloads up to 250gms and up to 3 hours motion from the on-board NiCads. 20x15x5cm.



**MUSCLE WIRES**  
Fascinating wires that CONTRACT WHEN ELECTRICALLY HEATED producing a useful amount of force (Up to 0.9kgf for 250um wire). Require 0.3 V/cm and currents from 100ma to 1Amp. Choose from four gauges of wire (50, 100, 150 and 250 um dia). Detailed Data and Project Book (128 pages) also available separately and with Delux Wire kit suitable for 13 projects.

**SERVO - IR - LCD CONTROLLERS**  
A range of low cost controller kits. R/C servos (up to 8 servos per board - simple RS232 commands from your PC hold servo in position until updated etc). LCD display drivers (All standard Hitachi controller types up to 4x20 characters. RS232 input). IR programmable receivers (7 output channels - accept any TV/HIFI controller - up to 25mA output per channel - programmable toggle/momentary switching action).

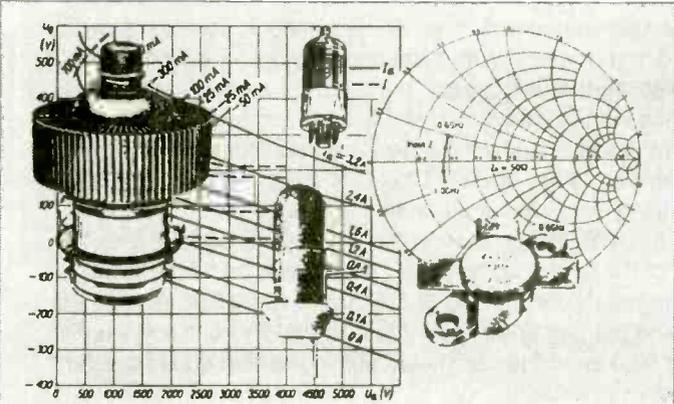
Please call to receive further details on any of the above products

**MILFORD INSTRUMENTS**  
Creative Products for Enquiring Minds  
01977 683665, Fax 01977 681465

# CHELMER VALVE COMPANY

*If you need Valves/Tubes or RF Power Transistors etc. ...then try us!*

We have vast stocks, widespread sources and 35 years specialist experience in meeting our customers requirements.

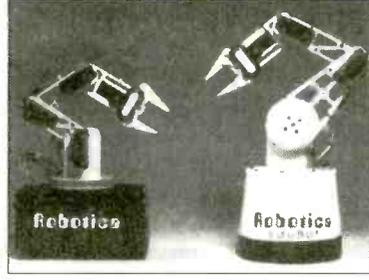


**Tuned to the needs of the Radio Amateur**

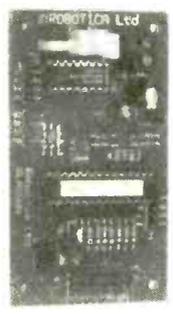
Chelmer Valve Company, 130 New London Road, Chelmsford, Essex CM2 0RG, England.  
Tel: 44-01245-355296/265865  
Fax: 44-01245-490064

# Robotica Ltd

**Robotic Arm Kits**  
**TOYBOT - EDUBOT**  
5 Axis open Kinematic Robotic arm kits with superb precision CNC machined parts, PC controlled with WINDOWS Software and fully programmable. Can be interfaced with four external devices or other robots.



**PIC Servo Controller**  
Controls up to 8 Servo  
Fully Addressable  
features two in and out ports for interfacing with up to 4 external devices or other controllers



Phone for a brochure and price list

**Robotica Ltd**  
3 PARK GATE, GLASGOW, G3 6DL  
TELEPHONE: +44 141 353 2261 FAX: +44 141 353 2614

# Practically Speaking

BY TERRY BALBIRNIE

*This month we go back for a refresher on Ohm's Law*

**T**his month we continue with some calculations used in electronics. We shall look at Ohm's Law and how it may be used during the testing and development of circuits. Ohm's Law is probably the most important calculation in this type of work. Even if your maths is very rusty, it is worth learning to use it because you cannot get very far without it.

## Ohm is where a volt lives

Suppose you wish to know how much current is flowing through a resistor in some circuit. You may, for example, wish to know that the current is not too high and draining the battery too quickly. One method would be to disconnect one end of the resistor from the circuit panel and connect a multitester set to a current range between the free ends. This would give a direct result but it would be very inconvenient to do. A better approach would be to connect the multitester set to a voltage range across the resistor. From a knowledge of the value of the resistor (using the colour code) you could use Ohm's Law to calculate the current flowing through it.

This method does not require any de-soldering and re-soldering and so is much quicker to carry out.

## Two out of three

Ohm's Law is a way of finding either the current, the voltage or the resistance by knowing the other two. It is expressed mathematically in the following three ways. The appropriate one is then used, depending on whether it is the current (I), the voltage (V) or the resistance (R) that you wish to know.

To find the current I (as in the above example) we use:

$$I = V/R$$

This means *current equals voltage divided by resistance.*

If we wish to find V we use:

$$V = I \times R$$

Which means *voltage equals current multiplied by resistance.*

If we wish to find R we use:

$$R = V/I$$

Which means *resistance equals voltage divided by current.*

You can then work out the result using a calculator or, if the numbers are easy, in your head.

You must remember that the current must be expressed in amps (not milliamps or microamps), voltage in volts (not millivolts or microvolts) and resistance in ohms (not kilohms or megohms). You will therefore need to convert any milliamps into amps, kilohms into ohms and so on (Practically Speaking deal with this last time).

## Examples

A resistor having a value 2R is found to have a voltage of 12V across it. The current flowing through it will therefore be 12 divided by 2 or 6A.

A resistor of value 8R has a voltage of 2V across it. The current flowing through it will be 2 divided by 8 or 0.25A. Note that here it is vital to divide 2 by 8 and not 8 by 2.

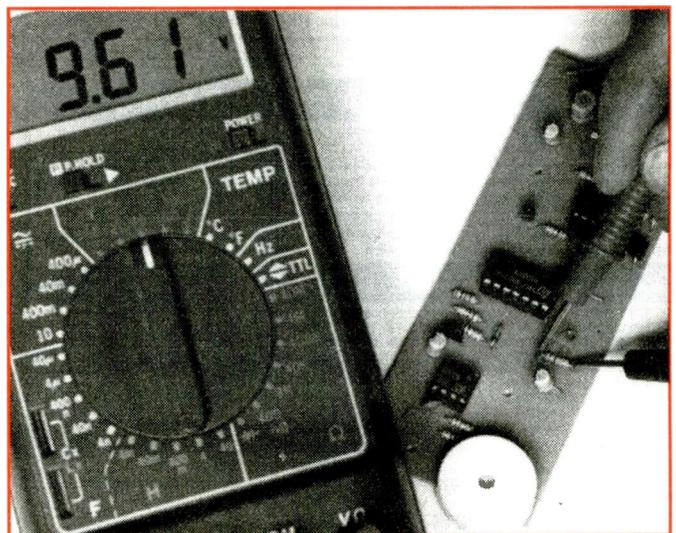
A resistor having a value of 4.7k has a current of 4mA flowing through it. The voltage across it will then be 0.004 multiplied by 4700 (having been converted into amps and ohms respectively) giving 18.8V

A resistor is found to have a voltage of 16.8V across it. The current flowing is 2.5mA. The value of the resistor is then 16.8 divided by 0.0025 or 6720 ohms.

*Note: if the resistance is left in kilohms and the current in milliamps, the calculations work without conversion. It will also work where the resistance is in megohms and the current in microamps.*

There is no problem measuring the voltage across a resistor when it is connected to the supply direct. However, most circuits are more complex and involve other resistors which appear in series with the one in question. In such situations, it is important for the meter itself to have a much higher resistance than that of the other resistors. This is because a negligible current must flow through the meter. If this were not so, it would seriously affect the result. A digital multitester generally has a resistance (usually called the impedance for reasons which will not be entered into here) of 10M or so and this will usually enable it to measure the voltage very accurately.

## Measuring the voltage across a resistor





# Higher Education in electronics

## SPECIAL

***If you are looking to go on to higher education in Electronics or Computer Science, this is the season to make up your mind what, where and how.***

**I**f you are one of ETI's younger, and maybe newer, readers you may be thinking about higher education, and whether to turn your main interest into a career.

You may not be studying electronics at school. The trend in recent years, especially in state schools in the UK, has been away from a few people doing electronics at GCSE level and towards everyone taking National Curriculum Design and Technology, and Science, both of which include some electronics.

The lack of a specialised electronics course at GCSE or 'A' level is not a barrier to higher study in electronics, engineering or computer science, especially if you are already an active hobbyist reading and building projects. There are numerous courses open to students with no specialist qualifications, and as many colleges also run introductory or foundation courses leading to degree study in electronics and engineering, you can go all the way if you are willing to dedicate the time and effort.

Not long before time of writing, a major semiconductor manufacturer opening new plant in the UK and expressing confidence in British design expertise nonetheless expressed concern about the lack of students studying Physics at school - an important requisite for high-level design work. But it is possible to make up study in these areas during Higher Education - something that engineering students may want to look into as they choose their courses.

To get a clearer idea about what qualifications you might need to work in a certain area of electronics, or, perhaps, what kind of employment your study could lead to, the first stop is your school careers officer. They should be able to give a broad view of what kind of employers are looking for electronics and engineering qualifications. Following this, it is worth finding out which colleges run the kind of courses you want to pursue - some reference works are listed at the end of this article - and writing or phoning for prospectuses as soon as possible. This will not only give you an overview of what the college teaches, and the kind of course modules you can take, but some prospectuses give information about which areas of industry your study can lead to.

Once you are forming your ideas, it can be thought-provoking to identify companies that employ technicians, engineers and designers and writing to (or phoning) their personnel departments with a general enquiry asking what kind of qualifications they are looking for. With large companies it may be more appropriate to write. With smaller companies, you are more likely to get a response if you (or someone in your family) makes a phone call. Make it clear that you are only looking for information and not fishing for a job. Take notes and try to keep calls short and to the point; all companies, especially small ones, avoid "time wasters". Of course, if you are lucky (or unlucky, depending on your view) you may get through to a boss who loves to tell people about the business. Possibly more than you ever knew there was to know!

Your school will introduce you to UCAS (Universities and Colleges Admissions Service), but if you are not at school, you can write after August 1 of the year you wish to enter college to UCAS, PO Box 28, Cheltenham, Gloucester GL50 3SA. You can also get assistance from your local Careers Office - look in your local phone book under, for instance, Careers Services. There are professional Careers Guidance companies, but look for local authority-run Careers Offices which will see you without charge.

### **Looking for a college**

Higher education colleges offer a variety of courses distinct to each college, from foundation courses and GCSEs up to degree level and beyond. Which you are looking for depends on your qualifications and experience so far, the kind of work you hope to do and the amount of time you want to dedicate. Broadly, if you have 'A' levels and can study for three to four years further, you can aim for a degree course. One criticism aimed at degree courses in the past was that while the student studied all-important theory to a high level, practical experience and, particularly, experience of business and industry was often lacking. The Universities' answer was that students are expected to be bright and flexible enough to gain additional practical and business skills quickly when they go into employment. There is no substitute for practical experience on the job, but experience is not a substitute for an all-round education, either.



They need to complement each other. However, many Universities are now more conscious of the need for industrial awareness and take steps to include this. The other side of the argument is that for dedicated design engineers, an extensive grasp of mathematical engineering principles is much more important than business awareness, which they can gain in working life if they have any aptitude for it. There is much truth in this view; high-level engineering is demanding. We would say, though, that unless you are aiming for an esoteric career in academic electronics or physics, that choosing a higher education course that shows an appreciation of industry needs will give you a better grounding. There is nothing to beat having an understanding of what is actually needed by your company's customers.

Wherever you hope to enter the higher education system, find out from your likely colleges what their attitude to industry is and whether any out-placements or industrial awareness modules are included in your course. This may help you in your final choice.

### **Highbury College**

Among the prospectuses that ETI looked at this year, Highbury College in Portsmouth offers a range of technology courses from foundation level up to pre-degree or a vocational degree equivalent. Highbury's Engineering (Electronics) BTEC

GNVQ Intermediate one-year course offers a broad-based introduction to Electronic Engineering, including relevant GCSEs if required, for students with no formal applications, leading straight to working life or on to A levels or the two-year Advanced BTEC GNVQ course - which itself leads the student into working life, or on to Degree or BTEC Higher National Diploma level. The BTEC HND is a two-year course offering a combination of academic and practical study in partnership with Portsmouth University, requiring five GCSEs (grade C or above) including Maths and a science, together with a relevant A or AS level pass, or the relevant BTEC Certificate or Diploma.

These are quite standard entry qualifications for Degree level, and the BTEC HNC is roughly equivalent to a Degree. A BTEC qualification is generally regarded as more vocational and less theoretically-based than a University; some employers may regard this as an advantage, but if you want to do design or research, or move into higher management you should consider entering for a degree course rather than an HNC as soon as you qualify.

Highbury also offers a two-year BTEC National Diploma at a slightly higher level than the Advanced GNVQ as a preparation for Degree study or working life. There is also a one-year introductory course in Electronic and Microcomputer Technology for unqualified applicants as a preparation for further study or trainee posts, including the Armed Forces. There is an equivalent set of Mechanical Engineering courses, as well as more general A level, GCSE and University Foundation courses on the same site. Another advantage of technically-based colleges like Highbury is that if you want to try your hand at video production (or journalism!), or get your hair curled by a fellow-student, you are very likely to be able to do so. There is also plenty of provision for student guidance, careers information, etc. and the college is happy for prospective students to call or visit the Student Advice Centre for advice before applying.

### **University of Hertfordshire**

The University of Hertfordshire is based on several separate campuses in Hatfield, Hertford, St. Albans and Watford in Hertfordshire, about 50 miles north of London. The Faculty of



Engineering is based at the Hatfield Campus in Hatfield, and offers several BEng degrees involving electronics studies, plus two BSc degrees, and several Masters (MEng) degrees. The engineering courses aim to meet the needs of project management and creative application of technical knowledge for useful ends, and students will undertake case studies, project work and laboratory work, as well as opportunities to work in teams with students from other disciplines. Many of the courses include an opportunity to study a European language, and there are some opportunities for industrial placements and study in Europe and the USA. There are alternative routes into engineering for people without standard entry qualifications; several degrees are

also offered as extended degrees with a preliminary year. The preliminary year also addresses important general topics such as teamwork. There are Electronics and Manufacturing programmes available within combined modular degrees, again for students who are not following a traditional maths and physics based route.

The University's BEng courses include BEng Honours Electronic Engineering, BEng Honours Communications Systems, BEng Honours Digital Systems, BEng Honours Electrical and Electronic Engineering, BEng Electrical Engineering, BEng Honours Electronic Engineering with Medical Electronics, BEng Honours Power Electronics and Control and BEng Honours Computer Aided Engineering, all of which either fully accredited by the Institution of Electrical Engineers (IEE) and lead towards Chartered Engineer status, or are accredited qualifications by the IEE. There is also a BSc Honours in Medical Electronics or Medical Electronics with German, which can lead towards Chartered Engineer status upon graduation, and a BSc Honours in Engineering Management, in combination with the University's Business School to train managers capable of handling the resources of modern manufacturing and engineering industries.

All these courses can be undertaken as an Extended Degree, and most of them have a required or (usually) optional Sandwich Year, with a paid industrial placement. A Sandwich Year provides practical experience in a real industrial environment, working with engineers, managers and technicians already case-hardened to the job and therefore with a somewhat different slant on it. Indeed, some feel that one benefit of college study is that students can acquire knowledge and experience without the pressures of commercial life - the two must in time be combined into a grasp of practical engineering.

The University of Hertfordshire also offers several computing BSc Honours degrees, mainly four-year sandwich courses, including Computer Science in Europe, currently based around German. Students learn German, do a six-month industrial placement and a year of study in Germany, and gain the Diploma Informatiker (German BSc.) as well as the UK BSc. As second language capability is now a very valuable asset in



Electronics Engineering, Aston University

building a career, courses of this type (which tend to have a limited number of places) are much sought-after.

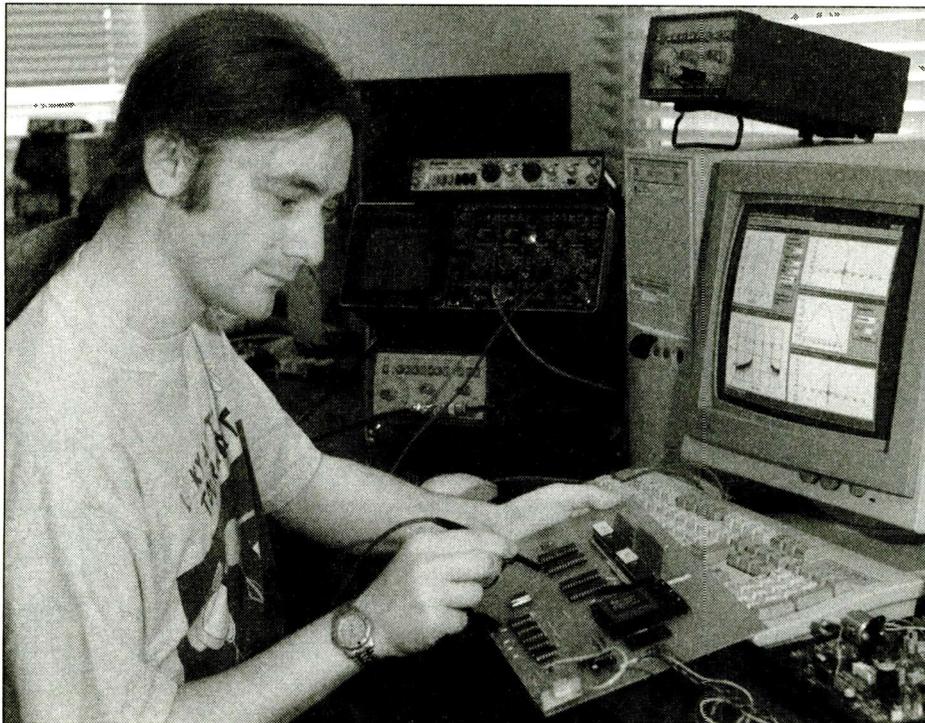
The faculty of Information Sciences also does a number of two-year (three years if Sandwich) HND courses in computing, which can lead to a final year degree course for students with good passes. A network of approved NVQ assessment centres at the University give students the opportunity to gain recognition in areas such as management, business administration, information technology, etc. as complementary to their degree courses.

The University encourages people who may not have traditional qualifications to enquire about routes. As with many colleges, a certain amount of advice about grants, application, how to build up qualifications for a career, and so on can be given to prospective students, especially those who are not coming from school and may not have access to this information.

### **Aston University**

Aston University in Birmingham has a well-established reputation for mathematics and engineering, and prides itself in particular on two benefits: its heavy investment in high-quality computing facilities for all its students, with IT integrated into all degree programmes - indeed, it is proud to be able to claim that students "cannot avoid developing high-level skills in computing and information technology" - and a graduate employment "second to none", with a higher proportion of graduates finding permanent employment within six months of graduating than any other British university. There is also an emphasis on optional Sandwich programs for practical professional experience.

Aston offers BEng degree courses in Electrical and Electronic Engineering, Electronic Engineering with Management studies, ElectroMechanical Engineering, Electronic Engineering and Computer Science, Communications Engineering and Electronics combined with a Business, Language, Science or Social Science subject. These are available as three year courses, or four years with a Sandwich year. Electrical and Electronics, and ElectroMechanical also have a foundation year (STEPS) available. The first year of all the Electronics and



Computer Science courses cover the fundamental principles of electronics engineering, physical science and computer science, so that whatever direction the student chooses to pursue in the second year and after, a grounding across all the related disciplines is firmly in place.

Arguably, as school courses become less specialised, firm grounding early in a degree course is increasingly necessary. As far back as the 1970s, when new math courses (some of them ill-fated) were being introduced into British schools, engineering students found that any gaps in their maths could not be filled by their University courses, and they had to make up lost ground as best they could. These days, good colleges are prepared to make certain that students are properly grounded during their course. A good study record at GCSE and A level, or any parallel qualifications offered, is still necessary for degree study at most Universities, but help can often be obtained in weaker subjects.

Aston's degree courses are accredited, as should be the case with good degree courses, by the IEE or the British Computer Society, or in the case of newer courses will be submitted for approval at the relevant body's next visit to the University. Aston has a further Open Day this year on Monday 29th September. University Open Days usually take place in late April/early May and September

### Other factors

When you depart on a Higher Education course, you will be spending between two and four years of your life in the neighbourhood of your college. If you are leaving your family home for this first time, this may also be your first major change of environment. College is rightly seen as a half-way house to independence, especially if you are not living on the College campus (the site where most of the teaching faculties and living accommodation are) throughout your course. Of course your choice of the right course and college and course is the most important consideration, but your choice of environment is not trivial. There are likely to be a number of good colleges offering courses that you want to follow, so look at them and consider where you would personally be happy to live. If you are not keen on outdoor pursuits, you may feel cut

off on a campus deep in the country. If you are an outdoor type, you may feel equally cut off in the middle of a large city. Some people prefer to live away from the main campus (if one exists; in London, for instance, college accommodation is scattered throughout the city and suburbs); you may be expected to find your own living quarters for at least one year of your course, as there is still a shortage of college rooms. So it is a good idea to look for somewhere you will be happy to live - as long as the course takes priority.

### Resources

Even small local libraries usually have reference books listing colleges and courses for the current or previous year. Some suggested sources are (usually to be found in the Reference section under Education - look under R378 and R370 for a start):

*The Times Good University Guide*  
edited by John O'Leary (Times Books)

*The Big Official UCAS Guide to University and College Entrance* (Letts Study Guides with The Independent)

*Which Degree 1997 - Volume 2: Engineering, Technology and Geography and Volume 3: Science, Medicine and Mathematics*  
CRAC Student Guide (Hobson's Publishing)

*DOHE (Directory of Higher Education): How to Choose your Higher National Diploma Course*  
edited by Eric Whittington (Trotman & Co.)

Don't be daunted by the mass of information that some guides offer (the UCAS guide, in particular, is perhaps more suited to careers officers than new students), but use them to pick out the addresses and phone numbers of colleges offering courses that appeal to you, and then contact the colleges themselves for their Prospectuses, which will give you their up to date entrance requirements and other details in a format designed for students. The DOHE Guide is handy for pointing out which colleges offering HNDs also have "transfer" courses to degree level.

### Next month

Next month we will be looking at some more colleges, including some Masters and other courses for postgraduates and people returning to college from working life.

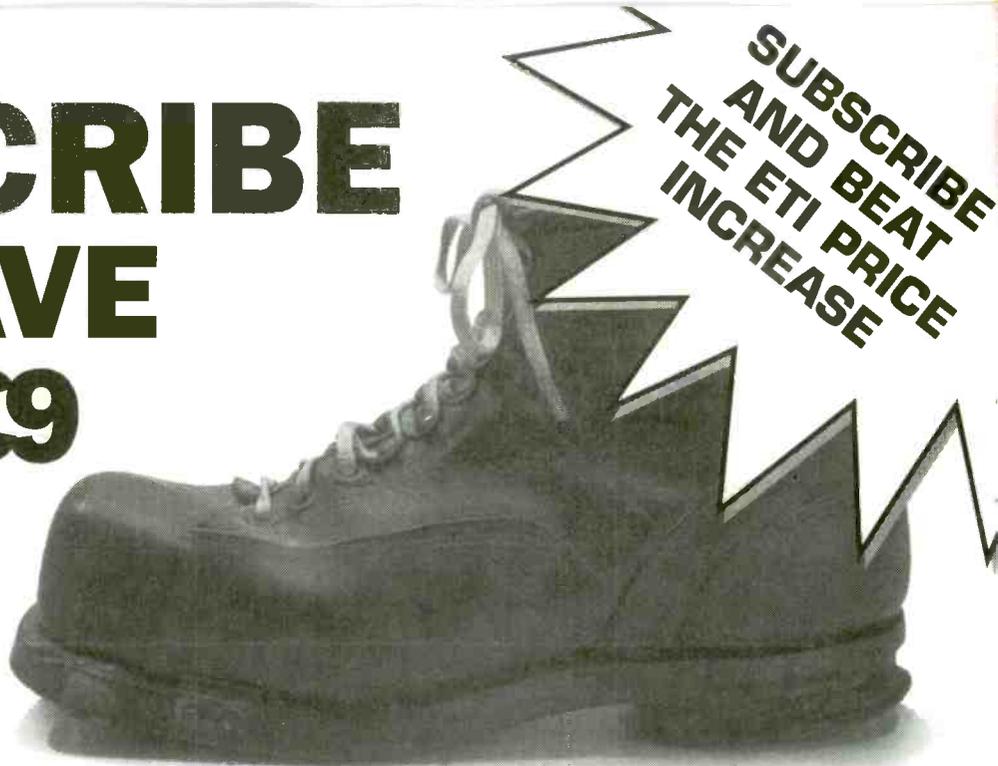
To obtain prospectuses from the colleges above, contact Highbury College on 01705 283373 or write to Highbury College, Cosham, Portsmouth PO6 2SA; contact the University of Hertford on 10707 284000 or write to the University of Hertfordshire, Hatfield Campus, College Lane, Hatfield, Herts AL10 9AB; contact Aston University on 0121 359 3611 or write to Aston University, Aston Triangle, Birmingham B4 7ET (email [prospectus@aston.ac.uk](mailto:prospectus@aston.ac.uk), Web Site <http://www.aston.ac.uk.home.html>)



# SUBSCRIBE AND SAVE UP TO £9

... and LET THE POSTMAN DO THE WORK!

