



*TOMORROW'S TECHNOLOGY TODAY*

# The Disk Drive of Tomorrow

1000 Gigabytes in your PC?



PC protection alarm  
Lock up your TV with Video Check  
Real-time 8-channel logic analyser

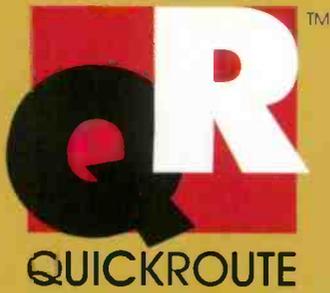
## PLUS

- Sentinel alarm tester
- Love Finder - Valentine project
- PIC Basic controller

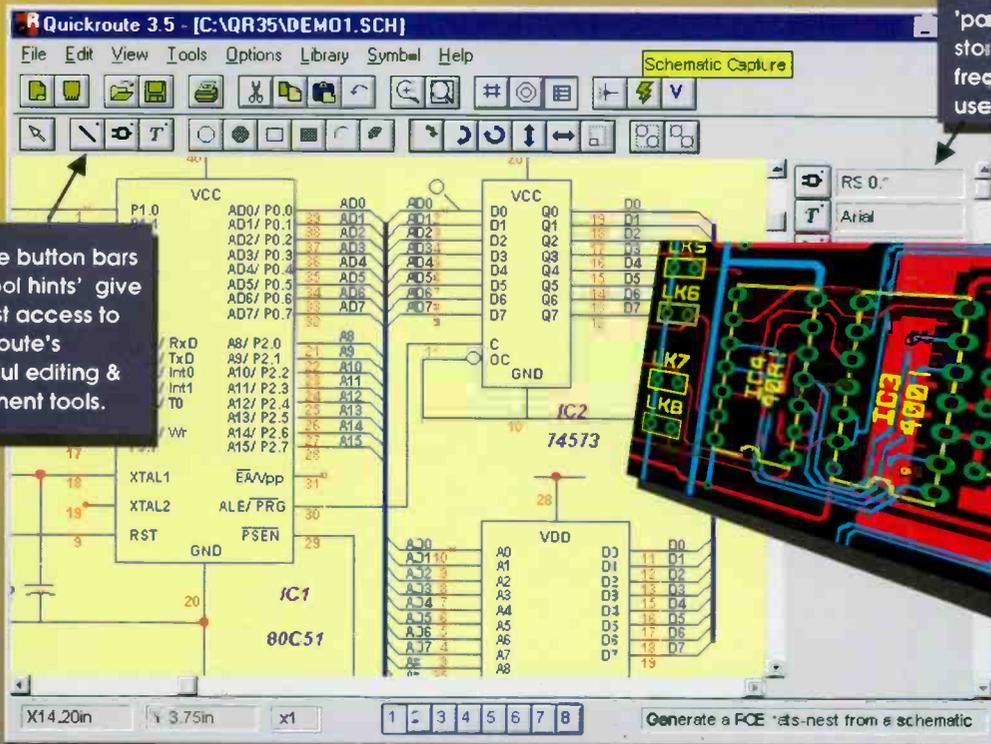
FEBRUARY 1996 £2.25



New  
Version 3.5



# Integrated PCB & Schematic Design System for Windows™



Multiple button bars with 'tool hints' give you fast access to Quickroute's powerful editing & placement tools.

The scrolling 'parts bin' stores frequently used objects.

"..of all the products included here, this is my personal favourite... Really, that's all I have to say about Quickroute - it certainly gets my vote!"

Review of QR 3.0 & other products  
Computer Shopper Nov 95

#### EASY TO USE

Quickroute 3.5 is a powerful, affordable and easy to use Integrated Schematic & PCB design system for Windows.™ With its multiple button bars, 'tool hints' and 'parts bin', Quickroute helps you to design quickly and efficiently.

#### POWERFUL

There are four different versions of Quickroute giving you a choice of features & price. Quickroute is available with multi-sheet schematic capture, auto-routing, 'engineering change' (modification of a PCB from a schematic), copper fill, and a range of file import/export options. See the table for a selection of features.

#### AFFORDABLE

Prices are Designer (£149), PRO (£249) and PRO+ (£399). The Personal edition is available for just £68, but has the manual provided on disk as on-line help. Post & Packing is £5 (UK), £8 (EC), £12 (World). VAT must be added to the total price.