SUBSCRIBE AND BEAT THE ETI PRICE INCREASE



## ACORN ARCHIMEDES WORLD

13 issues  
 UK: WAS £48.75, NOW  
 £39.75, YOU SAVE £9,  
 Europe: £60.50, Overseas:  
 £62.50, USA: \$100.00



Now this just has to be a good deal! Not only will you save a considerable amount of money, but your postman will also deliver the next 13 issues of your favourite electronics magazine directly to your door - with no fuss, no hassle, and no future price increases.

So go on, subscribe now, save your shoe leather, and up to 70p per issue.

Here's why YOU should subscribe to either ETI, Ham Radio Today or Acorn Archimedes World:

- ◆ FREE home delivery in the UK.
- ◆ A saving of up to £9 a year.
- ◆ Price protection - you won't pay any more if the cover price goes up.
- ◆ Guarantee receiving every issue.

This is one deal where you really can't lose.

**REMEMBER, it's always cheaper to subscribe!**

All savings are based upon buying the same number of issues from your newsagent, UK only.



## HAM RADIO TODAY

13 issues  
 UK: WAS £32.50, NOW  
 £29.00, YOU SAVE £3.50,  
 Europe: £39.50, Overseas:  
 £41.50, USA: \$66.00

## E.T.I. PRICE FREEZE OFFER!

13 issues  
 UK: WAS £32.50, NOW  
 £27.00, YOU SAVE £5.50,  
 Europe: £40.00, Overseas:  
 £41.80, USA: \$64.00



The cover price of ETI has now risen to £22.50 BUT you can still subscribe at the old price - if you order today! After this issue we will have to charge a new, higher rate - so take advantage of this offer now!

## SUBSCRIPTION ORDER FORM

YES, I would like to subscribe to (please tick):  Acorn Archimedes World  Ham Radio Today  E.T.I. for the next 13 issues (all subscriptions will start with the next available issue, unless extending).

The total value of my order is £..... I enclose a cheque/PO payable to 'Nexus Special Interests', or please debit my Access/Visa/Mastercard/AMEX account:

Card No:

Expiry...../.....

Signature.....

### Your Details:

Name: Mr/Mrs/Miss Initial:.....Surname:.....

Address:.....

Post Code:.....

Tel no:.....

Please return, together with your payment, to: Nexus Subscriptions, Tower House, Sovereign Park, Lathkill Street, Market Harborough, Leics LE16 9EF  
 Offer closes: 31/8/97 Code: 0210

**TO ORDER BY PHONE, PLEASE CALL OUR CREDIT CARD HOTLINE ON 01858-435344 (Mon to Fri, 9am - 5.30pm)**

Please tick this box if you do not wish to receive information from other companies

# SPEED CONTROL in DC Motors

## PART ONE

***When David Ponting gained possession of a high-quality reel to reel recorder, all he had to do was create a constant-speed capstan drive suitable for both sides of the Atlantic. So began the experiments to find the best control circuit.***

**I**t was a most magnificent machine and I was being given it for nothing! It seemed that no-one else even wanted to give house room to this ancient but truly beautiful Rolls Royce of a reel-to-reel tape recorder. It was in excellent condition.... except that the all-important capstan motor had burnt out. The other two motors which provide the spooling and tension functions were fine, but the capstan motor which has to turn at a very precise and constant speed under a varying load no longer existed.

The original motor was a synchronous 115 volt AC type whose speed was locked to the American mains frequency of 60 Hz.. So even if I could replace it with a new one, the tape recorder would still not operate properly in England: any recording made on it would be non-standard and could only be replayed on the same machine.

So I started to look for circuits which are designed to drive small AC or DC motors at very constant speeds. I tried electronics magazines, past and present. I searched through collections of circuits in numerous books. I found nothing. There were many circuit designs that allowed a potentiometer to control and set the speed of a motor to the required value, but I found none that then kept that speed constant as the loading on the motor changed. I began to think that I would have to fit

an excessively large motor whose power would hardly notice a small varying load.

But surely there must be a better answer than that? I decided that if there were no tried and tested circuits available, I would have to start from scratch.

It quickly became clear that some sort of feedback loop (figure 1) was going to be required.

### The feedback loop

The speed of the motor has to be measured in some way, and that measurement has to be compared with a speed standard. For example, suppose we want a motor to rotate at exactly 1000 revolutions per minute. We switch the motor on, count the number of revolutions the motor is actually making, and then compare this with the required 1000. If the measured figure is 999 or smaller, we can use the difference from 1000 to speed the motor up; but if the measurement is 1001 or larger, we can use the error to slow it down. If the revolution counter is measuring exactly 1000, we can turn the power to the motor off and not turn it on again until the speed drops to 999. We could arrange that the motor is braked if the speed exceeds 1000, but in practice loading and friction will automatically provide braking. So the power to the motor can be off both when the speed is exactly 1000 and when it is higher.

Having got that far in my thinking, I began to look around for what motors are available and soon discovered an advertisement which offered a DC motor with a fitted 'tach' (tachometer). In addition, the advertisement said that the motor operated from 6 to 21 volts, with a speed of 2900 rpm at 12 volts (300mA) and 5300 rpm at 21 volts (380mA). This told me that without any control circuit, the speed of this motor when unloaded depended directly on its supply voltage.

I responded to the advertisement and, when my motor arrived, I found that there were four connectors, two to power the motor and two which were the output of the 'tach'. Initially I was not sure what this output would be, and so I looked at it on an

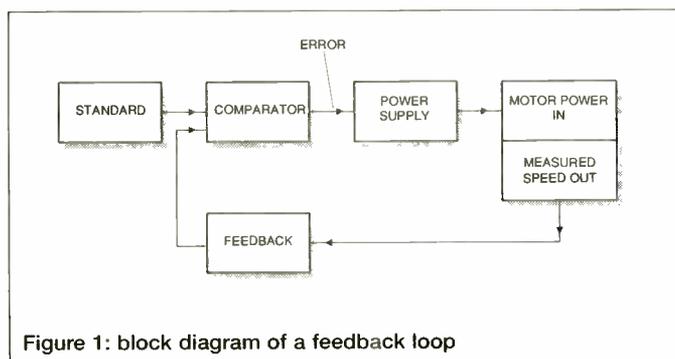


Figure 1: block diagram of a feedback loop

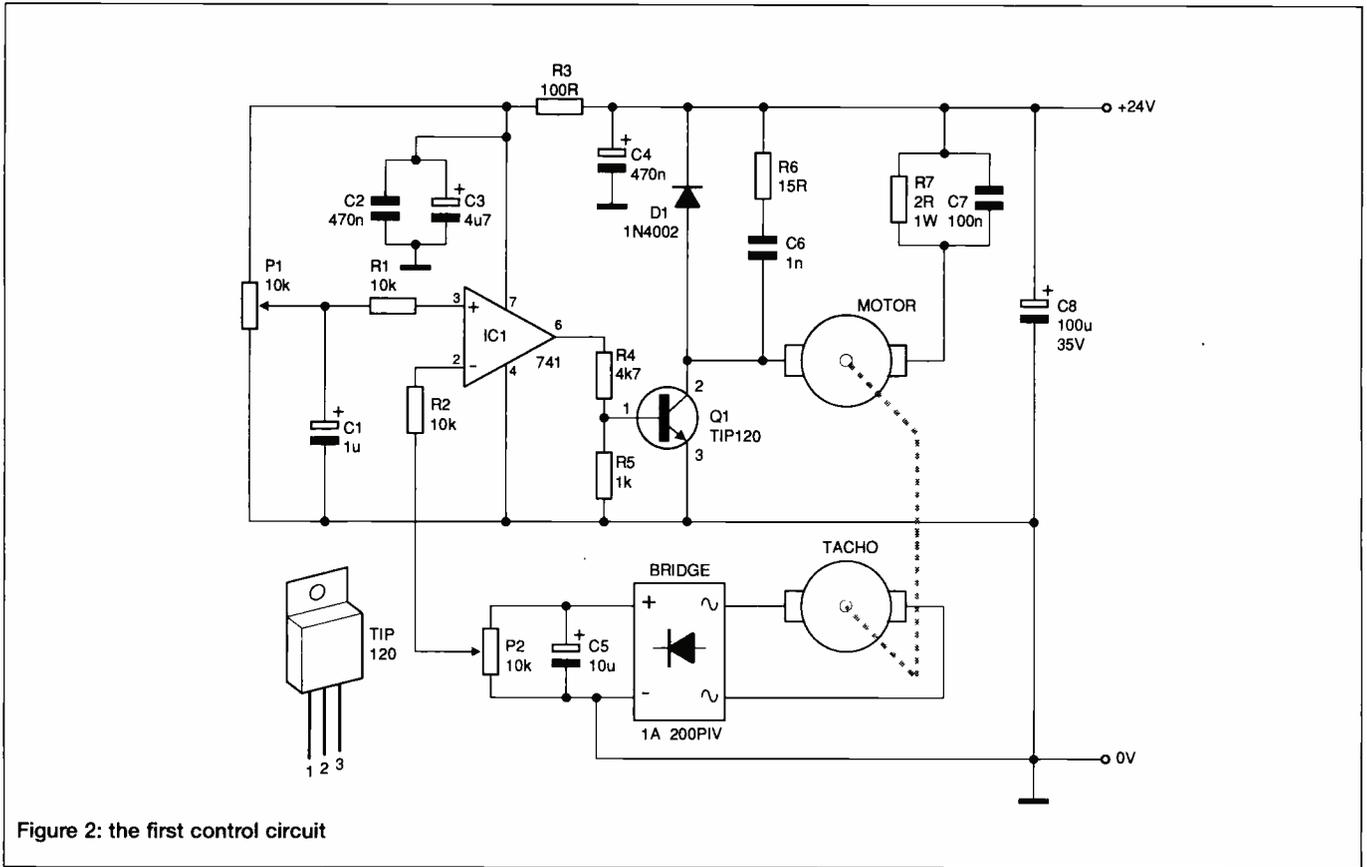


Figure 2: the first control circuit

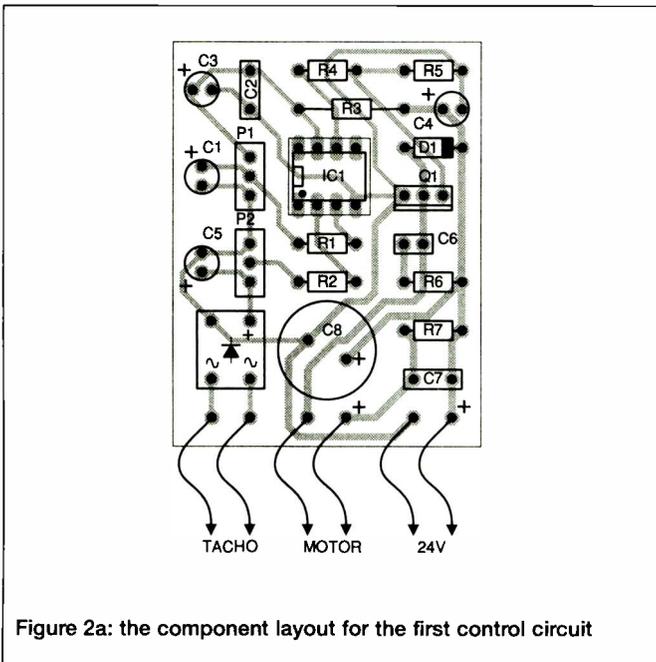


Figure 2a: the component layout for the first control circuit

oscilloscope. As I had suspected, it was a very regular sine wave whose peak-to-peak voltage was completely independent and floating with respect to the power supplying the motor. Clearly this tach was just a small AC generator driven directly by the shaft of the motor. The original advertisement had included the additional information that "the tach produced approximately 3.15 volts per 1000 rpm". I was able to confirm this experimentally when I found that at 1000 rpm the output of the tach was 3.2 volts rms.

Much more important than the value of this voltage is the fact that as the speed of the motor increased, the peak-to-peak AC tach voltage increased as well. Clearly the size of this voltage is a measure of the speed of the motor.

So, if the tach voltage can somehow be compared to a fixed voltage which represents the required speed, our aim of a motor which rotates at constant velocity under varying loads is achieved. This led me to my first useable control circuit (figure 2 is the circuit and figure 2a is the component layout for this board).

### How it Works

As connected, the output of IC1, an ordinary LM 741 op-amp, is high (within a couple of volts of 24) as soon as the power to the circuit is applied. Consequently Q1 is switched on via R4 and the motor starts to turn, drawing its power via R7.

Driven by the motor, the tach starts to generate an increasing AC voltage. This is rectified by the bridge, smoothed by C5 and reaches pin 2 of IC1 via P2 and R2. At pin 3 of IC1 is a fixed voltage set by P1.

Eventually, if the 24 volt supply is great enough, the motor will spin so fast that the rectified and smoothed DC from the tach into pin 2 of IC1 will exceed the set voltage into pin 3. When that happens, the output at pin 6 will go low (within a couple of volts of zero), Q1 will switch off, and the motor will start to slow down until the voltage at pin 2 drops below that at pin 3 when the whole process repeats itself.

In effect, the motor is supplied by pulses of power resulting in its rotating at constant speed even when the loading on the motor changes. When that happens, the pulses just get longer, supplying the motor with greater power. The final speed of the motor can be controlled either by adjusting P1 or P2, or both.

R3, C2, C3 and C4 de-couple the supply to the motor from that to the control circuit. R7 is a 1-watt current limiting resistor, and should be of a higher wattage if the current to the motor exceeds 1 amp. R6, CG and C7 limit the electronic noise produced by all switching circuits similar to this. D1 is an important component as, with a highly inductive load like a motor, every time the power to the motor is switched off, a

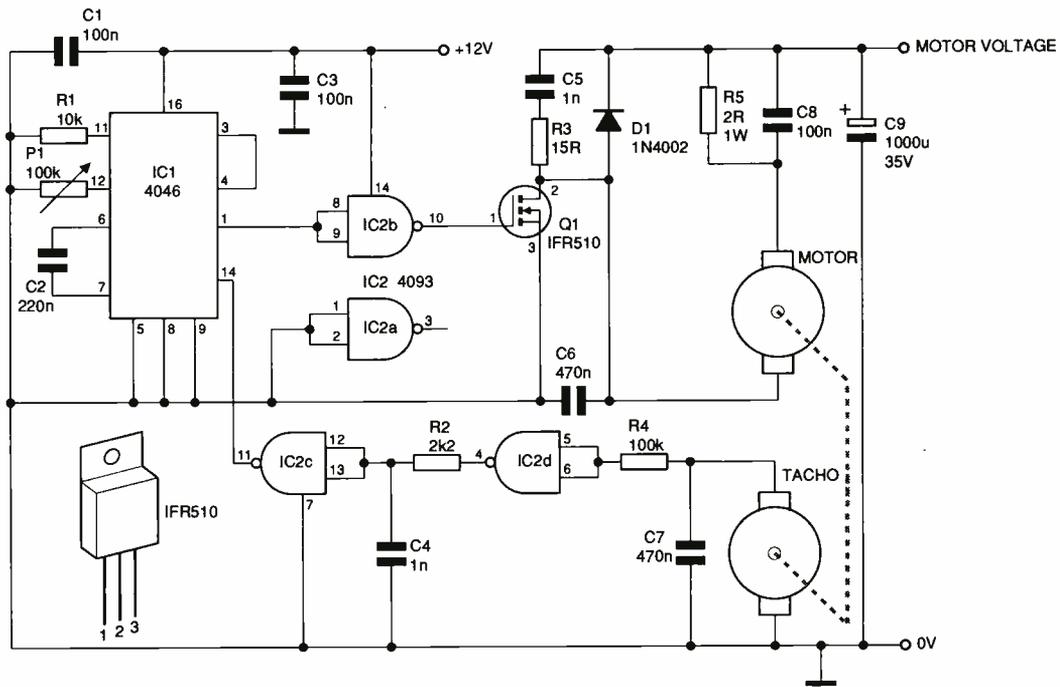


Figure 3: the 4046 circuit

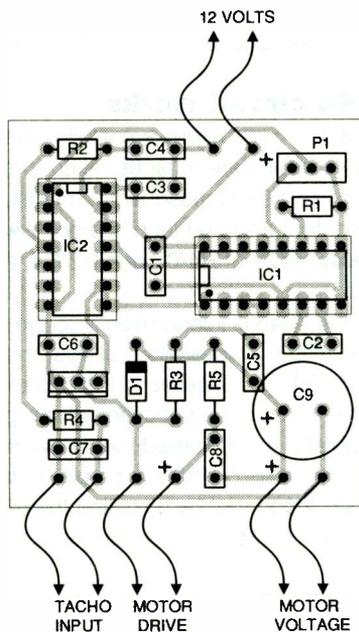


Figure 3a: the component layout for the 4046 circuit

reverse voltage is generated in the motor's windings, which would destroy the transistor if the diode were not there to clamp this voltage to the 24 volt rail.

### Success and the first problem

Using this rather straightforward circuit, a very stable and relatively constant rotational speed can be achieved. For the tape recorder I was trying to restore, transporting the tape at the standard speed of 7.5 inches per second required the motor to rotate at 1800 rpm. Using this circuit, I could set the motor to 1800 rpm when it was unloaded (200 mA), and the

rotational speed was only reduced by 8 rpm when the motor was heavily loaded and close to stalling (greater than 1 amp). Further, driving the motor by this pulse method (which is called pulse-width modulation, or PWM), ensures that the motor starts readily, has a high torque as it starts to rotate, and continues to provide that high torque when it reaches its constant speed.

So this motor, driven by the above circuit, seemed to meet all my requirements for constant speed. But I quickly discovered that there was one major problem: if the motor was run for an extended period of time, its speed increased away from that set by the standard. In practice, starting from cold at a set 1800 rpm, the speed had increased to 1910 rpm after running for about an hour or so.

The reason for this is annoying but interesting. The current passing through the main windings causes the motor to warm up. This results in the windings of the tach coils also becoming warmer. When copper is heated, its resistance increases and the result is that the output voltage of the tach decreases. Consequently, the motor speeds up to produce a voltage to match the "standard". If the motor could be cooled so that it never became warmer, this circuit would provide the necessary accuracy to run a tape recorder. As it is, someone with perfect pitch would be only too well aware that the key of music played on the machine would increase in pitch by about a semi-tone after running for half an hour. However, if your need for (relatively) constant velocity is met by a motor whose speed variation is no more than about +6 percent after running for an hour and then remains more or less constant, the above circuit is for you. Unfortunately it was not sufficiently accurate for me. So it was back to the drawing board.

### AC frequency

It had occurred to me when first checking the tach on my motor that not only did the rms voltage increase as the motor's speed increased, but so did the frequency of the AC signal. To

## Figure 2

'P1', 'P2'	10k
R1,2	10k
R3	100R
R4	4k7
R5	1k
R6	15R
R7	2R 1 watt
C1	1uF electro
C2	470n
C3	4u7 electro
C4	470n electro
C5	10u electro
C6	1n
C7	100n
C8	1000u 35V electro
D1	1N4002
Q1	TIP120
1C1	741
Bridge	1A 200PIV

## Figure 3

R1	10k
R2,4	2k2
R3	15R
R5	2R 1 watt
P1	100k
C1,3,8	100n
C2	220n
C4	100k
C5	1n
C6,7	470n
C9	1000u 35V
D1	1N4002
Q1	IFR510
IC1	4046
IC2	4093

## Figure 5

R1	2k2
R2	1M
R3	1k
R4	15R
R5	2R 1 watt
R6	220R
R7	1k3
R8	2k
C1	100p
C2	5 - 25p
C3	1u tantalum
C4	100n
C5,9	100n
C6,7	1n
C8	470n
C10	1000u 16V electro
D1	1N4002
Q1	IFR510
IC1	4060
IC2	4017
IC3	4077
IC4	7812
IC5	LM317
XTAL	1.8432 MHz

date I had concentrated on the voltage increase because the comparison of two voltages is so much easier than the comparison of two frequencies. But the latter clearly became the route I was going to have to take since, unlike voltage at a given speed, the frequency of the tach output was independent of the temperature of the motor's windings.

By experiment I found that at a speed of 1800 rpm, the frequency of the AC output from the tach was (coincidentally) 180 Hz.. Now I had to consider what I should use as a comparator and how I should obtain an adjustable frequency which would become my standard.

It was at that point that I remembered that I had recently done some work on a little used but useful 4000 series CMOS chip, the 4046. This IC is generally employed as the basis for a phase-locked loop, a not-so-dissimilar function to what I wanted.

The 4046 effectively includes two independent exclusive-or gates, both having pins 3 and 14 as common inputs and pins 1, 2 and 13 as outputs. Now both exclusive-or and exclusive-nor gates can be thought of as frequency comparators. Consider the two-input, exclusive-nor gate: when both inputs are the same, the output is high, ie when the frequency and phase of each signal into the inputs are identical, the output is high; as soon as there is any difference between the two inputs, the output is low more often than it is high. It seemed like a promising start.

In addition, the 4046 has an on-board voltage-controlled oscillator, a VCO. With a couple of resistors and a single capacitor, a varying voltage into pin 9 will reappear at pin 4 as a corresponding variable frequency. I found that you get a similar effect if you fix the input voltage and vary one of the resistors.

### How the 4046 circuit works

Looking at figure 3, the tach output eventually enters the 4046 at pin 14. Using this input, care must be taken to ensure that the signal here is noise-free. Consequently, to ensure a clean square wave, the output from the tach is processed through the two resistor/capacitor pairs of R4/C7 and R2/C4, and the two gates, N4 and N3.

Input pin 3 on the 4046 is joined directly to pin 4, the output of the on-board oscillator. As described above, the frequency of this VCO is determined by the values of the two resistors into pins 11 and 12, the value of the capacitor joining pins 6 and 7, and the DC voltage at pin 9. I wanted the output of the VCO to have the relatively low value of 180 Hz, so pin 9 was held at zero volts and I then found that by adjusting the resistance of P1 at pin 12, I could achieve an output frequency of 180 Hz at pin 4.

The final output from the 4046 I took from pin 1. This is essentially low when the frequency into pin 14 is less than that into pin 3, is high when the two inputs receive equal frequencies, and is mainly high when the frequency into pin 14 exceeds that into pin 3. This represents the reverse of what I wanted, hence the use of gate N2 of 1C2, used here as an inverter. Gate N1 is unused and so its inputs are tied low to prevent random switching.

The motor's power supply is switched by a mosfet transistor, type IFR 510, and the rest of the circuit around the motor helps to limit switching noise.

The positive supply to the motor's circuit is critical this should be set high enough so that the motor will speed the revolutions per minute required and there lock with the signal, but it should not be so high that the motor speeds through the locking point before it can be stabilised by the clock.

AN5521	1.35	STK73410/2	5.95	TEA2026C	4.50
AN5732	1.40	STK73605	4.50	TEA5170	1.40
AN6327	9.85	STR441	18.99	TUA2000-4	4.25
AN6677	8.50	STR451	29.99	U884B	2.35
BA5114	1.55	STR3125	5.50	JAA1008	3.00
BA6218	1.85	STR4211	5.50	UPC1178	1.05
BA6219	1.20	STR4090	11.15	UPC1182H	5.15
HA11423	1.65	STR20005	5.00	UPC1278H	2.20
HA13119	2.50	STR40090	4.00	UPC1420	4.50
KA6210	4.99	STR50103A	3.85	UPD1937	3.00
LA3220	0.60	STR54041	3.75	25A814	0.71
LA4183	1.35	STR58041	3.75	25A839	1.40
LA4445	1.90	STR80001	6.00	25A1062	1.00
LA4495	1.40	STR1706	4.75		
LA4588	2.55	STRD1806	4.50		
LA7835	2.35	STRD6008	10.00		
LB1415	2.25	TA227	1.85		
LM301	0.25	TA7271	2.50		
LM317T	1.50	TA7280	2.25		
M491BBI	4.75	TA7281	2.20		
M49BBI	6.75	TA7698	5.00		
M51393	5.95	TA8200	3.50		
M58655	3.30	TA8210	3.00		
MB3730	1.70	TA8214	3.00		
MB3756	8.00	TA8215	3.00		
STK078	6.00	TA8205	3.95		
STK435	4.00	TA8659	13.00		
STK461	10.50	TA75339	**		
STK2250	7.45	TDA3500	4.99		
STK4121/2	7.00	TDA3645	8.00		
STK4141/2	5.50	TDA3650	8.99		
STK4142/2	6.50	TDA3850	18.99		
STK4162/2	6.25	TDA4400	1.75		
STK4171/2	8.10	TDA4500	3.50		
STK4191/2	8.50	TDA4505A	4.10		
STK4352	6.20	TDA4505B	4.10		
STK4372	5.65	TDA4505M	5.25		
STK4803	7.05	TDA4505K	6.15		
STK4843	7.05	TDA4660	4.50		
STK5315	5.85	TDA4950	1.40		
STK5332	1.80	TDA5660P	2.50		
STK5338	3.25	TDA7072	3.99		
STK5361	4.15	TDA8370	14.00		
STK5372	2.85	TDA8405	8.00		
STK5372H	4.15	TDA8732	5.95		
STK5412	3.75	TEA2018A	1.50		
STK5471	3.85				
STK6732	14.00				
STK7226	7.50				
STK7308	4.05				
STK7308	4.05				
STK7348	4.05				
STK7356	4.75				
STK7004	6.50				
STK73410	5.15				

#### ELECTROLYTIC CAPACITORS

<b>250V Working</b>		
1UF (5/pack)	1.00	
4.7UF (5/pack)	1.50	
10UF (5/pack)	1.70	
22UF (each)	0.40	
33UF (each)	0.56	
47UF (each)	0.65	
100UF (each)	1.28	
<b>400V Working</b>		
1UF (5/pack)	1.10	
4.7UF (5/pack)	1.50	
10UF (each)	0.70	
22UF (each)	0.75	
4.7UF (each)	1.40	

#### IC-DATABASE ON FLOPPY DISK

The most important technical data & functions of 48000 semi (20k IC's + 28k Transistors / Trnack on floppy disk only £14.99 + p/p & Vat

**TEST CD2**  
This CD can be used to control CD player - 71 different test signals  
- Running time 30 min - Sinus/  
Rectangle/white & pink noise -  
Complete with instruction book  
£12.99 each

**TEST CD3**  
With this CD a technician can control & adjust the electrical data of CD players in a minimum of time will improve the repair results in adjusting cd player after changing the laser unit.  
£20.99 each

Please phone us for the types not listed. Please add 60p post & packing and then add 17.5% VAT to the total. Callers by appointment only.



#### J.J. COMPONENTS

Rear of 243 247 Edgeware Road,  
The Hyde, Collindale, London NW9 6LU  
Tel: 0181 205 9055  
Fax: 0181 205 2053

Free Fax Order Line only: 0800 318498

PHONE FOR OUR FREE 1996 CATALOGUE

## SUMMERTIME IS OUTSIDE BROADCAST TIME



For broadcasting over any standard telephone network

£199 - £399 Prices to suit your pocket



#### PARTRIDGE ELECTRONICS

Suppliers of approved equipment for use on P.S.N. or private circuits

56 Fleet Road, Benfleet ESSEX, SS7 5JN  
Phone: 01268 793256 Fax: 01268 565759

## osziFOX

£80

A universal 20 MHz storage oscilloscope

A slimline storage oscilloscope and digital voltmeter with a sampling rate of up to 20 MHz. Inclusive software enables the recorded signals to be displayed simultaneously on a PC screen.

Sample Rates: From 50 ns to 1 ms. Purveyors of Quality

Input Voltage: 1 V, 10 V, 100 V.

Trigger: ±Internal, ±External, Auto.

Voltmeter: AC and DC.

Supply Voltage: 9 V to 13 V DC, 13 mA, external.

Trigger, ground, power & serial cables included.

**No Nuts Limited**

2 Chase Cottages,  
New Road, Aldham,  
Essex CO6 3QT Tel. & Fax 01206 213322

Also Available;  
3 mW Laser Pointers £26  
CCD Camera Modules from £60  
Pinhole camera in wall clock £80  
Colour CCD modules from £170  
Please add £2 p&p to all orders.

## Printed Circuits in Minutes Direct From LaserPrint!

8 1/2" x 11"  
\* Or Photocopy  
\*\* Use standard household iron or P-n-P Press.



1. LaserPrint\*  
2. Press On\*\*  
3. Peel Off  
4. Etch

Use Standard Copper Clad Board  
5 Sheets £12.50, 10 Sheets £25.00 + VAT. Add £2.50 postage  
Complete kits to manufacture your own PCB's from £40.00, or individual items of material, chemicals, etchant etc.

**PRESS-N-PEEL ETCHING SUPPLIES**  
18 Stapleton Road • Orton • Southgate  
Peterborough PE2 6TD • Tel: 01733 233043

## LOUDSPEAKER KITS!

We stock a range of DIY Loudspeaker Kits suitable for enthusiasts of any experience. Home building is a great way to cut the cost of a new loudspeaker system without losing quality or performance. From the traditional all round speaker, to the top-class high-end systems, home building will help you realise your own ideas of sound & design, being easily adapted to your living environment and your budget.

All Kits are supplied with simple instructions and cabinet dimensions. No soldering is required as the crossover comes ready wired & fixes to gold-plated connection terminals. We have a comfortable listening area with many kits always on demonstration.

**SOUTH COAST SPEAKERS LTD.**

326 Portswood Road, Southampton, Hampshire SO17 2DT  
Full colour catalogue & price lists available. Please ask!



**TEL/FAX: 01703-559312**

## £1 BARGAIN PACKS

If you would like to receive the other four £1 lists and lot of other lists, request these when you order or send SAE.

**TEST PRODS FOR MULTIMETERS** with 4mm sockets. Good Length very flexible lead. Ref: D86

**8 OHM PM SPEAKERS**, size 8" x 4", pack of two. These may be lightly rusty and that is why they are so cheap but are electrically OK. Ref: D102.

**PAXOLIN PANELS**, size 8" x 6", approximately 1/16" thick, pack of two, Ref: D103

**13A SOCKET**, virtually unbreakable, ideal for trailing lead, Ref: D95.

**PIEZO BUZZER** with electronic sounder circuit, 3V to 9V D.C. operated, Ref D76.

**DITTO** but without internal electronics, pack of two, Ref: D75.

**LUMINOUS ROCKER SWITCH**, approximately 30mm sq. pack of two, Ref: D64.

**ROTARY SWITCH**, 9-pole 6-way, small size and 1/4" spindle, pack of two, Ref: D54.

**FERRITE RODS**, 7" with coils for Long and Medium waves, pack of two, Ref: D52.

**MAINS DP ROTARY SWITCH** with 1/4" control spindle, pack of five, Ref: D49.

**ELECTROLYTIC CAP**, 800µF at 6.4V, pack of 20, Ref: D48.

**ELECTROLYTIC CAP**, 1000µF + 100µF 12V, pack of 10, Ref: D47.

**MINI RELAY** with 5V coil, size only 26mm x 19mm x 1mm, has two sets of changeover contacts, Ref: D42.

**MAINS SUPPRESSOR CAPS** 0.1µF 150V A.C., pack of ten, Ref: 1050.

**TELESCOPIC AERIAL**, chrome plated, extendible and folds over for improved F.M. reception, Ref: 1051.

**MES LAMP HOLDERS**, slide on to 1/4" tag, pack of 10, Ref: 1054.

**PAXOLIN TUBING**, 3/16" internal diameter, pack of two, 12" lengths, Ref: 1056

**ULTRA THIN DRILLS**, 0.4mm, pack of 10, Ref: 1042.

**20A TOGGLE SWITCHES**, centre off, part spring controlled, will stay on when pushed up but will spring back when pushed down, pack of two, Ref: 1043.

**HALL EFFECT DEVICES**, mounted on small heatsink, pack of two, Ref: 1022.

**12V POLARISED RELAY**, two changeover contacts, Ref: 1032.

**PAXOLIN PANEL**, 12" x 12" 1/16" thick, Ref: 1033.

**MINI POTTED TRANSFORMER**, only 1.5VA 15V-0V-15V or 30V, Ref: 964.

**ELECTROLYTIC CAP**, 32µF at 350V and 50µF section at 25V, in aluminium can for upright mounting, pack of two, Ref: 995.

**PRE-SET POTS**, one megohm, pack of five, Ref: 998.

**WHITE PROJECT BOX** with rocker switch in top left-hand side, size 78mm x 115mm x 35mm, unprinted, Ref: 1006.

**6V SOLENOID**, good strong pull but quite small, pack of two, Ref: 1012.

**FIGURE-8 MAINS FLEX**, also makes good speaker lead, 15m, Ref: 1014.

**HIGH CURRENT RELAY**, 24V A.C. OR 12V D.C., three changeover contacts, Ref: 1016.

**LOUDSPEAKER**, 8 Ohm 5W, 3.7" round, Ref: 962.

**NEON PILOT LIGHTS**, oblong for front panel mounting, with internal resistor for normal mains operation, pack of four, Ref: 970.

**3.5MM JACK PLUGS**, pack of 10, Ref: 975.

**PSU**, mains operated, two outputs, one 9.5V at 550mA and the other 15V at 150mA, Ref: 988.

**ANOTHER PSU**, mains operated, output 15V A.C. at 329mA, Ref: 989.

**PHOTOCELLS**, silicon chip type, pack of four, Ref: 939.

**LOUDSPEAKER**, 5" 4 Ohm 5W rating, Ref: 946.

**LOUDSPEAKER**, 7" x 5" 4 Ohm 5W, Ref: 949.

**LOUDSPEAKER**, 4" circular 6 Ohm 3W, pack of 2, Ref: 951.

**FERRITE POT CORES**, 30mm x 15mm x 25mm, matching pair, Ref: 901.

**PAXOLIN PANEL**, 8 1/2" x 3 1/2" with electrolytics 250µF and 100µF, Ref 905.

**CAR SOCKET PLUG** with P.C.B. COMPARTMENT, Ref: 917.

**FOUR-CORE FLEX** suitable for telephone extensions, 10m, Ref: 918.

**PROJECT CASE**, 95mm x 66mm x 23mm with removable lid, held by four screws, pack of two, Ref: 876.

**SOLENOIDS**, 12V to 24V, will push or pull pack of two, Ref: 877.

**2M MAINS LEAD**, 3-core with instrument plug moulded on, Ref: 879.

**TELESCOPIC AERIAL**, chrome plated, extendible,

pack of two, Ref: 884.

**MICROPHONE**, dynamic with normal body for hand holding, Ref: 885.

**CROCODILE CLIPS**, superior quality flex, can be attached without soldering, five each red and black, Ref: 886.

**BATTERY CONNECTOR FOR PP3**, superior quality, pack of four, Ref: 887.

**LIGHTWEIGHT STEREO HEADPHONES**, Ref: 898.

**PRESETS**, 470 Ohm and 220 kilohm, mounted on single panel, pack of 10, Ref: 849.

**THERMOSTAT** for ovens with 1/4" spindle to take control knob, Ref: 857.

**12V-0V-12V 10W MAINS TRANSFORMER**, Ref: 811.

**18V-0V-18V 10W MAINS TRANSFORMER**, Ref: 813.

**AIR-SPACED TRIMMER CAPS**, 2pF to 20pF, pack of two, Ref: 818.

**AMPLIFIER**, 9V or 12V operated Mullard 1153, Ref: 823.

**2 CIRCUIT MICROSWITCHES**, licon, pack of 4, Ref: 825.

**LARGE SIZE MICROSWITCHES** changeover contacts, pack of two, Ref: 826.

**MAINS VOLTAGE PUSH SWITCH** with white dolly, through panel mounting by hexagonal nut, Ref: 829.

**POINTER KNOB** for spindle which is just under 1/4", like most thermostats, pack of four, Ref: 833.

## TOROIDAL MAINS TRANSFORMERS

All with 220/240V primary winding, 0-6V +0.6V at 50VA would give you 6V at 8A or 12V at 4A, price £5, Order Ref: 5PG1. 0-30V + 0.30V at 120VA would give you 30V at 4A or 60V at 2A, price £8, Order Ref: 8PG2. 0-110V + 0-110V at 120VA would give you 110V at just over 8A or 220V at 1/2A, price £8, Order Ref: 8PG3. 0-35V +0-35V at 150VA would give you 35V at 4A or 70V at 2A. Price £8. Order Ref: 8PG9. 0-35V + 0-35V at 220VA would give you 35V at 6 1/2A or 70V at 3 1/4A, price £9, Order Ref: 9PG4. 0-110V + 0-110V at 220VA would give you 110V at 2A or 220V at 1A, price £10, Order Ref: 10PG5. 0-45V + 0-45V at 500VA would give you 45V at 11A or 90V at 5 1/2A, price £20, Order Ref: 20PG7. 0-110 + 0-110V at 500VA would give you 110V at 5A or 220V at nearly 3A, price £25, Order Ref: 25PG7.

**TWO MORE TOROIDAL TRANSFORMERS**, Order Ref: 4P100 is 120W and will give you 27V at 4.5A or 54V at 2.5A, price £4. An interesting thing about this transformer is that it is very easy to add turns, 4 turns will give you 1A. Order Ref: 1.5P47 is 25W and will give you 24V at 1A or 48V at .5A, Price £1.50.

**SUPER WOOFERS**. A 10" 4ohm with a power rating or 250W music and normal 150W. Has a very heavy magnet and is beautifully made and finished by Challenger. Normal selling price for this is £55 + VAT, you can buy at £29 including VAT and carriage. Order Ref: 29P7.

The second one is a 8" 4ohm, 200W music, 100W normal. Again by Challenger, price £18, Order Ref: 18P9. Deduct 10% from these prices if you order in pairs or can collect. These are all brand new in maker's packing.

**VENNER 75A TIME SWITCH**. This is a top class instrument, costs probably around £60 new. Electricity board but taken out of service because they changed to solar control. These have 2 on/off per 24 hours, price £8 each, Order Ref: 8P66.

**12V MOTOR**. 1/10hp with 1 1/4" spindle extending from each end. Motor body diameter is 3" and body length 5". Price £8, Order Ref: 8P65.

**SOLDERING IRON**. Super mains powered with long life ceramic element, heavy duty 40W for the extra special job. Complete with plated wire stand and 245mm lead, £3, Order Ref: 3P221.

**DIGITAL THERMOMETER**. Suitable for outdoors or indoors, has an extra wide temperature range - 50°C to + 70°C, complete with heavy duty battery which should last several years. Its sensor can be outside but the read out inside, £4, Order Ref: 3P222.

**MINI AM/FM TUNING CAPACITOR**. Only 1" square but has a good length of 1/4" diameter spindle, with 4 variable preset caps for fine tuning. Price £1, Order Ref: D202.

**ANOTHER 7" FERRITE ROD AERIAL**. This is an extra special 1/2" diameter with long and medium wave coils. Price £1 each, Order Ref: D203.

**DYNAMIC MICROPHONE**. 600 ohm, plastic body with black mesh head, on/off switch, good length lead and terminated with audio plug. £2, Order Ref: 2P220.

**TELEPHONE EXTENSION LEAD**, flat plug one end, socket the other, 12M, £2, Order Ref: 2P338.

**FIGURE-8 FLEX**, mains voltage, 50m, £2, Order Ref: 2P345.

**INFRA-RED RECEIVER**, as fitted TV receiver, £2, Order Ref: 2P304.

**2A MAINS FILTER AND PEAK SUPPRESSOR**, £2, Order Ref: 2P315.

**45A DP 250V SWITCH ON 6" X 3" GOLD PLATE**, £2, Order Ref: 2P316.

**LOCTITE MEDAL ADHESIVE**, tube and some accessories. £2, Order Ref: 2P215.

**35mm PANORAMIC CAMERA**. Has super wide lens, ideal for holiday viewing, is focus free and has an extra bright and clear view finder. Brand new and guaranteed, individually boxed. £6.50, Order Ref: 3P188.

**FLASHING BEACON**. Ideal for putting on a van, a tractor or any vehicle that should always be seen. Uses a XENON tube and has an amber coloured dome. Separate fixing base is included so unit can be put away if desirable. Price £5.00, Order Ref: 5P267.

**12V 2A TRANSFORMER**, £2, Order Ref: 2P337.

**12V-0V-12V TRANSFORMER**, 35VA, £2.50, Order Ref: 2.5P13.

**HIGH RESOLUTION MONITOR**, 9" by Phillips, in metal frame for easy mounting. Brand new, offered at less than the price of the tube alone, £15, Order Ref 15P1.

**15W 8" 8ohm SPEAKER AND 3" TWEETER**. Amstrad, made for their high quality music centre, £4 per pair, Order Ref: 4P57.

**INSULATION TESTER WITH MULTIMETER**. Internally generates voltages which enables you to read insulation directly in Megohms. The multimeter has four ranges: A.C./D.C. volts; 3 ranges milliamps; 3 ranges resistance and 5 amp range. Ex-British Telecom, tested and guaranteed OK, yours for only £7.50 with leads, carrying case £2 extra, Order Ref: 7.5P4. We have some of the above testers not working on all ranges, should be repairable, we supply diagram, £30, Order Ref: 3P176.

**LCD 3 1/2 DIGIT PANEL METER**. This is a multi-range voltmeter/ammeter using the A-D converter chip 7106 to provide five ranges each of volts and amps. Supplied with full data sheet. Special snip price of £12, Order Ref: 12P19.

**MINI BLOW HEATER**, 1kW, ideal for under desk or airing cupboard, etc. Needs only a simple mounting frame, £5, Order Ref: 5P23.

**MEDICINE CUPBOARD ALARM**. Or it could be used to warn when any cupboard door is opened. The light shining on the unit makes the bell ring. Completely built and neatly cased, requires only a battery. £3, Order Ref: 3P155.

**DON'T LET IT OVERFLOW!** Be it bath, sink, cellar, sump or any other thing that could flood. This device will tell you when the water has risen to the pre-set level. Adjustable over quite a useful range. Neatly cased for wall mounting, ready to work when battery fitted. £4, Order Ref: 3P156.

### TERMS

Send cash, PO, cheque or quote credit card number - orders under £25 add £3 service charge.

## J & N FACTORS

Pilgrim Works (Dept E.T.I.)  
Stairbridge Lane, Bolney,  
Sussex, RH17 5PA  
Telephone: 01444 881965  
(Also fax but phone first)

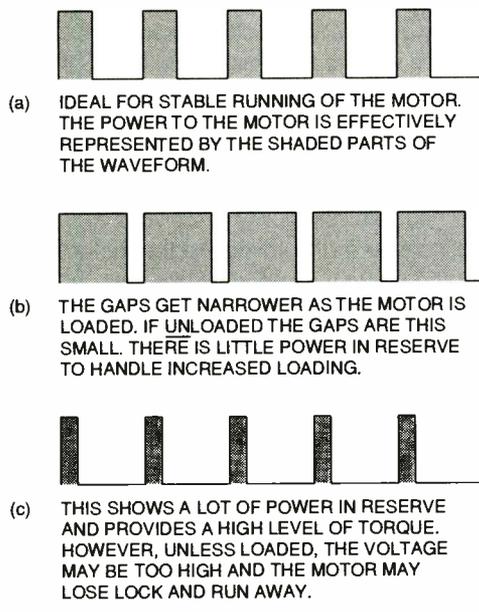


Figure 4: waveforms into pin1 of the mosfet transistor IFR510

Referring to Figure four, section (a) shows the ideal waveform into pin 1 of the mosfet when the motor speed is firmly locked to the clock frequency. The shaded part of the waveform is a representation of the power driving the motor. If you provide mechanical loading of the motor, you will see (section (b) that the shaded areas will increase in size horizontally, showing that the motor is working harder to hold its speed constant.

The same effect will occur if you just reduce the voltage to the speed-locked motor. Now the waveform will again look like Section (b) but there will be a smaller amount of potential power to cope with any increased loading. Indeed, as loading increases, the gaps may narrow until they disappear altogether and the motor may stall.

If the voltage applied to the motor is too high, Section (c), there is a greatly increased reserve of power, but if the shaded areas become too narrow, the motor may again become unstable, lose lock and speed up out of control.

The circuit in figure 3 meets many of the requirements I had for a replacement motor for my tape recorder. Unfortunately, the clock frequency in this circuit is very dependent on the stability of the 12 volt supply to the control circuit, and a 7812 voltage regulator chip was not quite stable and constant enough for my very high quality tape recorder. A more accurate clock seemed to imply some sort of crystal drive.

### How the crystal drive circuit works

The clock is built around the 4060, a chip which not only permits the design of a crystal-driven oscillator, but also has a number of pins which allow the repeated division-by-two of the crystal's fundamental frequency, down to a level more useful for this application. When connected as shown in the diagram, the

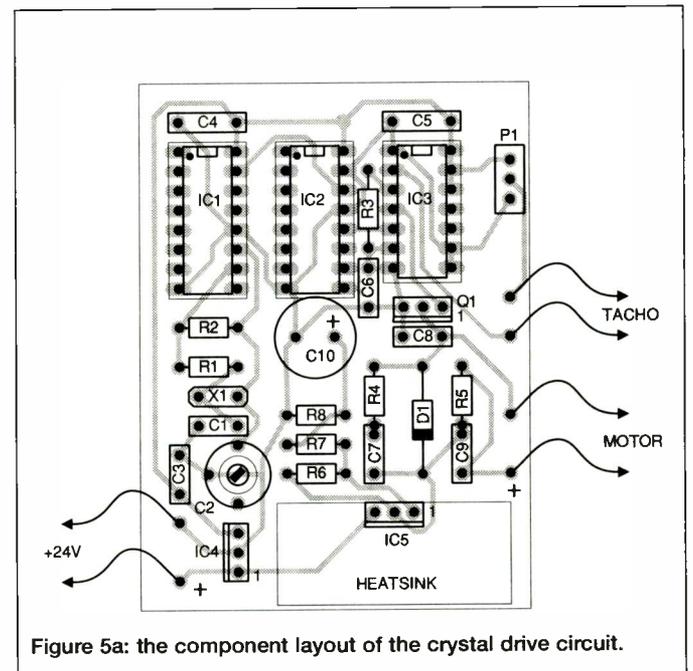


Figure 5a: the component layout of the crystal drive circuit.

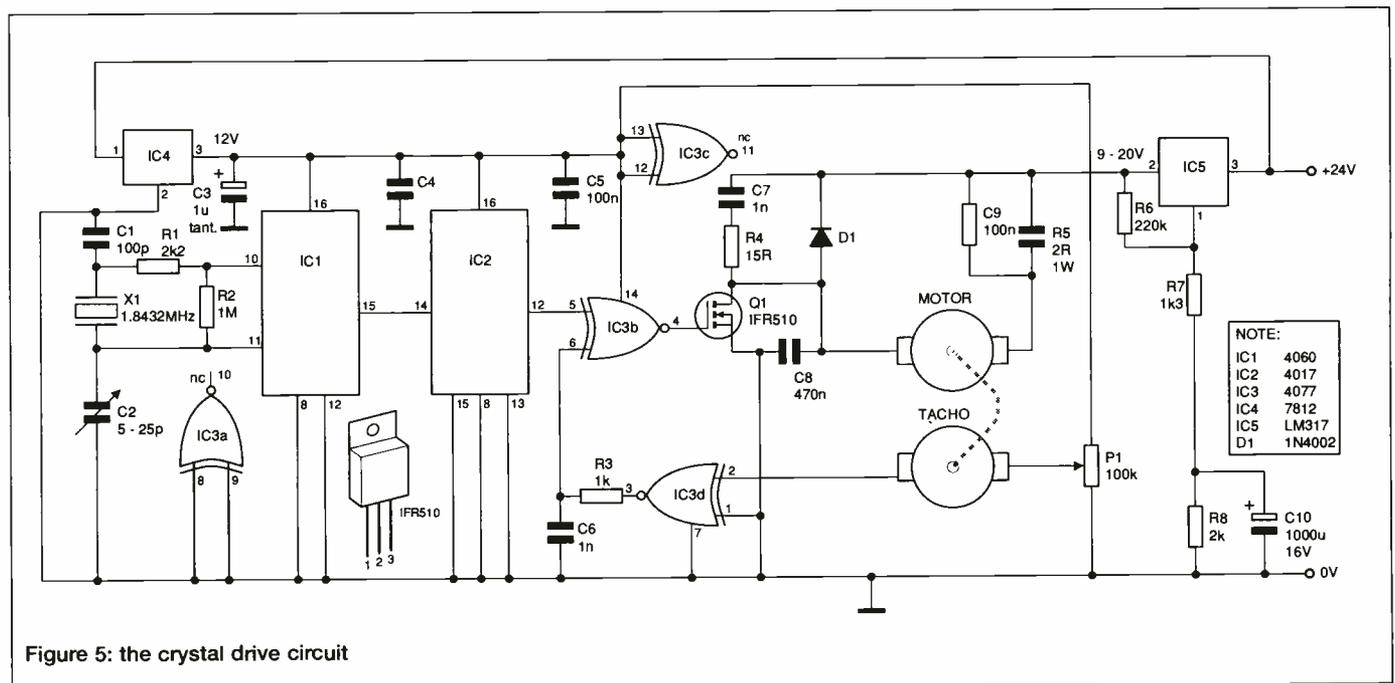


Figure 5: the crystal drive circuit

4060 produces a 1800 Hz signal at pin 15. This is derived from the fundamental of the 1.8432 megahertz crystal by dividing it by 2 to the power of b.

The next IC in the chain is the 4017, used here as a decade divider. Consequently, the 1800 Hz. signal applied to the clock input at pin 14 is divided by 10 and emerges from pin 12 as a frequency of 180 Hz..

Clearly I did not chose this particular crystal at random. Knowing that I wanted a final frequency of 180 Hz and that divisions by 2 and 10 are easy, I worked backwards to try and find a suitable one. Only a small amount of trial and error was required to arrive at a fundamental of 1.8432 MHz. for which crystals are easily available.

Using this circuit does produce a very accurate and stable clock, but it also means that changes in the clock frequency, and hence variation of the "standard", are only possible by division.

An understanding of the workings of the rest of this circuit largely follows previous explanations. However there are perhaps one or two points which should be made.

The clock function of the previously used 4046 chip is no longer required, and so this IC is replaced by a 4077 which has four exclusive-nor gates on board. One of these, N2, is used as the comparator. These gates are more tolerant of noise at inputs than those of the 4046, but they do require a very exact 50 percent duty cycle (that is, equal high and low states in the waveform). Consequently, one side of the tach is joined to P1 which allows exact adjustment to 50 percent of the final waveform into pin 6 of N2. Gate N4 and the low pass filter R3/C6 square off the tach's sine wave and eliminate any spikes which might be present.

The rest of the circuit is similar to the previous one except that figure five does show how the two voltages are produced: 12 volts for the control circuit and eventually 20 volts to drive the motor. I say *eventually* 20 volts, because that is what the output voltage is when a total resistance of 3k3 (R7 + R8) is connected between pin 1 of the variable voltage regulator, LM 317, and earth. But the inclusion of C9, a 1000 microfarad capacitor, means that on the first application of 24 volts to the input of LM 317, the initial output from pin 2 will be about 9 volts and will rise relatively slowly to 20 volts as C9 charges. This gradual increase in the voltage to the motor's drive circuit ensures that the motor will speed up gradually, allowing it to lock at the required speed and not race through that point. Incidentally, there is never any doubt when the shaft speed is locked: the motor will maintain constant rotation against powerful attempts to load the motor.

Care must be exercised in the construction and setting up of this circuit since mains hum can be a problem. Motor jitter can also be present as a result of comparing two similar frequencies which may "beat" together. However, the final circuit shown as figure five meets all the requirements for a constant speed motor to run my tape recorder.