Personal  
Designer  
PRO  
PRO+

	Personal	Designer	PRO	PRO+
PCB & Schematic Design	✓	✓	✓	✓
Schematic Capture		✓	✓	✓
Auto router			✓	✓
Design Rule Checking			✓	✓
Export WMF & Tango			✓	✓
Expert Gerber/NC-Drill			✓	✓
Extended Libraries			✓	✓
Tango + Gerber Import			✓	✓
Update PCB from schematic				✓
DXF & SPICE Export				✓
Copper Fill				✓



Tel/Fax 0161 449 7101

Quickroute Systems Ltd., 14 Ley Lane, Marple Bridge, Stockport, SK6 5DD, U.K.

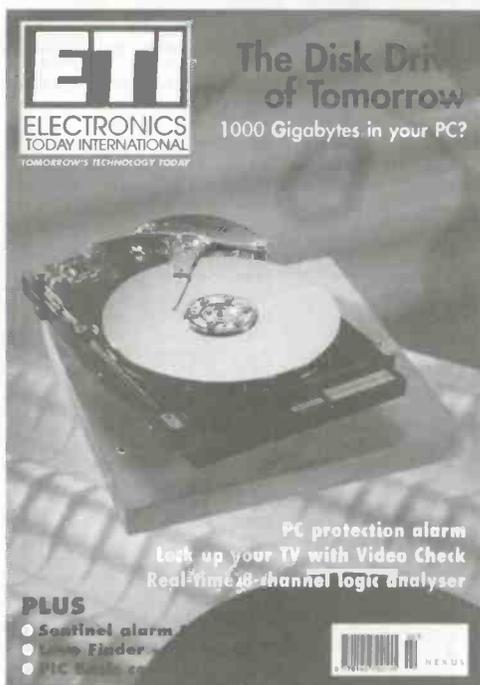
email info@quicksys.demon.co.uk



Phone now  
for more  
information

Prices and specifications subject to change without notice. All trade marks are acknowledged & respected.

# Contents



**ETI**  
ELECTRONICS  
TODAY INTERNATIONAL  
TOMORROW'S TECHNOLOGY TODAY

**The Disk Drive of Tomorrow**  
1000 Gigabytes in your PC?

PC protection alarm  
Look up your TV with Video Check  
Real-time 8-channel logic analyser

**PLUS**

- Sentinel alarm
- Love Finder
- PIC based

NEBUS

**Volume 25 No.2**

## & Features & Projects



### The Magnetic Disk Drive 12

Nick Hampshire takes a look at the technology behind the familiar hard disk found in every PC and asks where will the inexorable growth in disk capacity end? Within a decade, will we all have a 1000Gigabyte drive in our computers?

### PC Alarm 22

If you are worried about having your computer equipment stolen, then this alarm project from Robert Penfold could keep the thieves at bay

### Love Finder 28

A simple little project from Terry Balbirnie which will liven up any St Valentines day party

### The ETI Basic micro controller 32

In part 5 of this premier project, Robin Abbott concludes his look at some other versions of the ETI PIC based controller module

### Video Check 38

If you want to stop your children staying up late and watching too much TV, then Bart Trepak's PIC based project could be just what you are looking for

### Logic Analyser 46

This PIC micro controller based project from Richard Grodzik is a real-time 8-channel logic analyser circuit which will display the data on your PC

### Sentinel Alarm Tester 52

If you need to check out whether a burglar alarm system is working, then this piece of test equipment from Bob Noyes should prove invaluable



### The Electronics Engineer's PC 58

This month Frank Guaschi takes a look at a PC software package called Math-plus which is designed to help you with the more complex problems in mathematics

### The Hughes Microphone 63

Ever wondered how some of the very earliest pieces of electronic equipment actually worked? Then join George Pickworth in this quest into the lost technology of the past

## Regulars

- News 6
- PCB foils 70
- Practically Speaking 68  
Terry Balbirnie's regular look at workshop practice
- Around the Corner 74  
Nick Hampshire takes a look at the technology of tomorrow



**Subscribe & Save**

SUBSCRIPTIONS & BACK ISSUES HOTLINES:  
**01858 435344**

ORDERS:  
ENQUIRES:  
**01858 435322**  
Lines Open 9am - 6.30pm

Phone the hotline and take advantage of our special offer detailed on page 66

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

\* PRICES INCLUDE V.A.T. \* PROMPT DELIVERIES \* 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" x H3 1/2" (2U) x D11"  
MXF400 W19" x H5 1/4" (3U) x D12"  
MXF600 W19" x H5 1/4" (3U) x D13"  
MXF900 W19" x H5 1/4" (3U) x D14 1/2"

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

**OMP X03 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 equalisers with bar graph LED Vu meters. **MANY OUTSTANDING FEATURES:-** including Echo with repeat & speed control, DJ Mic with talk-over switch, 6 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.