But wouldn't it be nice if as well as a tape speed of 7.5 inches per second, I could also record and play tapes at other standard speeds?

In a following article I want to look at a motor with a different kind of tach, develop a circuit which uses as the standard clock the frequency of the mains (either 50 or 60 Hz. at the flick of a switch) and which allows the tape recorder to run at 3.75 and 15 inches per second as well as at 7.5 ips.

<i>T.I.S.</i>	<b>2 John Street, Larkhall, Lanarks, ML9 1HE</b> <b>Tel: 01698 883334 / 884585 Fax: 884825</b> Send a S.A.E. for your <u>FREE</u> Catalogue & Quote.	<i>T.I.S.</i>
---------------	--	---------------

### Unconditional replacement or refund on any item if not as requested

<p><b>TOP SELLING BOOKS</b></p> <p>Pract' TV or VCR Repairs-£16.95 (Both £30)          Buy/Sell/Serv'/Repair Used Equipment :-          CD, TV or VCR - £10.95 each (All 3 £27)          6 Giant IC Ref' Manuals - £12.95 each          Data Ref' Guide - Identifies/ prices/ cross-ref's          data for most models - £9.95 (3.5" Disk £5)          Microwave Energy &amp; Ovens - £9.95          3.5" Disk Drives - £9.50          The Giant Fault-Finding Guides:-              CTV's £16.95 / VCR's £16.95</p>	<div style="border: 1px solid black; padding: 2px; display: inline-block;">VISA</div> <div style="border: 1px solid black; padding: 2px; display: inline-block;">MASTERCARD</div> <p style="font-size: 1.5em; margin: 0;"><b>SERVICE MANUALS</b></p> <p style="text-align: center; border: 1px solid black; padding: 2px; margin: 5px 0;"><b>DESIGNER COLLECTIONS</b></p> <p><b>Comprehensive Circuits Collections</b> of any make of CTV as requested, prices from £8 to £49 (IE. Alba/Bush £20) Full list in Free Catalogue.</p> <p><b>Amateur Kit:</b> 10 Service Manuals (as needed), Data Ref', Pract' TV &amp; VCR Repairs, Radio Repairs, Thorn Serv' Set &amp; any 3 CTV Circ Collections. <span style="float: right;">£199</span></p> <p><b>Professional Kit:</b> As above + 10 Serv' Man's, Microwave E&amp;D, Buy/Sell/Serv' Collection &amp; 2 More CTV Circ's. <span style="float: right;">£370</span></p>	<p><b>3 UNIQUE SERVICE MANUAL OFFERS GUARANTEED SAVINGS TO YOU NOW!!</b></p> <p>*<b>LIBRARY</b> Joining fee £65.00          You receive any Service Manuals, no matter how expensive, for £10 each, and you get a £5 credit for any you return.</p> <p>*<b>PRE-PAY MANUALS</b>          You get 20 Service Manuals, as and when you need them; as many or few at a time as you want, for a one-off payment of £185.</p> <p>*<b>SERVICE MANUAL EXCHANGE</b>          If you have a Service Manual we <u>don't</u> have and need another manual (ie. TV for TV, VCR for VCR), we will exchange it for FREE.</p>
---	---	---

**Please add £2.50 to all orders to cover Postage & Handling**

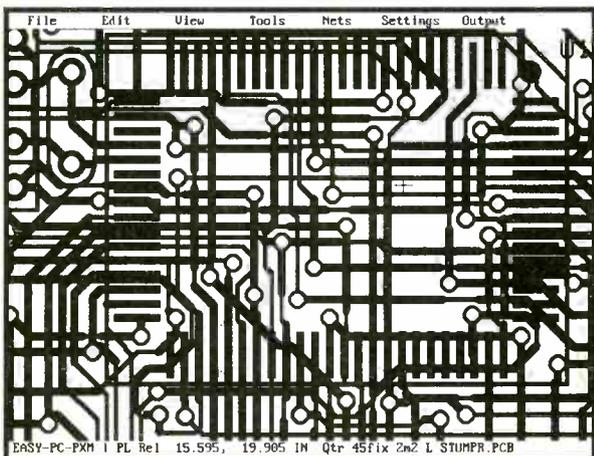
**WORLD'S LARGEST SERVICE MANUAL COLLECTION**

*Normal Prices Given (Some Manuals may be Cheaper or more Expensive)*

	VCR/VIDCAM - FULL MANUALS £16.50 - CIRCUITS £8.00 COMPLETE	
	CTV's / CD's - FULL MANUALS £12.50 - CIRCUITS £6.00 COMPLETE	

AUDIO, CD, COMPUTERS, MONITORS, DOMESTIC / TEST EQUIP', ETC.. FROM £4.00

# THE **Autrouter** for EASY-PC Pro' XM!



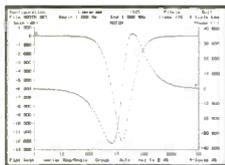
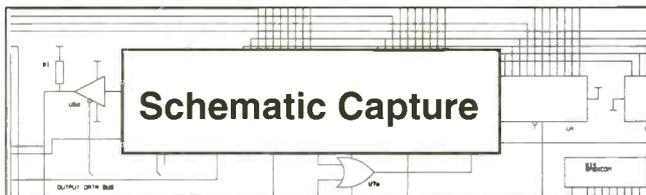
EE Product News "Products of the year"  
Award Winner (USA Magazine)

"The Best Autorouter that I have seen costing  
less than £10,000!" R.H. - (Willingham, UK)

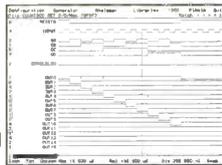
- Uses the latest Shape Based, 32 Bit, Multi-pass, Shove-aside and Rip-up and Re-try Technology
- AutoRoute very large and complex boards
- User Controllable,  
User Configurable
- 100% Completion where other autorouters fail
- 100% Autorouted 140 Components on a 210mm x 150mm board in less than 10 minutes! (75MHz Pentium)
- **Could Easily Pay For Itself On The First Project**

## MultiRouter - only £295/\$475!

### Integrated Electronics CAD



Analogue  
& Digital  
Simulation



Prices from UK£75 / US\$145

### Affordable Electronics CAD

<b>EASY-PC Professional:</b> Schematic Capture and PCB CAD. Links directly to ANALYSER III, LAYAN and PULSAR.	From \$275	£145
<b>MultiRouter:</b> 32bit Multi-pass Autorouter for EASY-PC Professional XM	From \$475	£295
<b>LAYAN: Electro-Magnetic</b> Layout Simulator. Include board parasitics in your Analogue simulations. Links with and requires EASY-PC Professional XM and ANALYSER III Professional	\$950	£495
<b>PULSAR:</b> Digital Circuit Simulator	From \$195	£98
<b>ANALYSER III:</b> Analogue Linear Circuit Simulator	From \$195	£98
<b>FILTECH:</b> Active and Passive Filter Design program	From \$275	£145
<b>STOCKIT:</b> Comprehensive Stock control program for the small or medium sized business	From \$275	£145
<b>EASY-PC:</b> Award Winning PCB and Schematic CAD.	\$145	£75
<b>Z-MATCH :</b> Award Winning Smith-Chart based program for RF Engineers.	From \$275	£145

*We operate a no penalty upgrade policy. US\$ prices include Post and Packing Sterling Prices exclude P&P and VAT.*

For Full Information and Demo' Disk, please write, phone, email or fax:-

## Number One Systems

UK/EEC: Ref: ETI, Harding Way, St.Ives, Cambridgeshire, ENGLAND, PE17 4WR.  
Telephone UK: 01480 461778 (7 lines) Fax: 01480 494042  
USA: Ref: ETI, 126 Smith Creek Drive, Los Gatos, CA 95030  
Telephone/Fax: (408) 395-0249

Email: [sales@numberone.com](mailto:sales@numberone.com)  
International +44 1480 461778

<http://www.numberone.com>



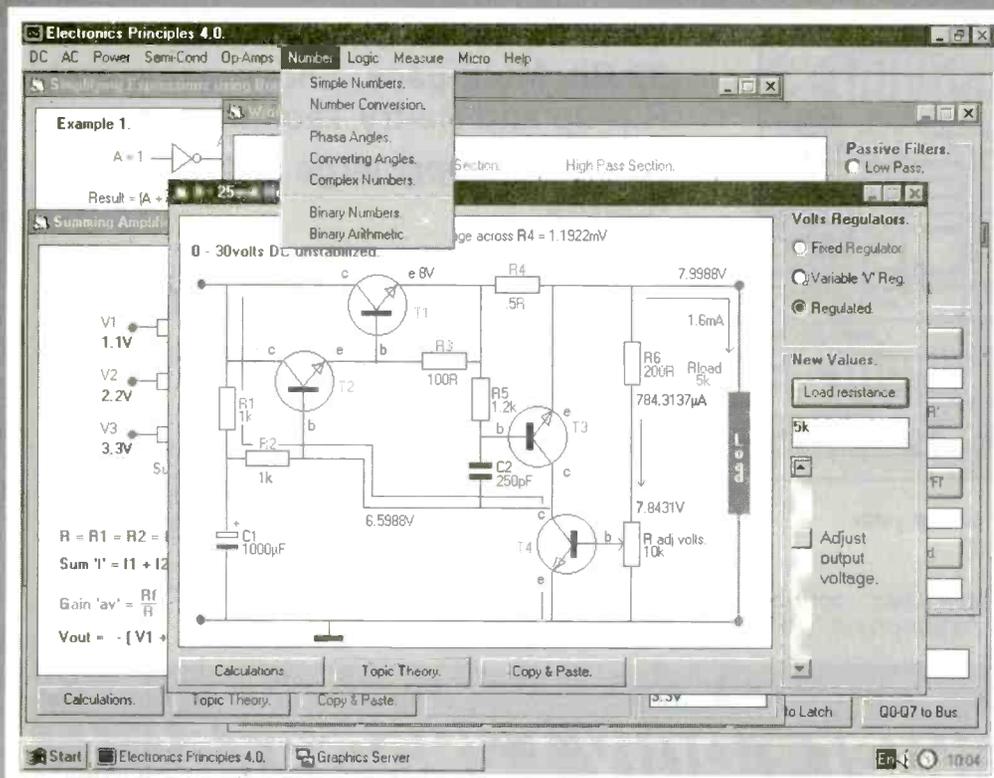
ada4prmu

# Electronics Principles 4.0

For Windows 3.1, '95 & NT.

If you are looking for an easy and enjoyable way of studying or improving your knowledge of electronics then this is the software for you.

£99.95\*



Electronics Principles 4.0 now has an even more comprehensive range of fully interactive analogue and digital topics. From current flow and dc circuits through switching and transistor operation to passive and active filters. Logic begins with simple gates through binary, hex and octal number conversion, addition and subtraction to Boolean algebra. Plus, microprocessor and microcomputer operation, registers, arithmetic and logic unit, ROM, RAM. Addressing modes and full instruction set which can be simulated on the screen. All version 3.0 topics are covered within this program.

Currently used in hundreds of UK and overseas schools & colleges to support GCSE, A-level, BTEC, City & Guilds and university foundation courses. Also NVQ's and GNVQ's where students are required to have an understanding of electronics principles.

## Mathematics Principles 3.0

£49.95\*

Study or revise mathematics in what we believe is an interesting and enjoyable way. Nearly two hundred graphics presentations, to enable learning by exploration. Including the GCSE syllabus.

## The popular Electronics Principles 3.0

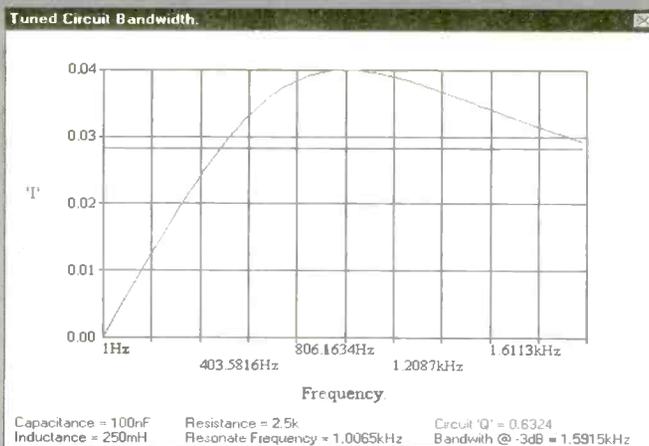
£49.95\*

Contains nearly 300 fully interactive analogue and digital topics. Electron current flow, transistor operation and biasing, MOSFET enhancement and depletion modes. Frequency and tuned circuits. Logic gates, counters and shift registers to binary arithmetic. To list just a few of those available

- All Inputs & outputs use electronics symbols.
- Hundreds of electronics formulae available for circuit investigation.
- Ideal for students and hobbyists who require a quick and easy way to get to grips with a particular point.
- Explore the subject as the Interactive graphics are redrawn showing phase angles, voltage and current levels or logic states for your chosen component values.
- Generate hard copies of graphics, text and calculations.

### Schools and Colleges.

A fully interactive 'textbook' on the screen.  
OHP slides and student handouts within minutes.  
Multi-user network version available.



### R.C.L Parallel Impedance.

Calculations.

$$I_R = \frac{50}{100} = .5 = 500\text{mA}$$

$$I_C = \frac{50}{31.83099} = 1.570796 = 1.5708\text{A}$$

$$I_L = \frac{50}{157.0796} = .3183099 = 318.3099\text{mA}$$

$$I = \sqrt{.5^2 + (.3183099 - 1.570796)^2} = 1.3486 = 1.3486\text{A}$$

$$\theta = \tan^{-1} \frac{1.570796 - .3183099}{.5} = 68.2378^\circ$$

$$Z = \frac{100 \times 157.0796 \times 31.83099}{\sqrt{157.0796^2 \times 31.83099^2 + 100^2 \times (157.0796 - 31.83099)^2}} = 37.0755\Omega$$

**EPT Educational Software. Pump House, Lockram Lane, Witham, Essex, UK. CM8 2BJ.**  
**Tel/Fax: 01376 514008. e-mail sales@eptsoft.demon.co.uk \* UK & EC countries add £2 per order for post & packing. VAT should be added to the total. Outside Europe £3.50 for air mail postage by return.**  
**Switch, Delta, Visa and Mastercard orders accepted - please give card number and expiry date.**  
**Cheques & Postal Orders should be made payable to EPT Educational software.**

# VALVE CHARACTERISTIC

# Tester

## PART 1

**Peter Kenyon's valve tester assists in checking the essential characteristics of most types of electronic valve, and making up matched pairs.**

**T**he increasing popularity of valves in new designs for audio amplifiers, pre-amplifiers and filters is creating the need for appropriate test equipment. This article describes a small portable unit (figure 1) which, with the aid of information from data sheets and other sources, enables the essential characteristics of most types of electronic valve to be obtained. Where two or more valves of the same type have to be matched, this unit provides a fast and convenient method.

Valves which use the most popular bases, B7G, B9A and 10 (International Octal) are catered for. The less common

base types can be accommodated by constructing an adapter to be plugged into the 10 socket.

The specification of the Valve Characteristic Tester is as follows:

Anode voltage ( $V_a$ ): 75 to 300 volts at up to 100mA

Screen grid voltage ( $V_{g2}$ ): Equal to  $V_a$  and up to 200 volts less than  $V_a$  at up to 25mA

Control grid ( $V_{g1}$ ): 0 to -6I volts

Heater voltage ( $V_h$ ): 1.4 volts fixed and 4.0 to 20 volts continuously adjustable at up to 2.5A

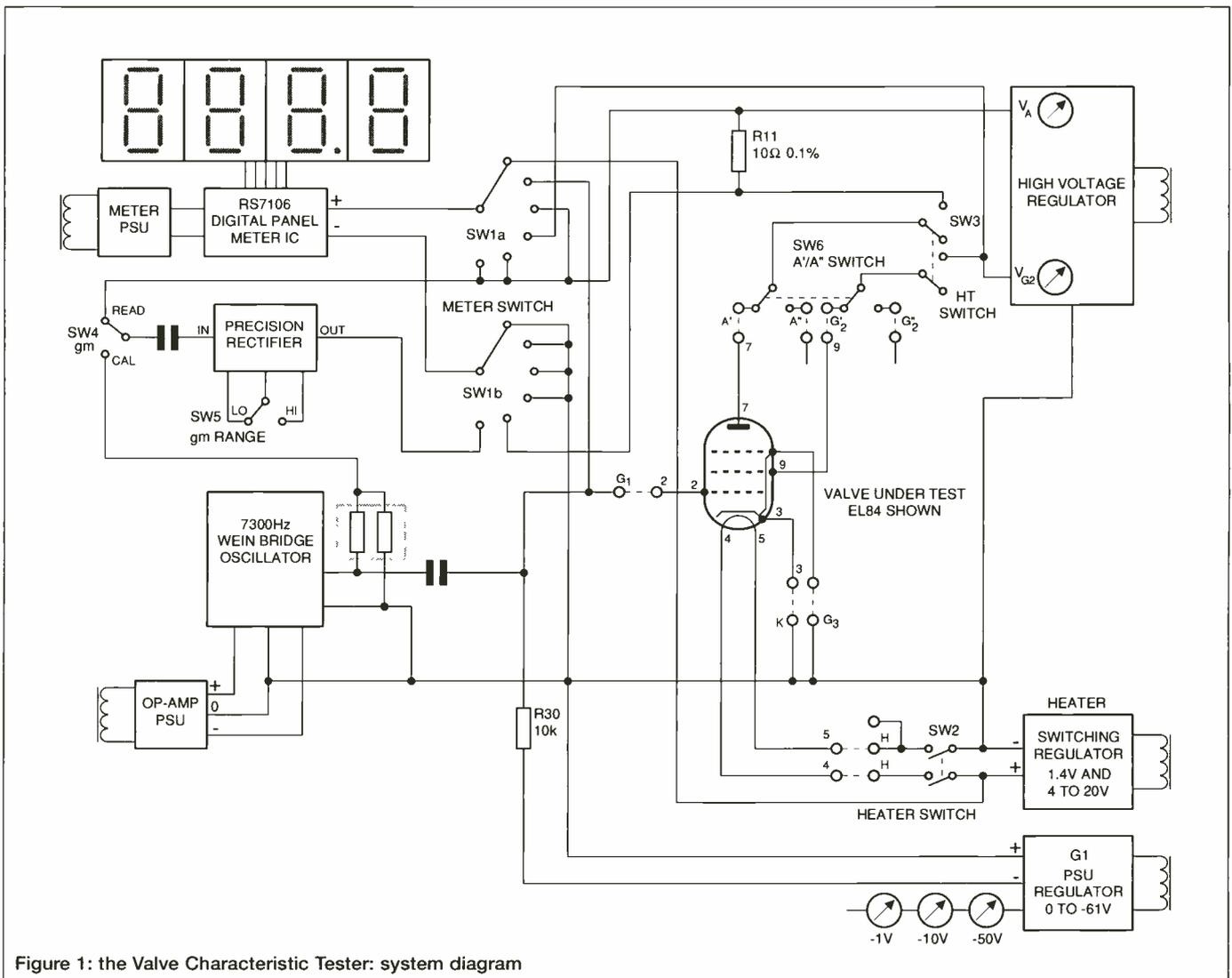


Figure 1: the Valve Characteristic Tester: system diagram

Readout of voltages, currents and mutual conductance (gm) is by a 34-digit LCD digital panel meter (DPM). Each of the set voltages can be read on the DPM before being applied to the valve under test.

Double valves can be tested one half at a time by means of the A'/A" switch.

### Principle of operation

To obtain valve parameters, the voltage developed across a precision 100ohm resistor is measured by the DPM. The 100ohm resistor is interposed in the anode circuit of the valve. Mutual conductance is measured by applying a 7300Hz sine wave to g1 of the valve. The resulting ac voltage developed across the 10ohm resistor is then measured, and gives a direct reading of gm in mA per volt (mA/V).

The DPM switch positions, starting from the anticlockwise position, lead the user logically from setting voltages to making measurements.

Operation is in the following order:

- Vh Set heater voltage
- Vg1 Set control grid voltage
- Va Set anode voltage

- Vg2 Set screen grid voltage
- Ia Measure anode current
- gm Measure mutual conductance. A READ/CAL switch is included with this function.

The layout of the main PCB and heater regulator PCB are shown in figure 14 and figure 15 with the Parts List near the end of this article.

### Pin assignment

Pin connections to the valve are made by plugging 2mm plugs on short leads into sockets designated h (heater), k (cathode), g1 (control grid), g2 (screen grid), g3 (suppressor grid or beam plate) and a (anode). In most manufactured valve testers, these connections have been made with thumbwheel switches. So that size and cost can be kept low in this design, the plug and socket arrangement was thought preferable.

**For optimum safety, it is recommended that a Residual Current Device (RCD) be used with this unit. The Valve Characteristic Tester is a mains powered, high voltage project, recommended for experienced mains constructors.**

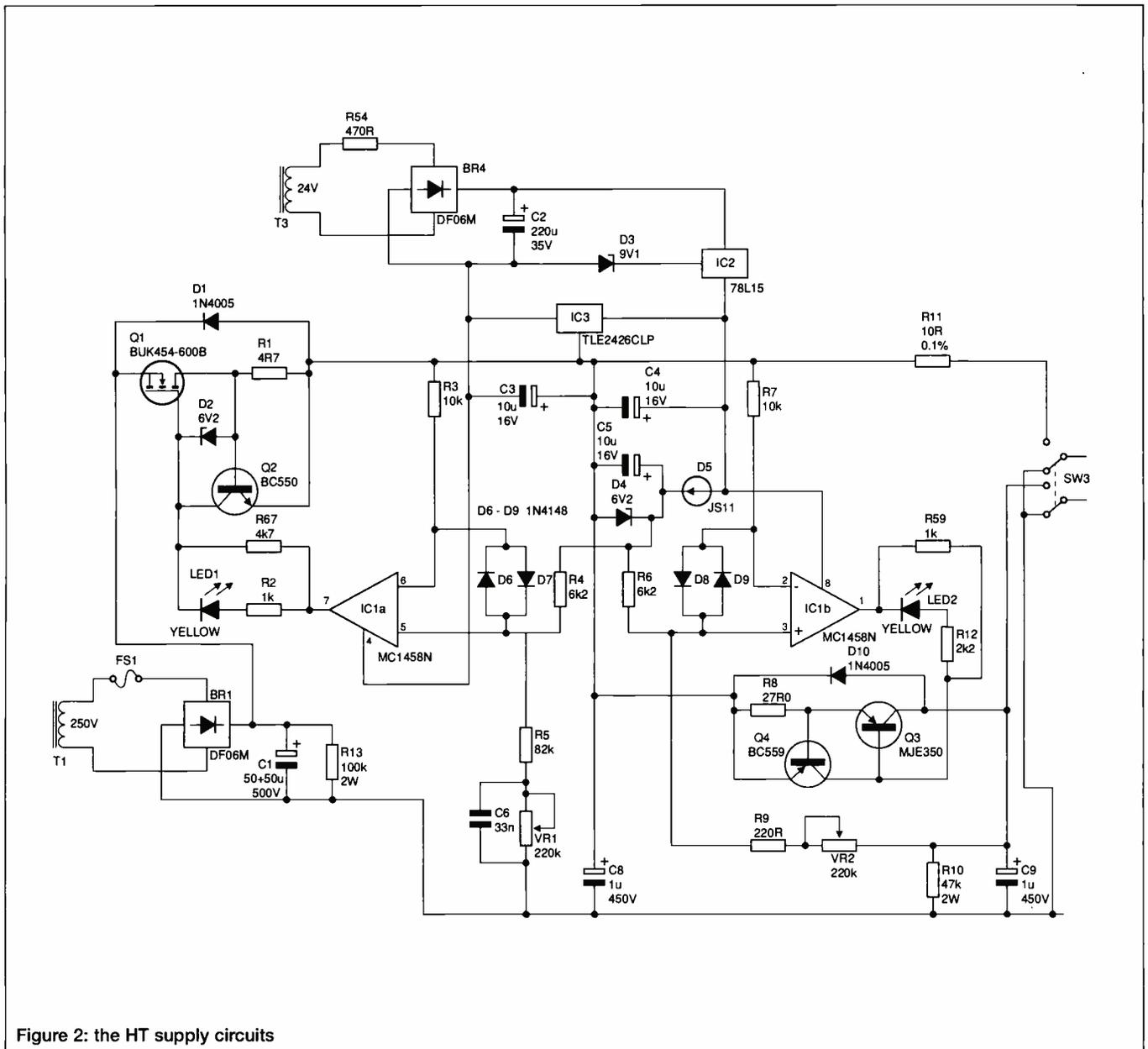


Figure 2: the HT supply circuits

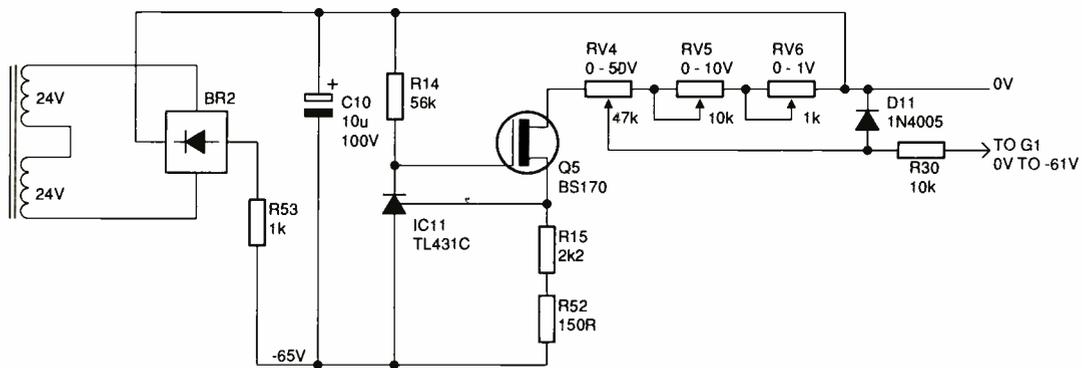


Figure 3: the G1 negative supply circuit

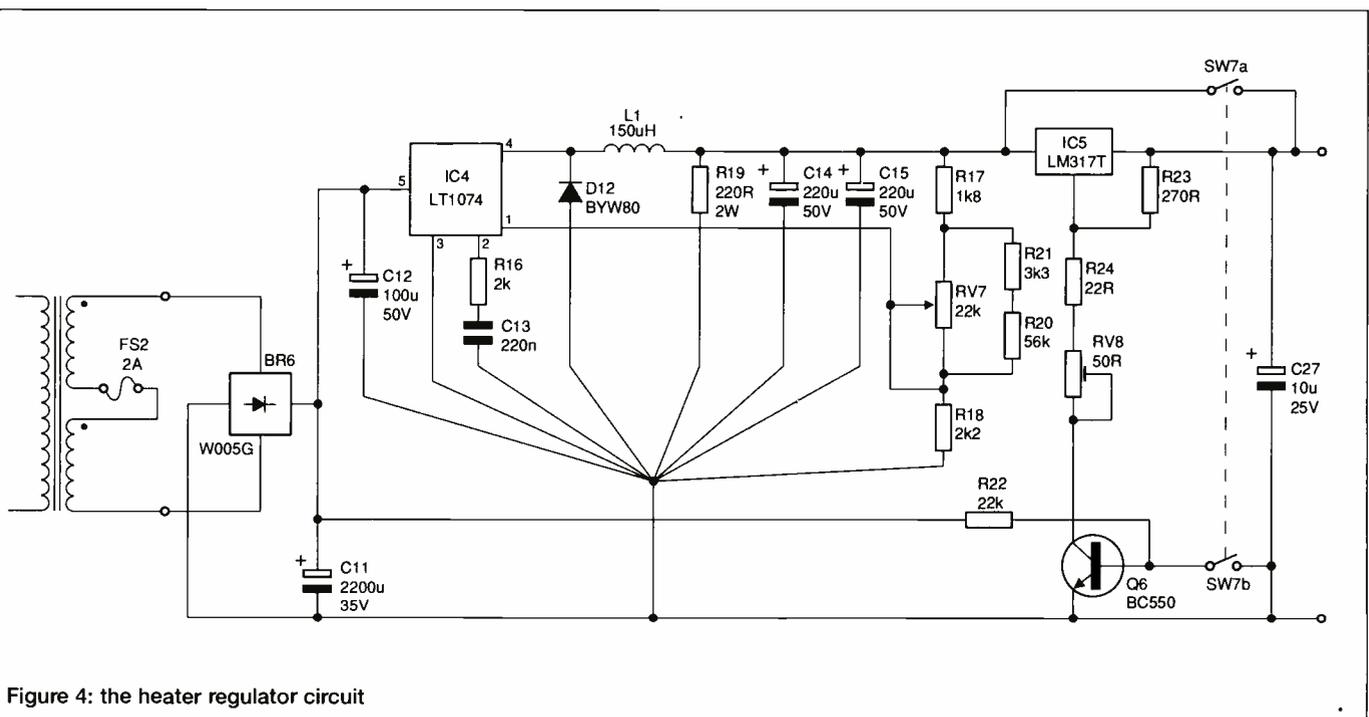


Figure 4: the heater regulator circuit

## HT Supplies

250 vac from T1 is rectified by BR1 and smoothed by C1 (figure 2). It is very important that C1 and the other high-voltage capacitors used in this design are NOT substituted by lower-voltage capacitors. A lower voltage capacitor here would fail, very likely causing permanent damage to the equipment. It is recommended that the part numbers specified or an exact equivalent are used. This is a high-voltage circuit and must be treated as such.

Q1 is the pass transistor, controlled by IC1a. In this regulator the op-amps are "floating" at  $V_a$ . Their +12 volt and -12 volt supplies are derived from a single 24vac transformer winding. This is rectified by BR4, regulated by IC2 and the mid rail is derived by IC3, a TLE2426CLP. This device is basically an op-amp and voltage divider in one three-pin package. Its use obviates the need for centre tapped windings.

Zener diode D4 provides a reference for IC1a and IC1b and is +6.2 volts with respect to (wrt)  $V_a$ . IC1a, in normal op-

amp fashion, will act to keep a zero voltage difference between its two inputs. Since R4 is 6k2, 1mA will flow through it and R5 and VR1 in series. IC1a will therefore drive the gate of Q1 to maintain 1mA in R5 and VR1. The output voltage at C8 is then proportional to  $VR1+R5$  and is 1 volt per 1k. D2 gives over-voltage protection for Q1 gate. When output current exceeds 100mA, 0.7V is developed across R1, turning on Q2 and robbing voltage from Q1 gate. The resulting current through Q2 lights LED1 to indicate that an over-current condition exists. This regulator sets the required anode voltage.

If a lower voltage is required for  $V_{g2}$ , VR2 is rotated anticlockwise. As with IC1a, IC1b will maintain a zero voltage difference between its two inputs. 1mA will flow through R9, VR2 and R10 in series to 0V. This type of regulator requires this 1mA to flow under all load conditions. For the lowest voltage likely to be set, a value of 47k is chosen for the minimum load. This regulator will maintain

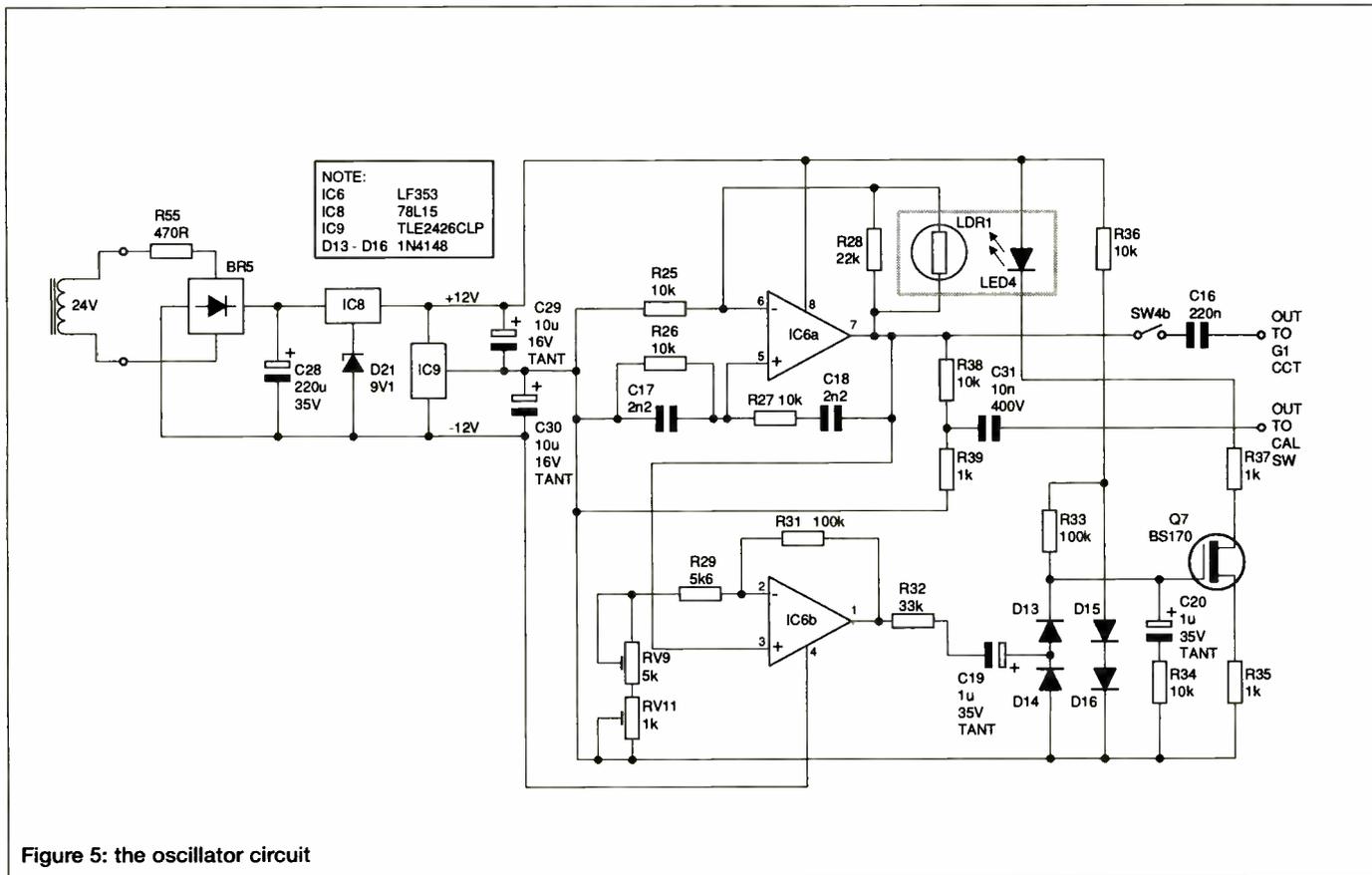


Figure 5: the oscillator circuit

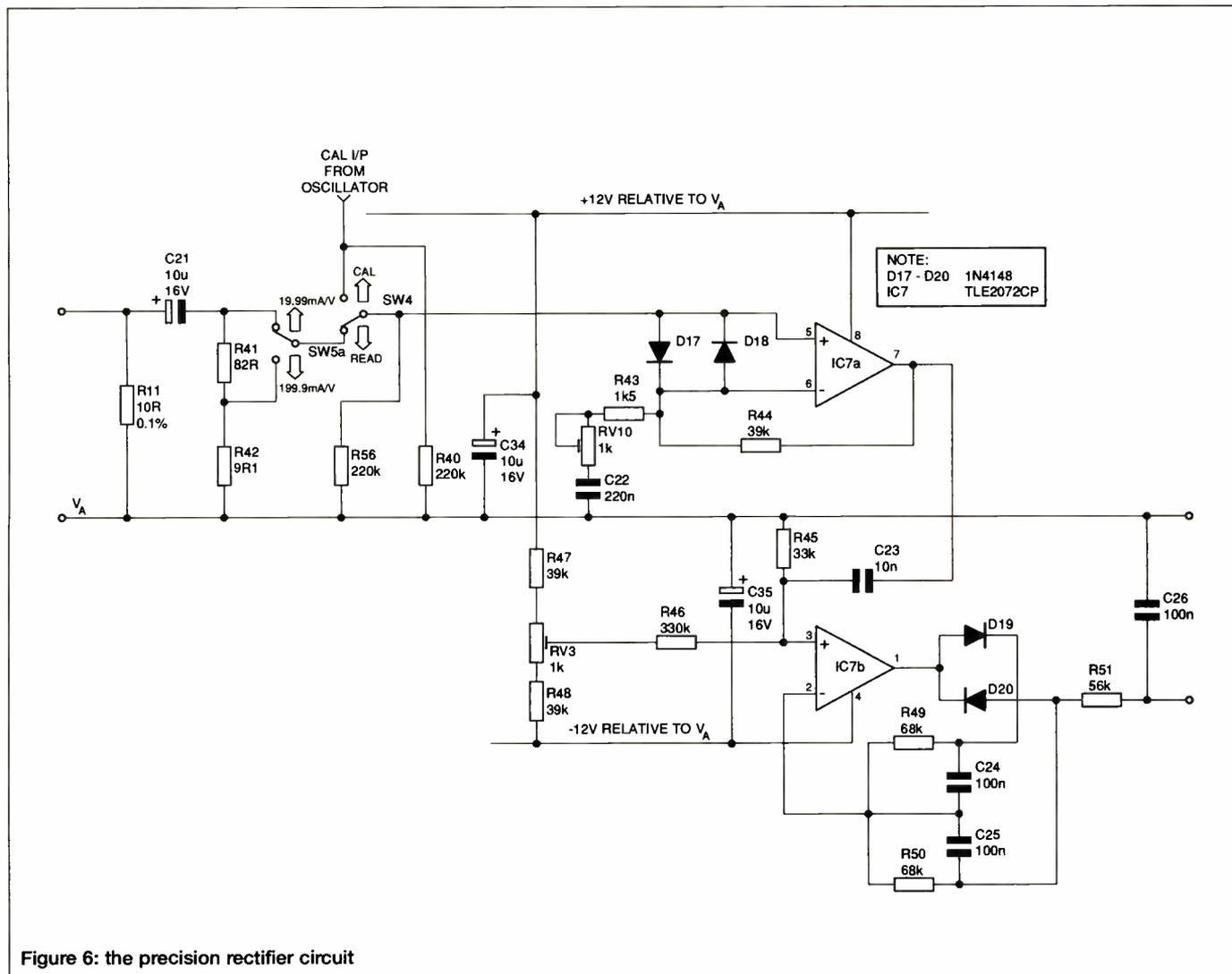


Figure 6: the precision rectifier circuit

# Radio Bygones



The leading vintage wireless magazine

INCLUDING IN THE AUG/SEPT ISSUE...

- A Lafayette HE-30 revived • Photography for collectors •
- Japanese transistor radios – a mini-history •
- The Grimeton dinosaur –  
the last Alexanderson alternator transmitter •

Annual subscription (6 issues) £18.50 in the UK,  
£19.50 to Europe; £23.75 the rest of the world, by  
airmail, or send £3.25 or a US\$5 Bill for a sample

Also from the publishers of *Radio Bygones* ...  
books for the vintage collector and enthusiast

## Watchers of the Waves by Brian Faulkner

A history of Maritime Coast Radio Stations in Britain over  
the past 100 years. 128 A4 pages with over 80 photos and  
24 drawings.

Price £13.50 to UK, £14.20 elsewhere.

## The Racal Handbook by Rinus Jansen

A review of Racal communications equipment – receivers,  
transmitters and ancillaries – from 1956 to 1975, mainly  
based on Racal technical sales literature. 102 A4 pages,  
with 59 photos and 24 drawings, plus specifications.

Price £13.00 to UK, £13.75 elsewhere.

## Comprehensive Radio Valve Guides

Facsimile reprints of books published by Bernards/Babani in  
the 1950s and '60s. Among the most comprehensive and  
user-friendly valve data ever published, the five books deal  
respectively with valves produced during 1934/51, 1951/54,  
1954/56, 1956/60 and 1960/63. English, European,  
American, USSR and Japanese types are covered.  
Each book contains between 40 and 56 A5 pages.

Price £2.95 each to UK, £3.25 elsewhere, or the  
complete set of five for £14 to UK, £15.50 elsewhere.

## Handbook of Radio, TV, Industrial & Transmitting Tube & Valve Equivalents

A companion to the above Valve Guides, listing  
commercial and military equivalents and comparables from  
both sides of the Atlantic. 60 A5 pages.

Price £2.95 to UK, £3.25 elsewhere.

## The Story of the Key by Louise R. Moreau

A reprint of a popular and profusely illustrated series from  
*Morsum Magnificat* magazine. 60 A5 pages.

Price £3.95 to UK, £4.25 elsewhere.

## Wireless for the Warrior - Vol. 1 by Louis Meulstee

A technical history of radio communication equipment in the  
British Army from Wireless Set No. 1 to No. 88. 360 A4 pages  
with over 150 photos and 300 drawings.

Price £27.75 to UK, £28.65 elsewhere.

**Wireless for the Warrior - Volume 2** (with more  
detailed information on WS18, 19, 22, 29, 31, 38, 42, 46, 48,  
52, 53, 62, 68 and 88) is expected to be published towards  
the end of 1997. If you would like to be sent further details  
as soon as they are known, write to the address below.

All book prices include postage. Overseas prices are for  
airmail despatch to Europe, surface mail elsewhere.  
Airmail rates to the rest of the world available on request.

Please make all cheques payable to G C Arnold Partners

G C Arnold Partners (E8), 9 Wetherby Close, Broadstone  
Dorset BH18 8JB, England. Telephone/FAX: 01202 658474



## Summer '97 Catalogue Includes 40 page full colour Computer Equipment Catalogue

The Summer '97 Edition brings you:

- ▶ Even further additions to the Computer section  
extending our range of PC components and  
accessories at unbeatable prices.
- ▶ **WIN!** a 15" CTX SVGA Monitor in our easy  
to enter competition.
- ▶ 100's of new products including; Books,  
Connectors, Entertainment, Test Equipment,  
Security, Speakers, Satellite Equipment and  
Tools.
- ▶ A full range of Aver Multimedia  
products for PC and Mac.
- ▶ £25 worth discount vouchers.
- ▶ 232 Page main Catalogue, plus 40 Page full  
Colour Computer Catalogue, incorporating 24  
Sections and over 4000 Products from some of  
the Worlds Finest Manufacturers.
- ▶ Available at WH Smith, John Menzies and most  
large newsagents, or directly from Cirkitt.
- ▶ **Get your copy today!**

**£2.20**  
+ 30p p&p

# Cirkitt



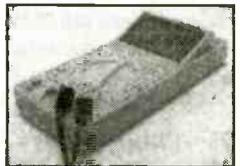
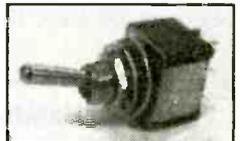
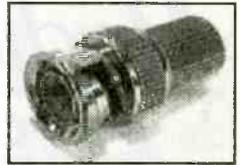
## Cirkitt Distribution Ltd

Park Lane · Broxbourne · Hertfordshire · EN10 7NQ  
Tel: 01992 448899 · Fax: 01992 471314  
Email: mailorder@cirkitt.co.uk



# GREENWELD

*Greenweld has been established for 23 years specialising in buying and selling surplus job lots of Electronic Components and Finished Goods. We also keep a wide range of newstock regular lines. Why not request our 1997 Catalogue and latest Supplement - both absolutely FREE!*



**1997  
CATALOGUE  
OUT NOW!**

Our stores (over 10,000 sq. ft.) have enormous stocks. We are open 8.00 am - 5.30 pm Monday to Saturday. Come and see us!



## BECOME A BARGAIN LIST SUBSCRIBER TO SEE WHAT'S ON OFFER BEFORE IT'S ADVERTISED GENERALLY

### Standard Bargain List Subscription

For just £6.00 a year UK/BFPO (£10.00 overseas), we'll send you **The Greenweld Guardian** every month. With this newsletter comes our latest **Bargain List** giving details of new surplus products available and details of new lines being stocked. Each issue is supplied with a personalised **Order Form** and details of exclusive offers available to Subscribers only.

### Gold Bargain List Subscription

For just £12.00 a year (£20.00 overseas) the **GOLD** Subscriber category offers the following advantages:

- The Greenweld Guardian** and latest **Bargain List** every month, together with any brochures or fliers from our suppliers
- A REDUCED POSTAGE RATE** of £1.50 (normally £3.00) for all orders (UK only) and a reply paid envelope
- 5% DISCOUNT** on all regular Catalogue and Bargain List items on orders over £20.00

**So Don't Miss Out - Subscribe Today!**

**27E Park Road · Southampton · SO15 3UQ**  
**TELEPHONE: 01703 236363 FAX: 01703 236307**  
**INTERNET: <http://www.herald.co.uk/clients/G/Greenweld/greenweld.html>**

**NEW RSGB BOOKS!**

## **RADCOM ON CD-ROM - 1996 EDITION**

To meet the requests of many radio amateurs we have produced this first CD-ROM which includes the editorial pages from every *RadCom* published in 1996 and, as a bonus, we have also included all the 1996 issues of *D-i-Y Radio* as well! No longer will you have to rummage through all your back numbers to find that elusive piece of information - with our easy search operation you can find it easily and quickly.

**Price £18.81\* plus P&P**

## **THE PMR CONVERSION HANDBOOK**

BY CHRIS LOREK, G4HCL

Once private mobile radio (PMR) equipment used by commerce and the emergency services is replaced by more advanced systems, it can be acquired very cheaply at rallies. Often it can be converted to amateur band usage quite easily and without expensive test equipment, giving high performance at a fraction of the cost of purpose-designed amateur gear. This handy book clearly shows you how to identify, choose and buy those PMR sets which are suitable for conversion and it gives step-by-step conversion instructions to help you all the way. Don't be without it at a rally!

**Price £15.28\* plus P&P**

## **YOUR FIRST PACKET STATION**

BY STEVE JELLY, G6URJ

First of the brand new RSGB Pocket Guide Series of books, this explains in simple, easy to understand language, how to set up a packet radio network. For those of you who have often wondered how to expand their use of amateur radio to the world of data communications - then this simple guide will show you.

**Price £5.74\* plus P&P**

(\* RSGB Members' prices available on request)

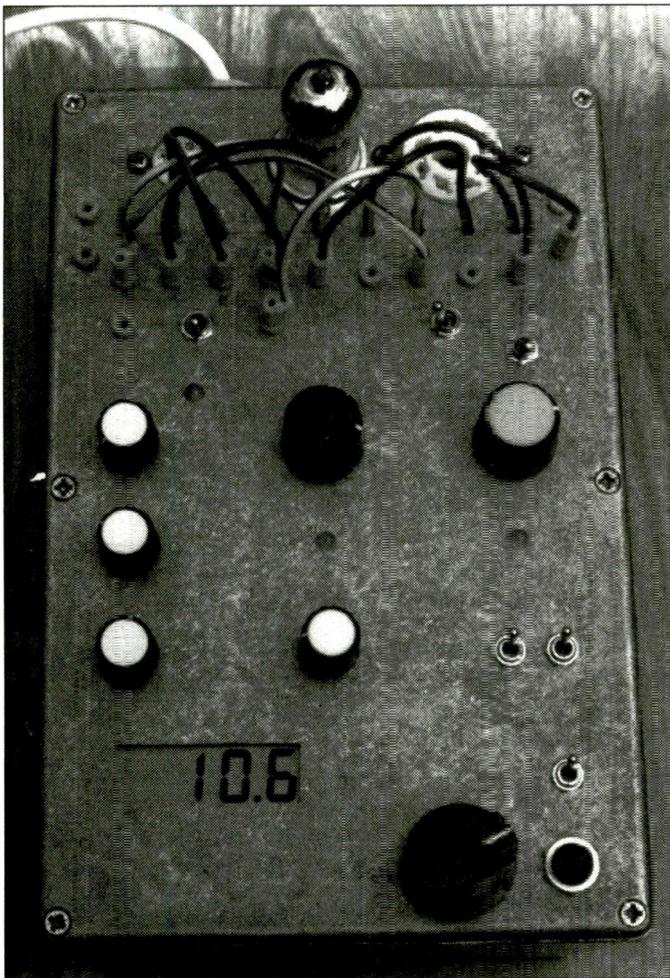
**To place your credit card order, telephone Julia or Emma on the RSGB Sales Hotline 01707 660888, or send your cheque/postal order to:**



**Radio Society of Great Britain**

**Lambda House, Cranborne Road, Potters Bar, Herts EN6 3JE ☎ 01707 659015**

**<http://www.rsgb.org>**



The top panel with a valve in test

the same voltage difference between its input and output.  $V_{g2}$  will therefore track  $V_a$  regardless of the voltage set for  $V_a$ , with the proviso that at least 1mA flows through  $VR2$ .  $Q4$  limits the current through  $Q3$  to about 25mA by robbing base current from  $Q3$ , lighting  $LED2$  to show overload. Add a small flat heatsink 25mm by 15mm to  $Q3$  to help heat dispersion.

### Control grid negative bias supply

In the  $g1$  negative bias supply (figure 3), 48vac is rectified by  $BR2$  and smoothed by  $C10$ . The programmable zener  $TL431C$  ( $IC7$ ) adjusts the current into its cathode to maintain 2.5V at its control pin. From  $I = E/R$ , a current of 1.064mA flows in  $R15$  and  $R52$ .  $Q5$  is in common gate mode, and this same current therefore flows in  $VR4$ ,  $VR5$  and  $VR6$ . Since this is a constant current, the voltage at the wiper of  $VR4$  (47k) will change with the settings of both  $VR5$  and  $VR6$ . Thus, up to 1 volt can be added by  $VR6$  (1k) and up to 10 volts can be added by  $VR5$  (10k).  $D11$  protects against flashover or other leakage in the valve under test.