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' (KSN1036A)** 3" tweeter 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 6" 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 80KHz. 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, KEY'B'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 EB8-50 & EB10-50 which are dual impedance tapped @ 4 & 8 ohm)**  
**BASS, SINGLE CONE, HIGH COMPLIANCE, ROLLED SURROUND**  
8" 50watt EB8-50 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 96dB. 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. 63Hz, 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 EB8-60TC (TWIN CONE) HI-FI, MULTI-ARRAY DISCO ETC. RES. FREQ. 40Hz, FREQ. RESP. TO 18KHz, SENS 89dB. 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



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.



**B.K. ELECTRONICS**

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

Tel. 01702 - 527572 Fax: 01702-420243

**SURVEILLANCE TELESCOPE** Superb Russian zoom telescope adjustable from 15x to 60x! complete with metal tripod (impossible to use without this on the higher settings) 66mm lens, leather carrying case £149 ref BAR69

**RADIATION DETECTOR SYSTEM** Designed to be wall mounted and connected into a PC, ideal for remote monitoring, whole building coverage etc. Complete with detector, cable and software. £19.95 ref BAR75.

**WIRELESS VIDEO BUG KIT** Transmits video and audio signals from a miniature CCTV camera (included) to any standard television! All the components including a PP3 battery will fit into a cigarette packet with the lens requiring a hole about 3mm diameter. Supplied with telescopic aerial but a piece of wire about 4" long will still give a range of up to 100 metres. A single PP3 will probably give less than 1 hours use. £99 REF EP79. (probably not licensable!)

**CCTV CAMERA MODULES** 46X70X29mm, 30 grams, 12v 100mA, auto electronic shutter, 3.6mm F2 lens, CCIR, 512x492 pixels, video outputs 1v 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! £5.99 ref EF138.

**TANDATA TD1400 VIEWDATA** Complete system comprising modem, infra red remote keyboard, psu, UHF and RGB output, phone lead, RS232 output, composite output. £9.95 ref BAR33

**MAGNETIC CARD READERS** (Swipes) £9.95 Cased, with flyleads, designed to read standard credit cards! they have 3 wires coming out of the head so they may write as well? complete with control electronics PCB, just £9.95 ref BAR31

**PANORAMIC CAMERA OFFER** Takes double width photographs using standard 35mm film. Use in horizontal or vertical mode. Complete with strap £7.99 ref BAR1

**COIN OPERATED TIMER KIT** Complete with coin slot mechanism, adjustable time delay, relay output, put a coin slot on anything you like! TV's, videos, fridges, drinks cupboards, HiFi, takes 50p's and £1 coins. DC operated, price just £7.99 ref BAR27.

**ZENITH 900 X MAGNIFICATION MICROSCOPE** Zoom, metal construction, built in light, shrimp farm, group viewing screen, lots of accessories. £29 ref ANAYLT.

**LUBITEL 166U** Twin lens Russian 2 1/4" sq reflex camera supplied with two free rolls of colour film, flip up magnifier, 3 element f4.5 lens. £19.99 ref BAR36.

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

**PLASMA SCREENS** 22x310mm, no data hence £4.99 ref BAR67

**NIGHTSIGHTS Model TZSA** 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. £210 ref BAR61. 1 years warranty

**FILIN-1** 150m range, 15 deg angle of view, focusing 10m-infinity. £179 ref BAR62. A separate infra red light is available at £30 ref BAR63.

**WHITE NIGHT SIGHTS** Excellent professional night sight, small, hand held with camouflaged carrying case £325. 1 years warranty.

**MEGA AIR MOVERS** 375 cubic feet per min! 240v 200 watt, 2,800 rpm, reversible, 7x7" UK made, new, Aluminium, current list price about £180 ours? £29.95 ref BAR35.