### Heater regulator

To minimise power dissipation,  $IC4$ , an  $LT1074CT$  switching regulator is used (figure 4). However, when 1.4 volts is required for battery valves,  $IC4$  is a pre-regulator and  $IC5$  ( $LM317T$ ) brings the output down to 1.4 volts, preset with  $VR8$ .  $VR7$  is a 22k pot with integral DPST switch. In the "off" position,  $Q6$  is biased on via  $R22$  into saturation giving 1.4 volts at the output. When  $VR7$  is rotated to the "on" position, contact 'a' bypasses  $IC5$  and contact 'b' removes bias from  $Q6$ , thus isolating  $IC5$  from the 0V rail and

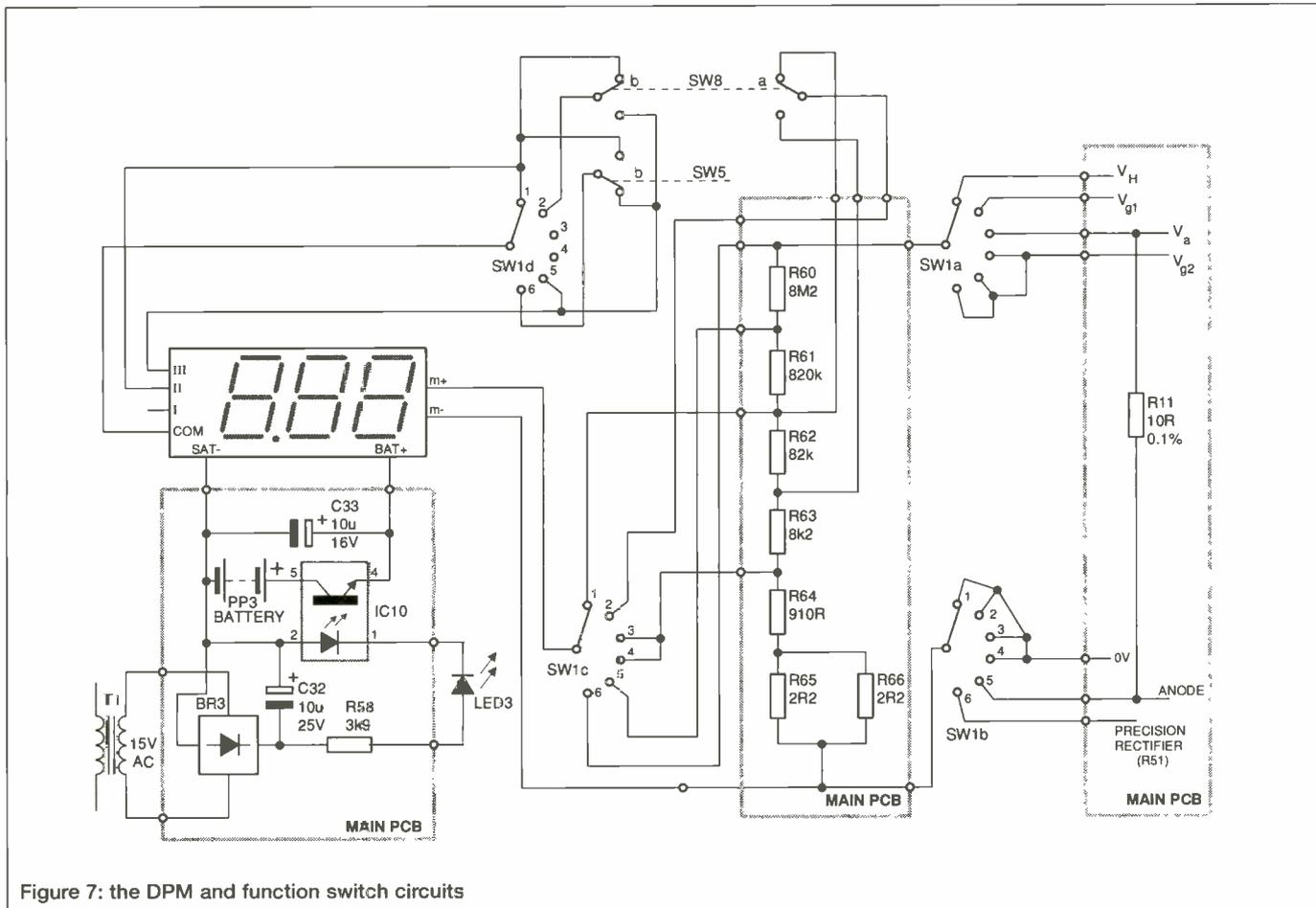


Figure 7: the DPM and function switch circuits

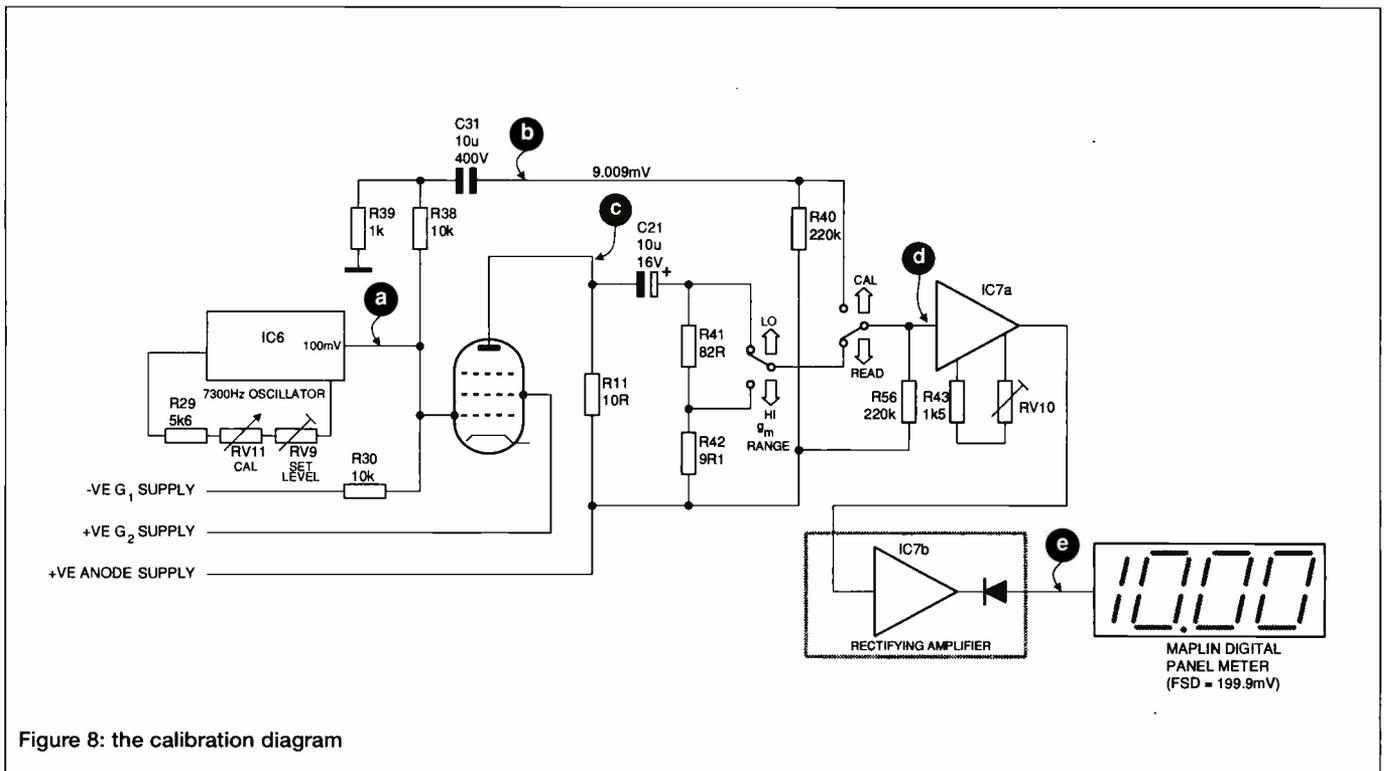


Figure 8: the calibration diagram

preventing damaging currents from flowing into its output. The heater voltage is now continuously adjustable from 4.0 volts up to 20 volts.

### The oscillator

The oscillator (figure 5) is a Wien bridge type, amplitude stabilisation being provided by a light dependent resistor illuminated by an LED. The output signal at IC6a is amplified by IC6b and rectified by D13 and D14 to provide a dc control voltage at Q7 gate. The resulting current through LED4 illuminates LDR1 to control the negative feedback loop of IC6a. D15 and D16 provide forward bias for Q7 and simultaneously give temperature compensation. The change in output voltage is less than 2 percent for a temperature change of 15 degreesC. The preset VR9 sets the output level, while VR11 is the front panel CALIBRATE control.

### Range switching

To measure ac volts a precision rectifier (figure 6), IC7, converts the ac signal across Rh to dc for measurement by the DPM. Since IC7 is only used in the anode circuit of the valve under test, it is powered by the same supply as IC1 and is, therefore, at Va above 0 volts. VR10 presets the gain of the precision rectifier.

A Maplin module (Catalogue reference GW01B) is used as the basis of the measurement system. This uses the ICL7106 dual ramp digital panel meter ic. SW1a and SW1b switch between the various measurement points in the valve tester. SW1c switches ranges while SW1d selects the appropriate decimal point. See figure 7.

A high pass filter comprising C21 and R41/R42 couples the signal voltage to IC7a. SW5 selects "gm HI" or "gm LO" for two ranges of mutual conductance. The "LO" range is likely to be the most commonly used range. SW4 is the "CAL/READ" switch. VR3 is an offset adjustment for the op-amp so that the DPM will read zero when no signal is present. To simplify the wiring, the negative output from the precision rectifier is measured by the DPM.

Power for the DPM is obtained from a PP3 9V battery. A 15vac winding on T1 provides current for the opto-isolator IC12 and LED3 in series, IC10 acting as the on/off switch for the DPM. Since the DPM module current consumption is less than 1mA, an alkaline battery life of at least 500 hours can be expected.

### Calibration

Referring to the calibration diagram, figure 8, consider the hypothetical valve under test (VUT) to have a mutual conductance, gm, of 10mA per volt. A signal at the control grid, g1, of 100mV will develop an ac voltage of:

$$E = (0.1 \times 10\text{mA/V}) \times R_a$$

where Ra is the combined value of R11 and R41 + R42 in parallel, 9.011ohms. Therefore, E equals 9.011mV. (Remember that measurement of dc current is developed across R11 alone, while measurement of ac current is developed across R11 and R41 + R42 in parallel.)

This voltage of 9.011mV is raised in level by IC7a and peak rectified by IC7b to read 100mV on the DPM. The decimal point is positioned to show 10.00.

Theoretically we could use our hypothetical valve to calibrate the Valve Tester, but since such a device does not exist, we use a combination of resistors to do the job. Thus, R38, R39 with R40 and R56 in parallel simulate the hypothetical valve.

To calibrate the Valve Tester, SW4 is moved to the "CAL" position and the front panel control VR11 is adjusted for a reading of 10.00 on the DPM. Switch SW4 back to "READ" and a real life valve can be measured.

### Next month

In the second and final part of this project in the next issue, we will print the construction details, wiring, Parts List and pcb layouts for the Valve Characteristic Tester.

## GAL PROGRAMMER £89.95

16V8 / 16V8A / 16V8Z / 20V8 / 20V8A / 20V8Z / 22V10



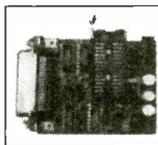
- Works on IBM PC / compatible / laptops/ Notebooks
- Plugs into Centronics printer port
- Fast and reliable programming
- Program protection fuses - prevent unauthorised copying
- Easy to use software - load/save in JEDEC format
- Supplied with PLAN Logic compiler software
- Stylish compact case with quality ZIF
- Complete with examples, connection lead, and PSU
- Full 12 months parts and labour guarantee

## P87C51/2 PROGRAMMER £79.95

Programs all makes of P87C51/2 and Atmel 89C51 Flash types Cased as above this unit plugs into serial port on any IBM PC or compatibles and comes complete with software, connection lead, PSU and full 12 months guarantee.

## PIC PROGRAMMER £69.95

12C508, 509, 16C54, 55, 57, 58A, 61, 64, 65, 71, 75, 84, 620, 621, 622, MEMORY CHIPS, 24LC01, 02, 16, 32, 65



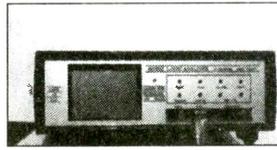
The enhanced Pic Programmer supports a large amounts of devices (listed above). Software supports Microchip, Intel Hex, binary format. Read / Write / Copy / Program fuses. Runs on IBM PC / compatible, connects to the Centronics port and requires 12-18V AC/DC PSU. Full 12 months guarantee.

Want more information on our products?  
Visit our website at <http://www.angelfire.com/free/leadedge.html>  
or E-mail us at [johnmorr@email.keyworld.net](mailto:johnmorr@email.keyworld.net)

Postage / Packing not included. No VAT or Credit Card surcharge.

## 50 MHZ 16 CHANNEL LOGIC ANALYSER

Special Offer!  
**£149.95**  
Until 31/08/97



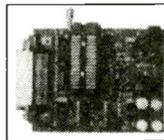
- Hi Resolution LCD Display  
8192 pixels - scrolling window
- 16 Channels  
Display mode selectable
- Truth Table Display  
Binary and Hexadecimal
- Printer Output  
Truth table / graphical display

- Multi Trigger Options - positive / negative / combination / free run
- Crystal Controlled Timebase - 18 ranges - 200ns to 0.5s / division
- TTL and CMOS inputs - unican distinguish logic levels
- 8 Channel Pod Set - cased with spring loaded miniature clips
- External Clock Feature - up to 50 MHZ
- Complete System - with 9v AC PSU, printer lead, manual and pod set
- Attractive Bench Case - fold away feet

The Logic Analyser (normally £325\_ comes with full 12 months guarantee. Second pod set available for £19.95.

## MEGAPROM EPROM PROGRAMMER

EPROMS / EEPROMS / FLASH EEPROMS / I2C BUS EEPROMS



Covers all devices from 2K to 8MEG

This unit plugs into the Centronics port on any IBM PC or compatible. The easy-to-use software supports Bin, Intel Hex, Motorola S, and ASC file formats. Read / Edit / Verify / Reprogram etc - very fast programming and verification. Requires 12-18V AC/DC PSU. The Megaprom comes with full 12 months guarantee.

**£99.95**

## LEADING EDGE TECHNOLOGY LTD



'White Rose', Xintill Street, Tarxien, Malta  
Phone: (00 356) 678509 Fax: (00 356) 667484



## Tomorrow's Technology In Your Hands Today

CROWNHILL ASSOCIATES LIMITED  
THE OLD BAKERY  
NEW BARN'S ROAD  
ELY  
CAMBS. CB7 4PW  
Tel: 01353 66 67 09  
Fax: 01353 66 67 10  
Email: Sales@Crownhill.co.uk

Prices are exclusive of VAT  
for machines and £1.50 for mail items  
for machines and £1.50 for mail items  
Crownhill Associates Limited

VISA  
MASTERCARD  
SWITCH

LOW COST INTRODUCTION TO SMART CARDS

**THE SMARTEST SOLUTION**  
Crownhill can offer a broad range of processor based smart cards from just £1.00 and Smart Card sockets for just £1.45 ea. PIC Microchip based Smart Cards now available at just £5.00 ea. DEVELOP YOUR OWN SMART CARD!  
Crownhill can supply over 150 different types of IC from more than 12 silicon suppliers. All can be incorporated into smart card format. Some cards are available from stock, most are manufactured to the customers specification.

### BASIC SMART CARD EVALUATION PACKAGE

- Smart Card Reader / Writer (Programming Interface)
- Software Applications (Use supplied in the package)
- Base IC Card (Basic Electronic Parts, Basic Logic)
- C. Library & Command descriptions for the user to design their own Smart Card applications using the cards provided
- Program Development Suite (Text Editor/Assembler, Simulator for programming the Cards provided)
- INTRODUCTION PRICE £39.95

### DIV SPECIAL £9.95

Circuit Diagram for an easy to build Smart Card Interface  
Supplied with P.C. Drive software to communicate with Real Smart Cards  
PCB for above £7.00

### SMART CARD INTERROGATION SYSTEM

- Smart Card Reader / Writer (Programming Interface)
- Smart Card Interrogation System, to identify the commands accepted by any valid Smart Card and log them to disk for evaluation. Will allow the user to 're send' smart commands and monitor the result.
- Password software to allow the user to monitor the data flow between Card and host system
- 244 page Hard Bound reference book covering all aspects of Smart Card design and programming
- Sample program to read memory type Phone cards
- Data on NEW Visa Smart Cards
- £149.95

### Professional Reader/Writer Package

Serial PC interface, technical documentation giving command protocols and .lib files for all cards listed below.  
This Intelligent Reader/Writer allows communication between a PC and cards that have different communication protocols. By taking care of the card specific particulars, it allows control of the cards without the user getting involved with the technical details of the card operation.

### INTRODUCTION PRICE £225.00

- US3  
USF015  
USM202  
USM204  
USM216  
USM224  
USM209
- SGS  
Thompson  
ST1305  
ST14C02C  
ST14C04C  
GPM44
- Gemplus  
GEM103  
GEM107  
GEM2K  
GEM4K  
GEM416
- Siemens  
SLE4406  
SLE4416  
SLE4418  
SLE4432  
SLE4438  
SLE4442
- Atmel  
AT88SC01  
AT88SC02  
AT88SC04  
AT88SC08  
AT88SC16  
AT88SC32

## SERVICE MANUALS & Technical Books

Available for most equipment, any make, age or model.  
Return the coupon for your FREE catalogue

MAURITRON TECHNICAL SERVICES (ETI)  
8 Cherry Tree Road, Chinnor, Oxon, OX9 4QY.

Tel: 01844-351694. Fax: 01844 352554 email:- mauritron @ dial.pipex.com  
Please forward your latest catalogue for which I enclose 2 x 1st Class Stamps, or £4.11 inc. vat for the complete Service Manuals Index on PC Disc plus catalogue.

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
POSTCODE \_\_\_\_\_

Photocopy this coupon if you do not wish to cut the magazine

## EQT LTD STEVENAGE

Professional Sub-Contract Manufacturing & Suppliers to the Electronics Industry

- Do you have a requirement for any of the following services:
- PCB Assembly (Conventional and Surface Mount)
  - Wave & Hand Soldering
  - Complete Equipment Manufacture
  - Device Programming from hand written shts or PC 3 1/2" disc
  - Cable Harness Assembly/loom Manufacture
  - Card Cage and Module Wiring
  - Full Inspection
  - Product Design/Consultation
  - Full Procurement Service
  - PCB Test & "Burn in" Facilities
  - Enclosure Design & Manufacture
  - PCB Artwork Manufacture
  - Circuits Drawn Professionally
  - Kit Procurement & Supply
  - Component Sales
  - Refurbishment a speciality
  - Top Quality Work at Reasonable Rates

Phone Steve on (01438) 360406 or fax details of your requirements to us on (01438) 352742  
EQT LTD, Cromer House, Caxton way, STEVENAGE, HERTS, SG1 2DF



The current flowing arriving at A must go somewhere. Not much of it can enter the opamp because the opamp has FET inputs with an input resistance of about 10(the the power of 12) ohms, that is, a million megohms. So the current flows into the capacitor and begins to charge it. But opint A must stay at 0V. To make it possible for C1 to accept the charge, the potential at its other terminal must go down. As current enters the capacitor and a potential difference develops between its terminals, the output of the opamp goes negative by just the right amount to hold A at 0V. A constant current of 3nA carries charge into C1 at the rate of 3nC per second. For a capacitor, capacitance C, charge q, the voltage across its is  $V=q/C$ . Thus the voltage across Cq increases by 3 nanocoulombs/470 nanofarads = 6.38mV per second, or approximately 0.4V per minute. Putting it the other way round, the voltage output of IC1 falls by 0.4V per minute. This is the basis of the timing. A beneficial feature of this circuit is that quite long times are obtainable when using a capacitor of relatively small value. This is an advantage over circuits that require large-value electrolytic capacitors, which not only vary widely from their nominal values but also change in value with use and as they age.

The output of IC1 is fed to the (+) inputs of three op amps wired as comparators. A resistor chain consisting of VR5 and three preset resistors provides a series of voltages with which to compare the ramping-down output from IC1. The voltage across the chain is fixed at -5.1V by another 3.9V Zener diode, ZD2. The values used for R5 and VR2 to VR4 depend on the total process time and the times of the individual stages. It is as well to calculate these before you build the project as you may need different values for any or all of these. We will illustrate the calculations by taking an example

# PARTS LIST for the Process Timer

**Resistors**  
(0.25W, 5% tolerance or better; variable resistors are all miniature horizontal presets)

R1, R4      1k  
R2            100k  
R3            10M  
R5            2.7k (for 5-min period)  
VR1          10k  
VR2 to VR4    1k (or other values as required)

**Capacitor**  
C1            470nF, metallised polyester, 100V

**Semiconductors**  
ZD1, ZD2      Zener diode, BZX79C, 3.9V  
LED1 to LED3    Light-emitting diodes  
IC1            TL054CN fet input quad op amp

**Miscellaneous**  
S1            2-pole single throw switch  
S2            Push-to-make push-button  
Stripboard (98mm x 40mm, 15 strips x 38 holes),  
1mm terminal pins (5 off), PP3 battery clips (2 off),  
14-pin dil ic socket.

of a telephone call timer. Suppose we want a total period of 5 minutes, subdivided into three periods, of lengths 1, 3.5 and 0.5 min. The first period is for indicating a reasonable limit for trunk calls. The middle period allows extra time for local calls. The final 0.5 min is the period for closing down the conversation prior to hanging up. It is a warning that time is nearly up. Maximum call time is 5 min.

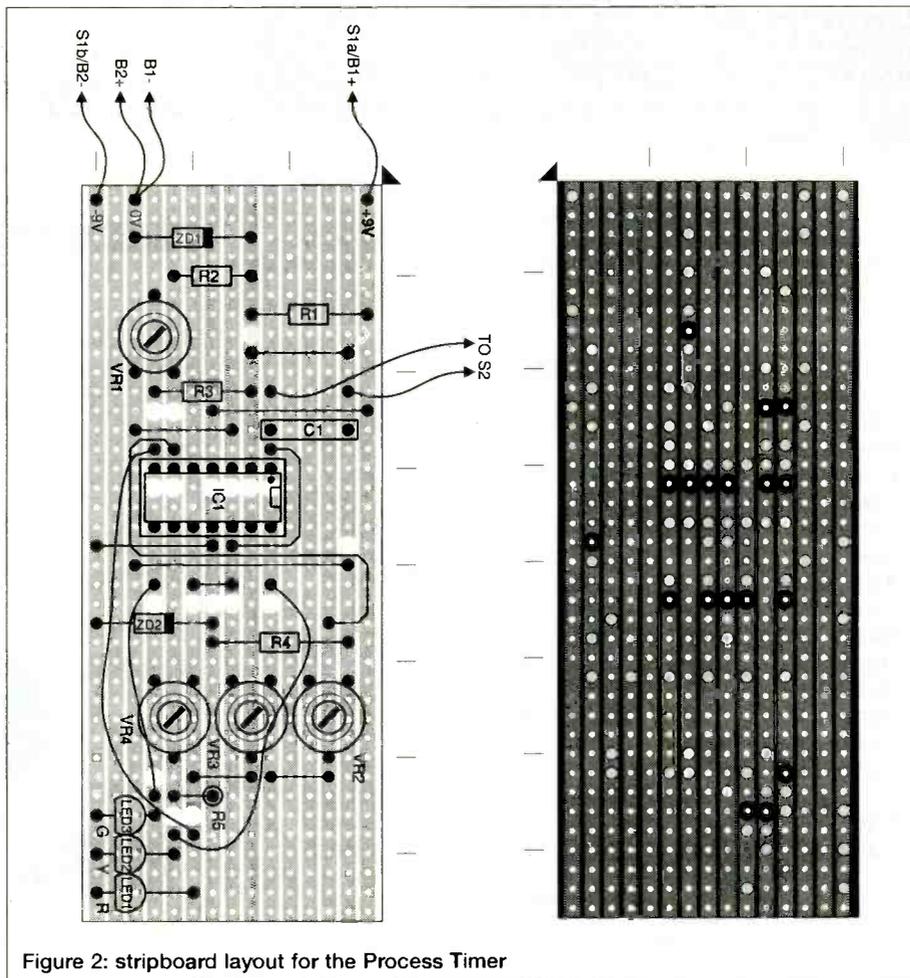
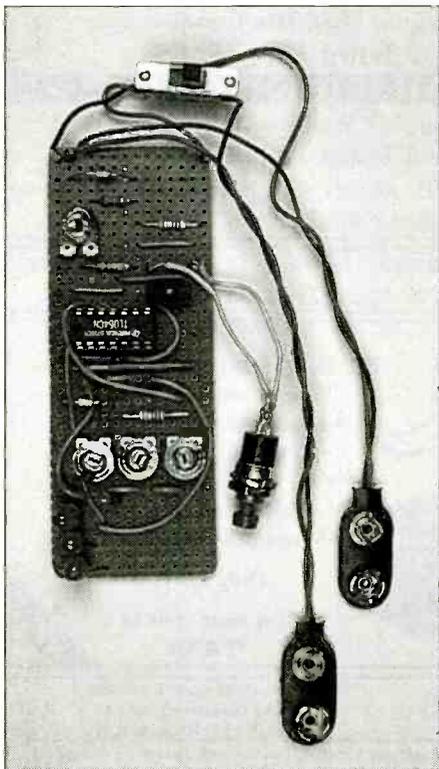
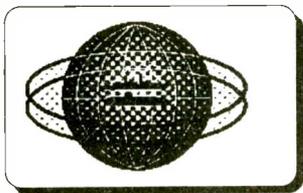


Figure 2: stripboard layout for the Process Timer



**Babcock Materials Management  
(Disposals Division)**

Regional Marketing Contractor for Scotland and Northern Ireland on behalf of the Ministry of Defence (Disposal Sales Agency)

**ELECTRONICS**

**SALE BY TENDER**

(Tender closes 10 am on 1st August 1997)

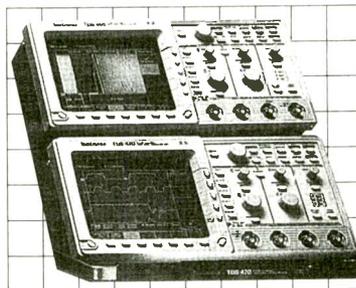
Over 200 lots including Spectrum Analysers, Oscilloscopes, Signal Generators, Circuit Boards, General Test Equipment etc

Catalogues available by contacting our Sales Office 01383 422258 or by fax on 01383 423022



**SUPPLIER OF  
QUALITY USED  
TEST INSTRUMENTS**

**OPERATING &  
SERVICE MANUALS**



**Cooke International**

**ELECTRONIC TEST & MEASURING  
INSTRUMENTS**

Unit Four, Fordingbridge Site,  
Main Road, Barnham, Bognor Regis,  
West Sussex PO22 0HD U.K.

**Tel: (+44)01243 545111/2**

**Fax: (+44)01243 542457**

**CATALOGUE AVAILABLE**

**OMNI ELECTRONICS**

174 Dalkeith Road,  
EDINBURGH EH16 5DX

The following items are available until stocks are finished.