**LIQUID CRYSTAL DISPLAYS Bargain prices,**  
16 character 2 line, 65x14mm £1.99 ref SM1612A  
16 character 2 line, 99x24mm £2.99 ref SM1623A  
20 character 2 line, 83x19mm £3.99 ref SM2020A  
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 details £249 ref TAL-1

**GOT AN EXPENSIVE BIKE?** You need one of our bottle alarms, they look like a standard water bottle, but open the top, insert a key to activate a motion sensor alarm built inside. Fits all standard bottle carriers, supplied with two keys. SALE PRICE £7.99 ref SA32.

**GOT AN EXPENSIVE ANYTHING?** You need one of our cased vibration alarms, keyswitch operated, fully cased just fit it to anything from videos to caravans, provides a years protection from 1 PP3 battery, UK made. SALE PRICE £4.99 ref SA33.

**DAMAGED ANSWER PHONES** These are probably beyond repair so just £4.99 each, BT response 200 machines. REF SA30.

**COMMODORE GAMES CONSOLES** Just a few of these left to clear at £5 ref SA31. Condition unknown.

**COMPUTER DISC CLEAROUT** We are left with a lot of software packs that need clearing so we are selling at disc value only 50 discs for £4, that's just 8p each!(our choice of discs) £4 ref EP66

**IBM PS2 MODEL 160Z CASE AND POWER SUPPLY** Complete with fan etc and 200 watt power supply. £8.95 ref EP67

**DELL PC POWER SUPPLIES** 145 watt, +5,-5,+12,-12, 150x150x85mm complete with switch, flyleads and IEC socket. SALE PRICE £9.99 ref EP65

**1.44 DISC DRIVES** Standard PC 3.5" drives but returns so they will need attention SALE PRICE £4.99 ref EP68

**1.2 DISC DRIVES** Standard 5.25" drives but returns so they will need attention SALE PRICE £4.99 ref EP69

**PP3 NICADS** Unused but some storage marks. £4.99 ref EP52

**DELL PC POWER SUPPLIES** (Customer returns) Standard PC psu's complete with fly leads, case and fan, pack of two psu SALE PRICE £5 FOR TWO! ref EP61

**GAS HOBS AND OVENS** Brand new gas appliances, perfect for small flats etc. Basic 3 burner hob SALE PRICE £24.99 ref EP72. Basic small built in oven SALE PRICE £79 ref EP73

**BITS AND BOBS** We have a quantity of cased modems, multiplexers etc different specs but ideal strippers. £4 each ref EP63

**RED EYE SECURITY PROTECTOR** 1,000 watt outdoor PIR switch SALE PRICE £9.99 ref EP57

**ENERGY BANK KIT** 100 6"x6" 6v 100mA panels, 100 diodes, connection details etc £69.95 ref EF112

**PASTEL ACCOUNTS SOFTWARE**, does everything for all sizes of businesses. Includes wordprocessor, report writer, windowing, networkable up to 10 stations, multiple cash books etc. 200 page comprehensive manual. 90 days free technical support (0345-326009 try before you buy) Current retail price is £129, SALE PRICE £9.95 ref SA12. SAVE £120!!

## WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

**MINI MICRO FANS** 12V 1.5" sq SALE PRICE £2. Ref SA13

**REUSEABLE HEAT PACKS.** Ideal for fishermen, outdoor enthusiasts elderly or infirm, warming food, drinks etc, defrosting pipes etc reusable up to 10 times, lasts for up to 8 hours per go. 2,000wh energy, gets up to 90 degC. SALE PRICE £9.95 REF SA29

**12V ZAMP LAPTOP** psu's 110x55x40mm (Includes standard IEC socket) and 2m lead with plug. 100-240v IP. £8.99 REF SA15.

**PC CONTROLLED 4 CHANNEL TIMER** Control (on/off times etc) up to 4 items (8A 240v each) with this kit. Complete with Software, relays, PCB etc. £25.99 Ref 96/26

**COMPLETE PC 300 WATT UPS SYSTEM** Top of the range UPS system providing protection for your computer system and valuable software against mains power fluctuations and cuts. New and boxed, UK made Provides up to 5 mins running time in the event of complete power failure to allow you to run your system down correctly. SALE PRICE JUST £89.00.

**SOLAR PATH LIGHTS** Low energy walklights powered by the sun built in PIR so they work when you walk past. Includes solar panel & rechargeable bat. SALE PRICE £19.95 REF EP52

**BIG BROTHER PSU** Cased PSU, 6v 2A output, 2m o/p lead, 1.5m input lead, UK made, 220v. SALE PRICE £4.99 REF EP7



Check out our  
**WEB SITE**

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

**RACAL MODEM BONANZA!** 1 Racal MPS 1223 1200/75 modem, telephone lead, mains lead, manual and comms software, the cheapest way onto the net all this for just £13 ref DEC13.