**MISCELLANEOUS**

Microswitch Omron V4 1A button	30p/each
RF screened ABS box 150x80x50mm	£1.50/each
PCB switches red, yellow, green & blue	10p/each
Please state colour mix required.	£1/pk 16
	£5/pk 100



**CAPACITORS**

Ceramic	1nF	50Vdc	6mm	50p/pk 10
Ceramic	2n2	50Vdc	5mm	80p/pk 20
Mono Ceramic	100nf	50Vdc	dil	£1/pk 20
Polyester	470nF	63Vdc	7.5mm	£1/pk 10
Polyester	680nF	100Vdc	15mm	50p/pk 10
Polyester	330nF	250Vdc	15mm	50p/pk 5
Bipolar (Rad)	6.8uF	100Vdc	7.5mm	30p/each
Axial Elec.	470uF	25Vdc	32mm	£1/pk 5
Axial Elec.	220uF	35Vdc	22mm	£1/pk 5
Radial Elec.	47uF	10Vdc	2.5mm	30p/pk 10
Radial Elec.	100uF	10Vdc	2.5mm	40p/pk 10
Radial Elec.	220uF	10Vdc	2.5mm	50p/pk 10
Radial Elec.	100uF	25Vdc	5mm	£1.25/pk 10
Radial Elec.	47uF	63Vdc	5mm	£1/pk 10
Radial Elec.	105°C		150mm solder tails	
	1,000uF	16Vdc	5mm	25p/each
Can Elec.	4,700uF	16Vdc	63x25mm	50p/each
Can Elec.	3,300uF	25Vdc	83x25mm	50p/each

Prices VAT inclusive. Add £1.25 P&P

Payment by cheque, PO, Switch, Amex, Visa, Mastercard

We stock a wide range of electronic components. Catalogue £2.00

Tel. 0131-667-2611 Fax. 0131-662-4063

**PIC DEVELOPMENT**

**PROGRAMMER PIC EEZE-V2**

Program/read/verify 16C54/55/56/57/58/61/62/620/621/622/63/64/71/73/74/84/Serial EEPROMs. Expansion port.

Built and Tested Only **£52.95**

**PROGRAMMER/ICE PIC EEZE-V3**

As above but with In-Circuit Emulation Capability.

Built and Tested Only **£72.95**

Both systems have ZIF sockets already fitted and expansion ports for current and future developments!

Other PIC developments. Learning pack for beginners, demonstration pack, PIC basic (Tel/write for details).



True PIC  
Real Time  
In  
Circuit  
Emulator



**TRICE™**  
PIC Real Time In-Circuit Emulation.

- Emulation to 20MHz.
- Step/Skip/Animate/Run etc.
- Variable speed selection.
- 8K x 16 Emulation RAM.
- Target Probes included.
- Supports 8/18/28 pin PIC's.

Only **£149.95**

Test your code in a  
**'TRICE'**



Please add £2.00 P&P and make cheques payable to LENNARD RESEARCH

Lynnwood Business Centre, Lynnwood Terrace,

Newcastle upon Tyne, NE4 6UL.

Tel: (0191) 273 2233. Fax: (0191) 226 0876.

Product pictures/info on our web site:

<http://www.lennardresearch.demon.co.uk>

## Calculations

We will assume that you have adjusted VR1 to produce a voltage of 30mV at its wiper, so obtaining a ramp down of 0.4V per minute (approximately, to make calculations easier). Pressing S2 sends the output of IC1 to 0V at 0 min. At 1 min it will have fallen to -0.4V, at 4.5 min (that is 3.5 min later) it will have reached -1.8V, and at 5 mins it is -2.0V.

Assume that the current through the chain is to be 1mA. The voltage across R5 is to be  $5.1 - 2 = 3.1$ . So the value of R5 is  $3.1 / 0.001 = 3100$  ohms. For convenience use 2.7 kilohms, and let the current be  $3.1 / 2700 = 1.15$ mA. If t is the required length of a period, the resistance needed is  $R = (t \times 0.4) / 0.00115$ . For periods of 1, 3.5 and 0.5 min the required resistances are 348, 1217, and 173 ohms. If you are not too worried about exact timing, you could use fixed resistors in place of the presets. Values of 330 ohms, 1.2 kilohms and 180 ohms would do. If you use presets, you need 1 kilohm or 470 ohm presets for VR2 and VR4, and a 2.2 kilohm or 4.7 kilohm preset for VR3. These are adjusted to the exact value as calculated.

For longer periods you can decrease the value of R5, or set VR1 to produce a voltage lower than 30mV and hence a slower ramp.

## Displays

With the circuit as shown in figure 1, all three LEDs come on when S2 is pressed. LED1 goes out at the end of the first period (in the example, after 1 min). LED2 goes out at the end of the second period (after 4.5min) and LED3 goes out at the end of the third and final period (after 5 min). We used ordinary 5mm red LEDs in our prototype but you can vary this by using

LEDs of different colours (red, yellow, green) or shapes. You can also use flashing LEDs. For example, if LED3 is a flashing type it effectively signals the imminent end of the process. It is also possible to wire the circuit for the reverse operation, with all LEDs off to begin with and all on at the end. Just reverse the input connections to the op amps.

## Construction

Figure 2 shows the stripboard layout and connections to the main switch S1. The circuit is powered by two 9V PP3 batteries, using two battery clips. First assemble the ramp generator circuit, which includes everything on the board to the left of column 20. The ramp generator is best tested at this stage, using a meter with high-impedance input, for example a digital multimeter. A moving-coil meter will probably require too much current and give misleading low voltage values at the wiper of VR1. Check the voltage at the cathode of ZD1; it should be close to 3.9V. Measure the voltage at the wiper of VR1 and adjust VR1 to bring this to 30mV or any other value you have decided upon. Finally monitor the voltage at pin 1 of IC1. This should be 0V when S2 is pressed and released, then fall steadily at a rate close to 0.4V per minute. If you have decided upon the timing of the periods, have a seconds clock handy, press and release S2 and note the voltages (negative) as each of the period ends. These figures form the basis for calculating the resistances required in the resistor chain (see previous section).

Having decided on timings, the values of resistances and the types of LED, assemble the rest of the circuit. If you are using presets, switch off the power, connect a multimeter across each in turn and adjust each to its calculated value.

# The Low Cost Controller That's Easy To Use

## Features

The K-307 Module provides the features required for most embedded applications

- Analogue** • 4 Channels in 1 Channel out
- Digital** • 36 Digital in or out & Timers
- Serial** • RS-232 or RS-485 plus I2C
- Display** • LCD both text and graphics
- Keyboard** • Upto 8 x 8 matrix keyboard
- Memory** • > 2Mbytes available on board
- Low Power** • Many modes to choose from

## Development

The PC Starter Pack provides the quickest method to get your application up & running

- Operating System** • Real Time Multi Tasking
- Languages** • 'C', Modula-2 and Assembler
- Expansion** • Easy to expand to a wide range of peripheral cards

## Other Features

Real Time Calendar Clock, Battery Back Up, Watch Dog, Power Fail Detect, STE I/O Bus, 8051 interface, 68000 and PC Interface

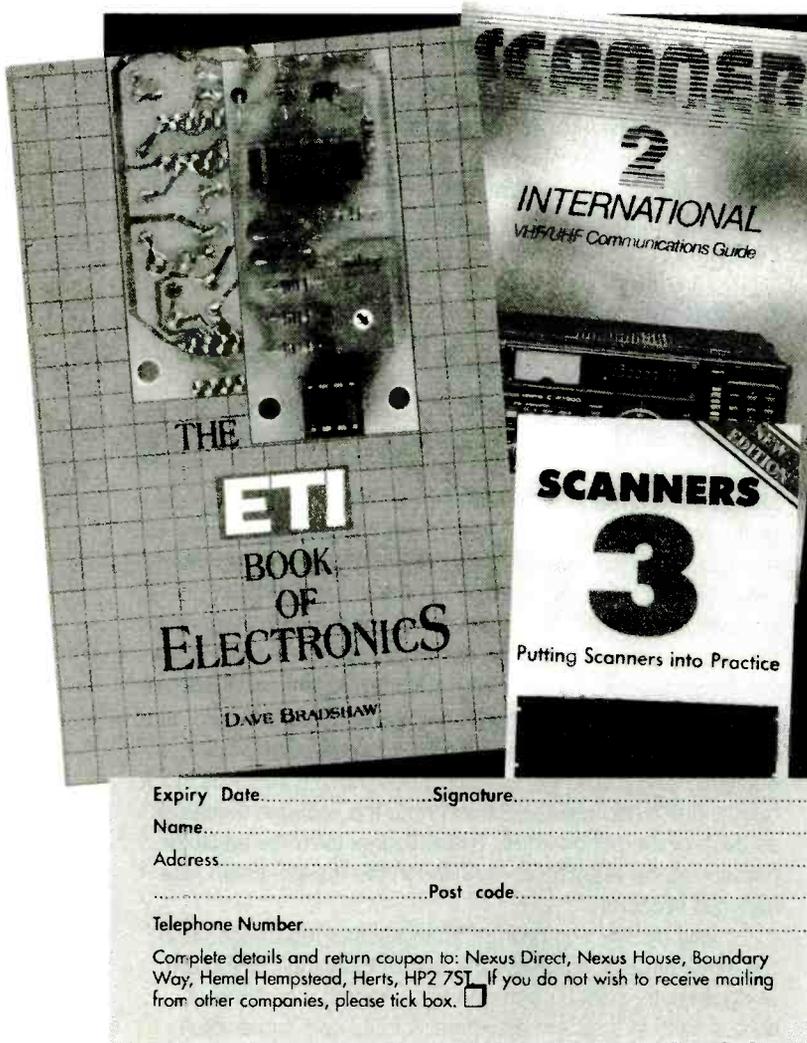
## Cambridge Microprocessor Systems Limited

Units 17 - 18 Zone 'D'  
Chelmsford Road Ind Est  
Great Dunmow Essex CM6 1XG  
E-mail cms@dial.pipex.com

Phone 01 371 875 644



SEE OUR WEBSITE  
<http://www.cms.uk.com>



## ETI Book of Electronics

This book is both a theoretical and practical introduction to electronics. It clearly explains the theory and principles of electronics and each chapter includes a project for the beginner to make. The projects are a loudspeaker divider, continuity tester, 'brown-out' alarm, freezing alarm, loudspeaker, mini-amplifier and a burglar alarm.  
 NB214 £12.45 UK £12.95 Overseas

## Scanners 2 International.

The companion book to Scanners provides even more information on the use of VHF and UHF communication bands and gives details on how to construct accessories to improve the performance of scanning equipment. The book is international in its scope and contains frequency allocations for all three ITU regions, including country-by-country variations.  
 NB216 £11.45 UK £11.95 Overseas

## Scanners 3 - Putting Scanners into Practice

This is the fourth revised and completely updated edition of Scanners, the complete VHF/UHF radio listeners guide and contains everything you need to know to put your scanner to better use. There is vastly more information than ever before on frequency listing: in particular actual frequencies used by coastal stations, airfields and the emergency services. Also included for the first time is a section on the HF (short wave) band as many scanners now cover this range.  
 NB217 £11.45 UK £11.95 Overseas

**Telephone orders: 01322 616300 ask for Nexus Direct:**

Please send me .....copies of NB.....@.....

Please send me .....copies of NB.....@.....

Please send me .....copies of NB.....@.....

I enclose my remittance of £.....

I enclose my cheque/PO for.....made payable to Nexus Special Interests  
 or please debit my Access/Visa.

Expiry Date.....Signature.....  
 Name.....  
 Address.....  
 Post code.....  
 Telephone Number.....

Complete details and return coupon to: Nexus Direct, Nexus House, Boundary Way, Hemel Hempstead, Herts, HP2 7ST. If you do not wish to receive mailing from other companies, please tick box.

# Construction Authors

**If** you have designed and built any kind of electronics gadget for yourself, your home, your friends or your business, it may be suitable for publication in ETI.

## Read on!

You may have a one-off project you would like to share; you may be a regular constructor with a new design you are especially pleased with, or you may be a pro designer trying out ideas and looking for feedback.

Your ideas may be simple or complex, analogue or digital, computer-related or rooted in tradition; elaborately cased or (in some cases) not cased at all. You may be a private hobbyist, an engineer of

advanced standing, or a student. You may be yourself and a soldering iron, a club or a business.

ETI is looking for original project design for publication. "Original" simply means that you have designed the project for a particular purpose or to a general specification, and have worked out how you want to do it for yourself. You can be applying well-known and established techniques, or using the latest components in new applications, as long as the final result is your own design.

For further details of authors' fees and how to write up a project for publication, please write to ETI for our Potted Project Production information sheet at PPP, ETI Nexus House, Boundary Way, Hemel Hempstead Herts HP2 7ST. A self-addressed envelope is always a help, but not a necessity.

## WRITE FOR ETI!

Much as we like all mod cons, project authors do not have to produce CAD output, professionally drafted plans or Shakespearean prose. ETI's mission is to publish projects and "how to" articles. ETI does not buy news items or short feature articles from outside contributors. ETI commissions a small number of full length feature articles from experienced independent contributors only.

## Innovations on Internet

Mail-order catalogue Innovations has re-launched its Internet sales with an updated Web site, Innovations On-Line. The well known suppliers of gadgets and "problem-solving products", many of them electronic, is offering a 10 percent discount to purchases made through the Web site "to attract new consumers" to the innovation of Web shopping. The web site has been improved with better search facilities to graphics pages and more accessible What's New pages. Secure ordering facilities are available via Netscape or Explorer. The web site address is [www.innovations.co.uk](http://www.innovations.co.uk)



## Pro Handy Earth Tester



The Norma Handy Geo is a compact handheld battery-operated professional-standard earth tester designed to measure 2-pole and 3-pole earthing resistance and noise voltage. The Geo can detect external ac and dc voltage, automatically define probes and has an adjustable limit for measured values. Backlighting is switchable, and the unit comes with a full 3-year warranty.

For information contact the Professional Instruments Distributors Association, 3 Brackenley Court, Embsay, N. Yorks BD23 6PX Tel 10756 799737.

## Advances in LCPs for component moulding

Chemical giant Hoechst, a world leader in the field of liquid crystal polymers (LCPs) are producing improved grades of their technical plastic Vectra to meet the demands of the continuing process of miniaturisation of electronic components in industry. The material has the property of a comparative increase in strength as the wall thickness declines, a benefit in the increasingly complicated, thin-walled component packages in use today. Likely applications are, for instance, components exposed to high mechanical and thermal stress, such as intricate

connectors, smart card readers and moulded interconnect devices (MIDs).

One variety, Vectra E130i, is particularly suitable for long, thin-walled connectors. The high-temperature toleration of the material allows it to withstand all current soldering methods, and the self-reinforcing property of LCPs in thin structures allow component sizes to be reduced. Other varieties combine suitability for electrolytic/chemical metallisation with the ability to flow into intricate moulds, and low processing temperatures and freedom from corrosion, which allows low-cost moulding techniques to be used. The toughness of liquid crystal polymers coupled with the ability to remain dimensionally stable at high temperature means that electronic functions can be combined with mechanical functions in the same component.

## Shorts...

**Technical market** research specialists Dataquest predict that the market for digital still (as opposed to video) cameras will remain firmly attached to the market for computer peripherals for at least the next three years, although it will expand to achieve nearly 6 million units by the year 2000, generating substantial sales for the digital still camera semiconductor industry. Research indicates that the higher price of digital cameras means that conventional film cameras (of which there are now a number of formats, some developing towards digital computer link-up in the future) will remain the most popular

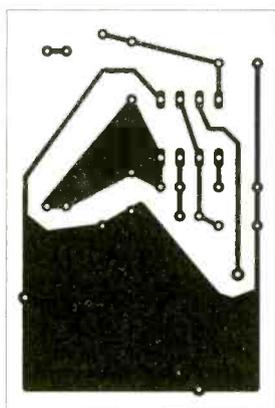
format until digital prices become more competitive. Dataquest have produced a report "Digital Still Cameras Develop into a New Semiconductor Market", which can be purchased via Tel. 0800 716089 ... **The publication** of consultation paper on the licensing of Trusted Third Parties for the provision of encryption services was announced in March by the Science and Technology Minister Ian Taylor. According to the Minister, "the proposals involve licensing TTPs who offer encryption services to the public in order to facilitate the development of electronic commerce; to protect consumers; and to preserve the ability of the intelligence and law enforcement agencies to fight serious crime and terrorism.

# ETI

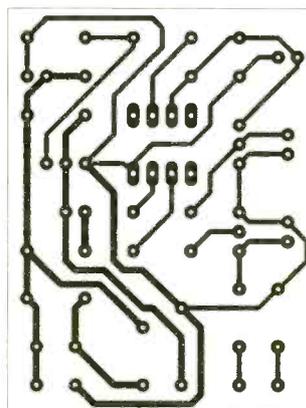
ELECTRONICS  
TODAY INTERNATIONAL

*TOMORROW'S TECHNOLOGY TODAY*

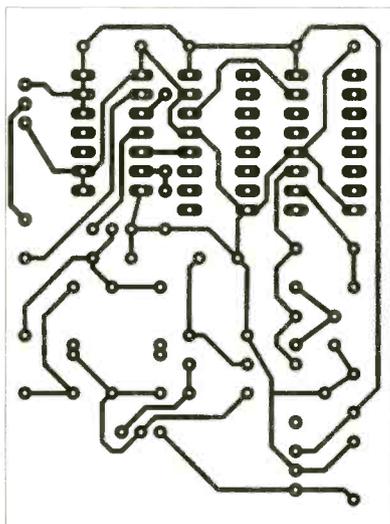
## FOILS FOR THIS ISSUE



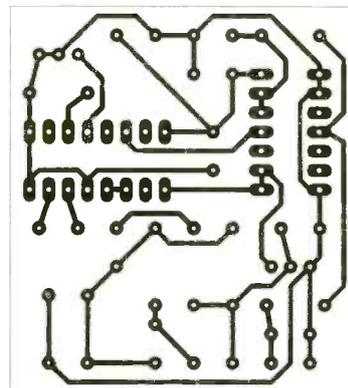
BRAKE LIGHT TESTER



DC MOTOR: THE FIRST CONTROL CIRCUIT



DC MOTOR: THE CRYSTAL DRIVE CIRCUIT



DC MOTOR: THE 4046 CIRCUIT



# PCB Service

ETI can supply printed circuit boards for most of our current projects - see the list below for boards available. For recent boards not listed, check the constructional article for an alternative supplier. Please use this order form or a copy of it. Check that all relevant information is filled in, including the Unit Order Code, and that you have signed the form if sending a credit card number. Overseas customers please add postage appropriate to the number of units you are ordering. Make cheques/POs/money orders, in £ sterling only, payable to Nexus Special Interest Limited. Please allow 28 days for delivery. Access/Visa orders may be made on 01442 66551 (ask for Readers Services). Only boards listed here are available from our PCB Service. For past issues of magazines, copy articles or binders, please see the admin panel (page 75) or contact Readers Services (see below) for information.

**Terms of trade**

Terms strictly payment with order. We cannot supply credit orders, but will supply a proforma invoice if requested. Proforma orders will not be processed until payment is received. All boards are manufactured from the foils that appear in the ETI Foils Pages for the appropriate issue. Please check that our foils are suitable for the component packages you intend to use before ordering as we cannot supply modified boards or replace boards that have been modified or soldered. Boards are only supplied in the listed units. Sorry, we cannot break units. Prices and stock may be altered without prior notice. Prices and stock listed in this issue supersede prices and stock appearing in any previous issue. ETI, Nexus Special Interests and their representatives shall not be liable for any loss or damage suffered howsoever arising out of or in connection with the supply of printed circuit boards or other goods or services by ETI, Nexus Special Interests or their representatives other than to supply goods or services offered or refund the purchaser any money paid in respect of goods not supplied.

Name and issue of project	Unit code	Price	Name and issue of project	Unit code	Price
ETI Issue 8 1997			ETI Issue 7 1997		
The Brake Light Tester	E/897/1	£5.09	Eprommer: main board (double sided)	E797/1	£13.32
The IQ Tester	E/897/2	£5.64	Eprommer: PSU board	E797/2	£5.64
DC Motors (3 experimental boards)			Eprommer: personality modules (double sided):	E797/3	
DC Motors: The first Control Unit	E/897/3	£5.09	Any ONE module board		£5.09
DC Motors: The 4046 Circuit	E/897/4	£5.09	Any two modules		£7.90
DC Motors: The Crystal Drive Circuit	E/897/5	£5.09	Any three modules		£11.85
All three DC Motors boards	E/897/3/4/5	£11.50	Any four modules		£15.80
			Any five modules		£19.75
			All six modules		£23.70
			Please specify which Eprom modules you require. Modules are for 2716, 2732, 2764, 27128, 27256 or 27512. One order code/overseas postal charge applies whether a selection or all six personality module boards are ordered.		
			Are Your Lights On?	E/797/4	£5.09
			Peak Reading VU Meter	E/797/5	£5.09

Please supply:  
Quantity

Project

Unit Order Code

Price

Total price

Prices are inclusive of post and packing in the UK. Overseas Post and Packing (if applicable): Add £1 per unit

Name .....

Address .....

I enclose payment of £ ..... (cheque/PO/money order in £ Sterling only) to:

PCB Service, READERS SERVICES DEPARTMENT, Nexus Special Interests Ltd., Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST UK.



Signature: ..... Card expiry date: .....

# ETI Classified



**Andy Forder**  
**01442 66551**

Send your requirements to:  
ETI Classified Department, Nexus, Nexus House,  
Boundary Way, Hemel Hempstead, HP2 7ST  
Lineage: 75p per word (+ VAT) (minimum 15 words)  
Semi display: (minimum 2.5cms)  
£10.50 + VAT per single column centimetre



Ring for information on series bookings/discounts.  
All advertisements in this section must be pre-paid.  
Advertisements are accepted subject to the terms and conditions  
printed on the advertisement rate card (available on request).

## FOR SALE



### 88-108MHz FM TRANSMITTERS

Professional PLL transmitter, Stereo Coder, and Compressor/Limiter kits licensable in the U.K. Also very stable VFO transmitter kits. Prices from under £10 and a 'Ready Built' service is available. Contact us for a free brochure including prices and more detailed information.

18 Victoria St, Queensbury, BRADFORD, BD13 1AR  
Tel 01274 816200 Email veronica@legend.co.uk



### VARIABLE VOLTAGE TRANSFORMERS

INPUT 220/240V AC 50/60  
OUTPUT 0-260V  
Price P&P  
PANEL MOUNTING  
0.5KVA 2.5 amp max £33.00 £5.00 (£45.83 inc VAT)  
1KVA 5 amp max £45.25 £7.00 (£61.39 inc VAT)  
SHROUDED  
0.5KVA 2.5 amp max £34.00 £5.00 (£47.00 inc VAT)  
1KVA 5 amp max £46.25 £7.00 (£62.57 inc VAT)  
2KVA 10 amp max £65.00 £8.50 (£86.36 inc VAT)  
3KVA 15 amp max £86.50 £3.50 (£111.63 inc VAT)  
5KVA 25 amp max £150.00 Plus Carriage & VAT  
10KVA 45 amp max £300.00 Plus Carriage & VAT  
6KVA 3 PHASE Star £205.00 Plus Carriage & VAT  
Buy direct from the Importers. Keenest prices in the country  
COMPREHENSIVE RANGE OF  
TRANSFORMERS-LT-ISOLATION & AUTO  
(110-240V) Auto transfer either cased with American socket and  
mains lead of open frame type. Available for immediate delivery.

### WIDE RANGE OF XENON FLASH TUBES

Write/Phone your enquiries  
ULTRA VIOLET BLACK LIGHT BLUE  
FLUORESCENT TUBES  
4ft 40 watt £14.00 (callers only) (£16.45 inc VAT)  
2ft 20 watt £9.00 (callers only) (£10.58 inc VAT)  
12in 8 watt £4.80 + 75p p&p (£5.52 inc VAT)  
9in 6 watt £3.96 + 50p p&p (£4.24 inc VAT)  
6in 4 watt £3.96 + 50p p&p (£4.24 inc VAT)

230V AC BALLAST KIT  
For either 6in, 9in or 12in tubes £6.05 + £1.40  
p&p (£8.75 inc VAT)  
The above Tubes are 3500/4000 angstrom. (350-  
400nm) Ideal for detecting security markings, effects  
lighting & Chemical applications.  
Other Wave Lengths of U.V. TUBE available  
for Germicidal & Photo Sensitive applications.  
Please telephone your enquiries.  
400 WATT BLACK LIGHT BLUE UV LAMP  
GES Mercury Vapour lamp suitable for use  
with a 400W P.F. Ballast  
Only £38.00 + £4.00 p&p (£49.35 inc VAT)

12V D.C. BILGE PUMPS  
500 GPH 15ft head 3 amp £19.98  
1750 GPH 15ft head 9 amp £34.55  
Also now available 24V D.C. 1750 GPH 15ft head  
5 amp £35.55. All designed to be used  
submerged. PRICES INCLUDE P&P & VAT

SUPER HY-LIGHT STROBE KIT  
Designed for Disco, Theatrical uses etc.  
Approx 16 pulses. Adjustable speed £50.00 + £3.00 p&p  
(£2.28 inc VAT)  
Case and reflector £24.00 + £3.00 p&p (£31.73 inc VAT)  
SAE for further details including HY-Light and industrial Strobe Kits.

Open Monday/Friday  
SERVICE TRADING CO  
57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB  
TEL 0181-995 1560 FAX 0181-995 0549  
ACCOUNT CUSTOMERS MIN. ORDER £10

5KVA ISOLATION TRANSFORMER  
As New Ex-equipment fully shrouded Line Noise  
Suppression, Ultra Isolation Transformer with terminal  
covers and Knock-out cable entries. Primary 120/240V  
Secondary 120/240V 50/60 Hz. .005 pF Capacitance  
Size L.37 x W.19 x H.16cm Weight 42 Kilos. PRICE  
£120.00 +VAT  
ex-warehouse. Carnage on request.

24V DC SIEMENS CONTACTOR  
Type 3TH8022 DB 2 x NO and 2 x NC 230V AC 10A  
contacts Screw or Din Rail fixing. Size H 120 x W 45 x  
0.75mm. Brand New Price £7.63 incl. P&P and VAT.

240V AC WESTOOL SOLENOIDS  
TT2 Mod 1 flat. 1 MAX stroke 1/4 in. Base mounting 1/2in.  
stroke 5/8 pull approx. TT6 Mod 1 Rat. 2 Max stroke 1/8  
in. Front mounting 1/2in. Front mounting 1/2 in. stroke  
15lbs pull approx. Price incl. p&p & VAT. TT2 £5.88, TT6  
£8.81. SERIES 400 £7.64.

AXIAL COOLING FAN  
230V AC 120mm square x 38mm 3 blade 10 watt Low  
Noise fan. Price £7.29 incl. P&P and VAT. Other voltages  
and sizes available from stock. Please telephone your  
enquiries.

INSTRUMENT CASE  
Brand new Manuf. by Imhof L31 x H18 x 19cm deep.  
Removable front and rear panel for easy assembly of  
components. Grey finish complete with case feet.  
PRICE £16.45 INCL. P&P & VAT 2 off £28.20 Inclusive.

SEWING MACHINE MOTOR  
Brand new 220/240V AC/DC SEW-TRIC 2 lead Brush  
Motor. Size L. 100mm x H. 70mm x W.55mm. Spindle.  
1/4in. dia x 1in. long. £14.10 incl. P&P & VAT

GEARED MOTORS  
71 RPM 20lb inch torque reversible 115V AC input  
including capacitor and transformer for 240V AC  
operation.  
Price inc VAT & p&p £27.73

SOLID STATE EHT UNIT  
Input 230/240V AC, Output approx 15KV. Producing 0mm  
spark. Built-in 10 sec timer. Easily modified for 20sec, 30  
sec to continuous. Designed for boiler ignition. Dozens of  
uses in the field of physics and electronics. eq supplying  
neon or argon tubes etc. Price less case  
£8.50 + £2.40 p&p (£12.81 inc VAT) NMS

EPROM ERASURE KIT  
Build your own EPROM ERASURE for a fraction of the  
price of a made-up unit kit of parts less case includes 12in  
8 watt 2537 Angstrom Tube Ballast unit, pair of bi-pin leads,  
neon indicator, on/off switch, safety microswitch and  
circuit £15.00 + £2.00 p&p (£19.98 inc VAT)

WASHING MACHINE WATER PUMP  
Brand new 240V AC. fan cooled. Can be used for a variety  
of purposes. Inlet 1/2in. outlet 1 in. dia. Price includes p&p &  
VAT. £11.20 each or 2 for £20.50 inclusive.

**SWC SCIENTIFIC WIRE COMPANY**  
ENAMELLED COPPER WIRE  
TINNED WIRE SILVER  
PLATED COPPER WIRE  
SOLDER EUREKA WIRE  
NICKEL CHROME WIRE  
BRASS WIRE LI TZ WIRE  
BIFILAR WIRE MANGANIN  
WIRE TEFLON WIRE NICKEL  
SAE BRINGS LIST 18 RAVEN  
RD LONDON E18 1HW  
FAX 0181 559 1114

**£50 BT INSTRUMENT FOR ONLY £7.50**  
We refer to the BT insulation tester and multi-meter with which  
you can read insulation directly in megohms, AC volts up to 230,  
4 ranges of DC volts up to 500, 3 ranges of milliamps and one  
5A range and 3 ranges of resistance. These are in perfect  
condition, have had very little use, if any, tested and fully  
guaranteed. Complete with leads and prods £7.50. Order Ref  
7.5P4. Carrying case which will take small tools as well, £2 extra.  
Postage £3 unless your order is £25 and over.  
J & N Factors  
Dept ETI, Pilgrim Works, Stairbridge Lane, Bolney,  
Sussex, RH17 5PA  
Telephone: (01444) 881965

**TELEPHONE BUGGING?**  
"STOP IT NOW!!"  
WITH  
THE NEW BUG X  
TERMINATOR.  
Blocks all phone taps &  
teletexts, keeps phone  
calls and fax's private.  
For details send a S.A.E. or  
Tel/Fax: Write for details with  
S.A.E. to: F.K.Electronics  
services, Northgate house, St.  
Marys Place, Newcastle Upon  
Tyne, NE1 7PN.

**Professional AUDIO TRANSFORMERS**  
FREE 16 PAGE CATALOG AVAILABLE  
Fax Toll-Free 0800-96-7106  
SESCOM, INC. sescom@anv.net  
2100 WARD DR., HENDERSON, NV 89015  
Tech Line 702-565-3993 (weekdays 8 am - 4 pm PST)  
Office 702-565-3400 Fax: 702-565-4828

**WANTED**  
TURN YOUR SURPLUS  
TRANSISTORS, ICs ETC INTO  
CASH immediate settlement.  
We also welcome the opportunity to quote  
for complete factory clearance  
Contact:  
**COLES-HARDING & CO**  
Unit 58, Queens Road, Wisbech,  
Cambs PE13 7PQ  
BUYERS OF SURPLUS INVENTORY  
ESTABLISHED OVER 20 YEARS  
Tel: 01945 584188 Fax: 01945 475216

Call Our Friendly  
Sales Team on  
01442 66551  
& ask for details

**Scrap Electronic and Mainframe Computer Equipment Wanted**  
Can dismantle and collect  
Tel: 0114 285 3327  
Sheffield Surplus  
Unit 2A  
870 Penniston Road  
Hillborough, Sheffield S6 2DL

**PLANS**  
ELECTRONIC PLANS, laser  
designs, solar and wind  
generators, high voltage teslas,  
surveillance devices, pyrotechnics  
and computer graphics tablet. 150  
projects. For catalogue, SAE to  
Plancentre Publications, Unit 7,  
Old Wharf Industrial Estate,  
Dymock Road, Ledbury,  
Herefordshire, HR8 2HS.

**PRINTED CIRCUIT BOARDS**  
PRINTED CIRCUIT BOARDS  
Designed & Manufactured  
● Prototype or Production Quantities  
● Fast turnaround available  
● PCBs Designed from circuit diagrams  
● Almost all computer files accepted  
Easy PC / Ariles / VuTrax / Cadstar Gerber /  
HPGL / Draw and many others.  
● Fast International service  
● Contract Assembly & Test available  
TELEPHONE 01232 473533  
INTERNATIONAL +44 1232 473533  
agar FAX - 01232 473533  
Circuits Email - agar@argonet.co.uk  
36 WOODCOT AVENUE, BELFAST BT5 5JA

**TRANSFORMERS**  
Variable Voltage  
Technology Ltd  
**TRANSFORMERS**  
For valve and transistor circuits  
HT Filament chokes high & low voltage  
Standard and custom design  
large and small quantities  
Unit 24E, Samuel Whites Estate, Medina  
Road, Cowes, Isle of Wight PO31 7LP  
Tel 01983 280592 Fax 01983 280593

**FAX your advert to us on 01442 66998**

**MICRO - ISP**

**In-system 8051 Programming in a FLASH!**  
**Now supports the AVR Microcontroller Family**

Code development for the 8051 family could not be easier. Simply plug the "Socket Stealer Module" into your existing 8051 socket and then use the Micro-ISP

Programmer to download code (and data) to your target microcontroller without even removing it from the target socket.

For further details watch this space next month!

**EQUINOX**

TECHNOLOGIES  
 The Embedded Solutions Company

Sales: 01204 492010 Technical: 01204 491110 Fax: 01204 494883  
 Visit our web page at: [www.equinox.tech.com](http://www.equinox.tech.com)  
 Email: [sales@equinox.tech.com](mailto:sales@equinox.tech.com)

**CQ CHRISTIAN AMATEURS!**

The World Association of Christian Radio Amateurs and Listeners actively promotes Christian fellowship worldwide, regular nets, activity days, Annual Conference (3rd-5th October 1997), handbook, magazine etc. Call our UK Sunday SSB nets 3747 kHz at 8am and 2pm, or 144.205 MHz at 3pm.



For full info write to our Membership Secretary  
**WACRAL**  
 51 Alma Road, Brixham,  
 South Devon TQ5 8QR

See Web [HTTP://www.G0PPQ.DEMON.CO.UK/](http://www.G0PPQ.DEMON.CO.UK/)

**Sphere Electronics**

Unit 13 Stream Park  
 Kingswinford  
 West Midlands  
 DY6 8HU

Tel/Fax 01384 357526  
 Email: [hardline@demon.co.uk](mailto:hardline@demon.co.uk)

**Micochip Pic's**

16C54 XT/P £2.00  
 16C55 XT/P £2.50  
 16C71 04/P £3.00  
 17C42 16/P £4.50  
 16C64 JW £15.00  
 16C74 JW £15.00  
 93LC46 £0.50

Pic Shareware Disk £5.00

All Orders Plus £1.00 P&P  
 Programming Available

**TO ADVERTISE IN THE NEXT ISSUE OF ETI CALL  
 ANDY FORDER NOW ON 01442 66551 OR FAX US ON 01442 66998**

**ADVERTISERS INDEX**

BETA LAYOUT .....18	GAREX ELECTRONICS .....38	NO NUTS .....49
BK ELECTRONICS .....34	GRANDATA .....4, 5, 6, 7	OMNI ELECTRONICS .....66
BULL ELECTRICAL .....10,17	GREENWELD ELECTRONICS .60	PARTRIDGE ELECTRONICS ...49
BADCOCK ROSYTH LTD .....66	HARRISON ELECTRONICS ...29	PRESS AND PEEL .....49
CMS .....67	ICS .....38	PICO TECHNOLOGIES .....32
CHELMER VALVE .....36	JJ COMPONENTS .....49	ROBOTICA .....36
COOKE INTERNATIONAL .....66	JPG .....29	R.D. RESEARCH .....31
CIRKIT DISTRIBUTION .....59	J+N FACTORS .....50	RSGB .....60
CROWN HILL ASSOCIATES ...63	LABCENTRE .....IFC	STEWART OF READING .....36
DISPLAY ELECTRONICS .....15	LEADING EDGE TECHNOLOGY ..63	SWIFT DESIGNS .....43
EPT EDUCATIONAL SOFTWARE ..54	MAURITRON .....63	TECHNICAL INFORMATION ..52
EQT .....63	MILFORD INSTRUMENTS ....36	TELNET .....29
ESR COMPONENTS .....27	NCT .....38	VISIBLE SOUND .....38
FOREST ELECTRONICS .....22	NO1 SYSTEMS .....53	
G.C. ARNOLD .....59		

**Swift Designs Ltd.**

EDWin - EED3 - CADSTAR

**??? PCB DESIGN OVERLOAD ???**  
**WE COULD BE YOUR ANSWER**

Swift design P.C.B. design bureau and Software house, can handle any overload that you might have, using the latest P.C.B. design software. Whilst all types of design are catered for, the company has specialised in the design of Loadboards and Testboards for both the Chip Manufacturing and computer Manufacturing Industries.

Using Visionics software, we have also been able to offer our customers a reverse engineering facility, which enables us to reproduce Printed Circuit Board databases from HPGL and Gerber files and also ultimately to reconstruct the original schematic circuitry.

B.T.C, Bessemer Drive, Stevenage, Herts SG1 2DX. Tel: 01438 310133 Fax: 01438 722751  
 Email: [Designs@Swiftdesigns.co.uk](mailto:Designs@Swiftdesigns.co.uk) Web Page: [WWW.Swiftdesigns.Co.uk](http://WWW.Swiftdesigns.Co.uk)

# Around the Corner

**E**very so often, a manufacturer can make the boast that their kit is currently the ruggedest on the streets (see News: The World's first 5 GB laptop disk drive). This leads us to wonder - how many computers are at risk? We knew someone who hit a printer once (yes: it broke. One of those £2.95 parts that costs £10 to replace.), and someone who used to thump his monitor (it made it work - right up to the day it blew up. He wasn't injured, but a colleague lost two hours' work when the circuit breaker tripped) and a technician who swears that hitting keyboards makes them work better (like the monitor, perhaps). But we have yet to meet anyone who hits computers. Even other people's computers. On trains? Maybe ...

But seriously, although for some electronics purists anything with a moving part is distinctly suspect, it is likely that rotating storage media will be with us for some time. The technological advances in hard discs should not be underestimated. Many people remember mainframe hard discs, with stacked disc packs used in a clean room environment, and storing a few hundred kilobytes if you were lucky.

The 'head crash' (now a science fiction title) used to be an ever present risk. A tiny particle, perhaps cigarette smoke, would get between the head and the disk, and trigger a destructive operation in which the head scraped the magnetic coating off the disc. This is still physically possible with modern hard discs, it doesn't happen often.

When 20 megabytes constituted a large hard disc, it was necessary to run a program to park the heads before moving the computer, to stop the heads clattering against the platter and chipping the magnetic coating off. Nowadays that is

taken care of in the mechanism, and when the power is switched off the heads are moved to a safe position. More effort is made to give each new generation of disc drives improved aerodynamics for the heads and ever smoother coatings for the platter to permit closer spacing between disc and head, so that we can read and write ever smaller magnetic domains.

What does this mean for portable computers? The most obvious problem is that the heads must not chip the platter even when shock is applied while data is being written. Ideally, there should be no disruption to the data storage accuracy.

There is another less obvious problem: the platter is spinning very fast, and even a small tilt applied to it will generate strong precession forces (which can be illustrated with an ordinary gyroscope). This precession is a result of the conservation of angular momentum, so the faster the spin, the more change in angular momentum from a given tilt, and the more force. This force tries to flex the platter, and puts strain on the bearings. The whole assembly must be rigid enough so that the platter does not contact the head and use it like a lathe tool to machine pieces off.

When you consider all these factors, the production of a 5 Gigabyte hard disc (see News) for use in a portable computer is another modern marvel.

## Last Month's Competition Winners

Congratulations to our RIAT competition winners from issue 6. 15 pairs of complimentary tickets to the Royal International Air Tattoo at RAF Fairford, Gloucester, in July are winging their way to the winning entries.

## Next Month...

Volume 26 no. 9 of **Electronics Today International** will be in your newsagent on 15th August 1997 ... **H. Paul Shuch** will be scanning the heavens for signs of life as yet unknown ... **Terry Balbirnie's** mock alarm flasher offers a very low cost safety feature for cars ... We take a look at some more **Electronics** courses, including some postgraduate and research departments ... all the regulars, and more.

*Contents are in preparation but are subject to space and availability.*



Published by  
Nexus Special Interests Limited  
Nexus House, Boundary Way,  
Hemel Hempstead, Herts HP2 7ST  
Tel: 01 442 66551  
Fax: 01 442 66998

## EDITORIAL

Editor  
Helen Armstrong  
Administration Assistant  
Lynn Bugden  
Consultant  
Andrew Armstrong

## PRODUCTION

Designer  
Dan Sturges  
Technical Illustrator  
John Puczynski  
Production Executive  
(Copy control)  
Marie Quilter  
Printed By  
Wiltshire Ltd., Bristol  
Origination by  
Ebony, Liskeard

## SALES

Advertisement Manager  
Andrew Forder  
01 442 66551 x331

Group Sales Manager  
Jason Wollington

## MANAGEMENT

Divisional Managing Director  
John Bridges  
Business Manager  
Stuart Cooke  
Circulation Manager  
William Pearson  
Marketing Manager  
Jason Doran  
Copy Sales Manager  
David Pagendam

## SUBSCRIPTIONS

UK: Orders 01 858 435344  
Enquiries 01 858 435322  
USA: Wise Owl Worldwide Publications, 4314  
West 238th Street, Torrance, CA 90005-45009  
USA: For VISA/Mastercard orders phone: (310)  
375 6258. Fax: (310) 375 0548. Pacific Time: 9am -  
9pm weekdays 10am - 6pm weekends

READERS SERVICES  
Back issues (last 12 months) £3.05 per issue if  
available. Older issues: photocopies of whole  
articles often available. Write to The Photocopy  
Service, Readers Services Department, at Nexus  
House, Boundary Way, Hemel Hempstead, Herts  
HP2 7ST.  
Binders for ETI: £7.50 each including UK post and  
packing. Overseas please add £1.50. Cheques to  
Nexus Special Interest at Nexus House, or phone  
VISA/Mastercard orders to Readers Services  
Department 01 442 66551



NEXUS

© Nexus Special Interests Limited 1997  
All rights reserved  
ISSN 01 42-7229

The Publisher's written consent must be obtained before any part of this publication may be reproduced in any form whatsoever, including photocopies, and information retrieval systems. While reasonable care is taken in preparation of magazine contents, the publishers, editors and their agents cannot be held legally responsible for loss howsoever arising from errors or other published material.

# MICRO-PRO THE STATE-OF-THE-ART PROGRAMMER



**NOW SUPPORTS**

**AVR™**

MICROCONTROLLER FAMILY

**UNLOCK NEW LIBRARIES**



Atmel - 89C, 89S  
(see table below)  
Philips/Intel - 87C-51/52-Fx  
Dallas - 87C520  
Comes as standard

Atmel  
E<sup>2</sup> - 24C, 25C, 28C, 59C, 93C  
FLASH - 29C, 49F  
Order Code: MPW-LIB MEM AT  
**£75.00**

FPGA Serial Configurators  
Atmel, Xilinx, Altera etc.  
Order Code: MPW-LIB-CON  
**£75.00**

A Security Dongle is required for the above libraries Order Code: MPW-LIB-SEC **£24.00**

**Features Include**

- Micro-Pro for Windows™ Programmer Interface Software
- FPGA hardware ensures future device support
- Supports most DIL devices! up to 40 pins without an adaptor
- Adaptors available for many other package types

Order code: MPW-SYS **£149.00**

The **Atmel** 8051 FLASH microcontroller family

Atmel Part Code	89C51	89C52	89C55	89S8252	89S53	89C1051	89C2051
Flash Code ROM (bytes)	4K	8K	20K	8K	12K	1K	2K
RAM (bytes)	128	256	256	256	256	64	128
EEPROM	-	-	-	2K	-	-	-
In-system re-programmable	-	-	-	YES	YES	-	-
I/O Pins	32	32	32	32	32	15	15
16-bit Timer/Counters	2	3	3	3	3	1	2
Watchdog timer	-	-	-	YES	YES	-	-
Interrupt sources	6	8	8	9	9	3	6
Serial UART (full duplex)	YES	YES	YES	YES	YES	-	YES
SPI Interface	-	-	-	YES	YES	-	-
Analogue comparator	-	-	-	-	-	YES	YES
Data pointers	1	1	1	2	2	1	1
Package Pins (DIL)	40	40	40	40	40	20	20

**C51 Microcontroller Starter System**

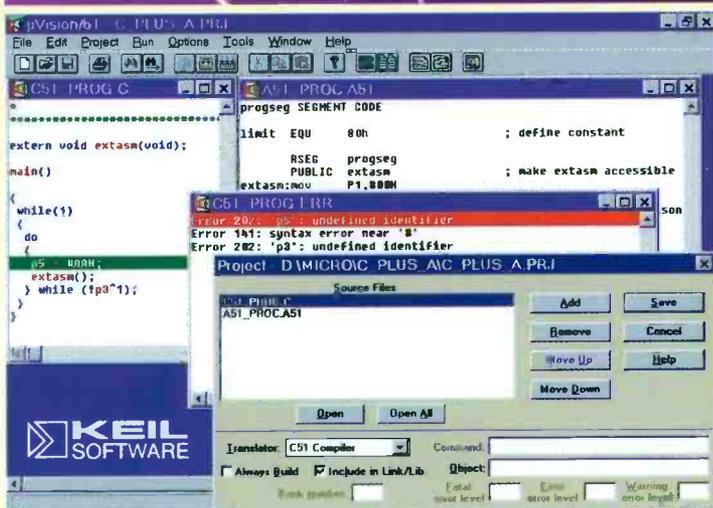


**UPGRADE to 8K NOW AVAILABLE**

- ✓ Optimising C Compiler
- ✓ Macro Assembler
- ✓ Software Simulator
- ✓ Device Programmer
- ✓ Evaluation Module
- ✓ Atmel AT89C2051
- ✓ Hardware/Software Documentation

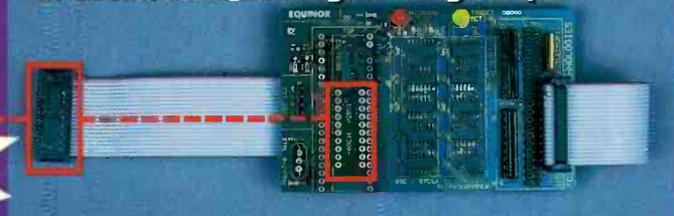
Plus FREE Atmel CD ROM data book

Order code: AT-89C-2K-5T **£199.00**



▲ KEIL Integrated Development Environment - C compiler + Assembler output restricted to 2K total program code.

**In-Circuit Parallel Programming Adaptor**



**Now you can re-program the entire 89C & 89S Atmel Microcontroller families in-circuit**

▲ Order code: AD-8051-ICPP **£125.00** (Requires Micro-Pro Programmer to operate)



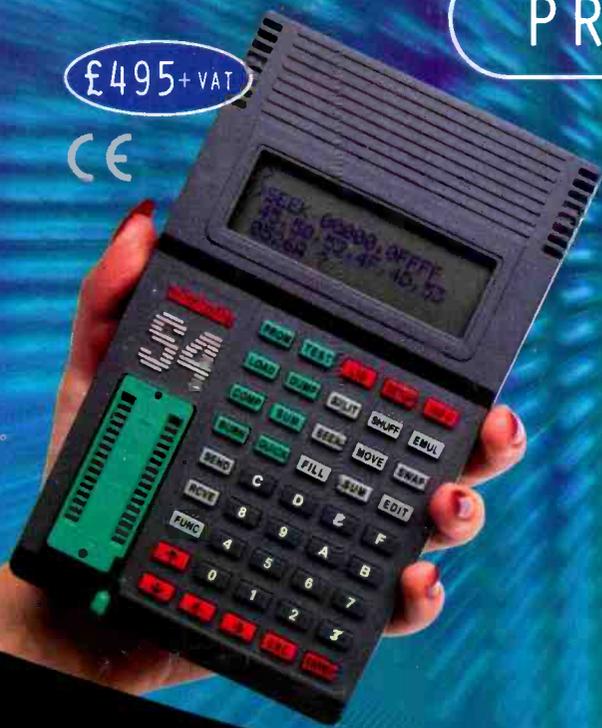
The Embedded Solutions Company

Visit our web page at: [www.equinox-tech.com](http://www.equinox-tech.com)  
Email: [sales@equinox-tech.com](mailto:sales@equinox-tech.com)  
229 Greenmount Lane, Bolton BL1 5JB UK



# STILL THE WORLD'S MOST POWERFUL PORTABLE PROGRAMMERS?

£495+VAT



NEW MODEL



£795+VAT

SURELY NOT.  
SURELY SOMEONE SOMEWHERE HAS  
DEVELOPED A PORTABLE PROGRAMMER  
THAT HAS EVEN MORE FEATURES, EVEN  
GREATER FLEXIBILITY AND IS EVEN  
BETTER VALUE FOR MONEY.

ACTUALLY, NO. BUT DON'T TAKE OUR  
WORD FOR IT. USE THE FEATURE  
SUMMARY BELOW TO SEE HOW OTHER  
MANUFACTURERS' PRODUCTS COMPARE.

## DATAMAN - 48LV

- Plugs straight into parallel port of PC or laptop
- Programs and verifies at: 2, 2.7, 3.3 & 5V
- True no-adaptor programming up to 48 pin DIL devices
- Free universal 44 pin PLCC adaptor
- Built-in world standard PSU - for go-anywhere programming
- Package adaptors available for TSOP, PSOP, QFP, SOIC and PLCC
- Optional EPROM emulator

## DATAMAN S4

- Programs 8 and 16 bit EPROMs, EEPROMs, PEROMs, 5 and 12V FLASH, Boot-Block FLASH, PICs, 3751 microcontrollers and more
- EPROM emulation as standard
- Rechargeable battery power for total portability
- All-in-one price includes emulation leads, AC charger, PC software, spare library ROM, user-friendly manual
- Supplied fully charged and ready to use

## S4 GAL MODULE

- Programs wide range of 20 and 24 pin logic devices from the major GAL vendors
- Supports JEDEC files from all popular compilers

## SUPPORT

- 3 year parts and labour guarantee
- Windows/DOS software included
- Free technical support for life
- Next day delivery - always in stock
- Dedicated UK supplier, established 1978

**Still as unbeatable as ever.** Beware of cheap imitations. Beware of false promises. Beware of hidden extras. If you want the best, there's still only one choice - Dataman.

Order via credit card hotline - phone today, use tomorrow.

Alternatively, request more detailed information on these and other market-leading programming solutions.

## MONEY-BACK 30 DAY TRIAL

If you do not agree that these truly are the most powerful portable programmers you can buy, simply return your Dataman product within 30 days for a full refund

**hotline**  
01300 320719



Orders received by 4pm will normally be despatched same day.  
Order today, get it tomorrow!

**DATAMAN**

Dataman Programmers Ltd, Station Rd,  
Maiden Newton, Dorchester,  
Dorset, DT2 0AE, UK  
Telephone +44/0 1300 320719  
Fax +44/0 1300 321012  
BBS +44/0 1300 321095 (24hr)  
Modem V.34/V.FC/V.32bis  
Home page: <http://www.dataman.com>  
FTP: <ftp.dataman.com>  
Email: [sales@dataman.com](mailto:sales@dataman.com)