**4.5mw LASER POINTER.** BRAND NEW MODEL NOW IN STOCK!, supplied in fully built form (looks like a nice pen) complete with handy pocket clip (which also acts as the on/off switch.) About 60 metres range! Runs on 2 AAA batteries. Produces thin red beam ideal for levels, gun sights, experiments etc. just £39.95 ref DEC49

**TRADE PRICE £28 MIN 10 PIECES**

**BULL TENS UNIT** Fully built and tested TENS (Transcutaneous Electrical Nerve Stimulation) unit, complete with electrodes and full instructions. TENS is used for the relief of pain etc in up to 70% of sufferers. Drug free pain relief, safe and easy to use. can be used in conjunction with analgesics etc. £49 Ref TEN/1

**COMPUTER RS232 TERMINALS. (LIBERTY)** Excellent quality modern units, (like wyse 50,s) 2xRS232, 20 function keys, 50 thro to 38,400 baud, menu driven port, screen, cursor, and keyboard setup menus (18 menu's). £29 REF NOV4.

**RUSSIAN MONOCULARS** Amazing 20 times magnification, coated lenses, carrying case and shoulder strap. £29.95 REF BAR73

**PC PAL VGA to TV CONVERTER** 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

**EMERGENCY LIGHTING UNIT** Complete unit with 2 double bulb floodlights, built in charger and auto switch. Fully cased, 6v 8AH lead acid req'd. (secondhand) £4 ref MAG4P11.

**SWINGFIRE GUIDED MISSILE WIRE.** 4,200 metre reel of ultra thin 4 core insulated cable, 28lbs breaking strain, less than 1mm thick! Ideal alarms, intercoms, dolls house's etc. £13.99 ref EP51

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

**ASTEC SWITCHED MODE PSU** BM41012 Gives +5 @ 3.75A, +12 @ 1.5A, -12 @ 4A, 230/110, cased, BM41012. £5.99 ref AUG6P3.

**AUTO SUNCHARGER** 155x300mm solar panel with diode and 3 metre lead fitted with a cigar plug. 12v 2watt. £8.99 REF SA25.

**TOP QUALITY CENTRIFUGAL MAINS MOTORS** SALE PRICE £2 FOR JUST £2.60 REF SA38

**ECLATRON FLASH TUBE** As used in police car flashing lights etc, full spec supplied, 60-100 flashes a min. £6.99 REF SA15.

**24v AC 96WATT** Cased power supply. New. £9.99 REF SA40

**MILITARY SPEC GEIGER COUNTERS** Unused straight from Her majesty's forces. SALE PRICE £44 REF SA16

**MICRODRIVE STRIPPERS** Small cased tape drives ideal for stripping, lots of useful goodies including a smart case, and lots of components. SALE PRICE JUST £4.99 FOR FIVE REF SA26

**SOLAR POWER LAB SPECIAL** You get TWO 6"x6" 6v 130mA solar cells, 4 LED's, wire, buzzer, switch plus 1 relay or motor. Superb value kit SALE PRICE JUST £4.99 REF SA27

**RGB/CGA/EGA/TTL COLOUR MONITORS** 12" in good condition. Back analysed metal case. SALE PRICE £49 REF SA16

**PLUG IN ACORN PSU** 19v AC 14w, £2.99 REF MAG3P10

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

**ACORN ARCHMEDES PSU** +5v @ 4.4A, on/off sw uncased, \*SOME OF OUR PRODUCTS MAY BE UNLICENSABLE IN THE UK

## BULL ELECTRICAL

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

MAIL ORDER TERMS: CASH, PO OR CHEQUE  
WITH ORDER PLUS £3 P & P PLUS VAT.  
PLEASE ALLOW 7-10 DAYS FOR DELIVERY PHONE ORDERS.  
WELCOMER (ACCESS VISA, SWITCH, AMERICAN EXPRESS)

TEL: 01273 203500  
FAX 01273 323077  
E-mail [bulk@pavillon.co.uk](mailto:bulk@pavillon.co.uk)

selectable mains input, 145x100x45mm £3.99 REF MAG72

**13.8V 1.9A PSU** cased with leads. Just £9.99 REF MAG10P3

**200 WATT INVERTER** Converts 10-15v DC into either 110v or 240v AC. Fully cased 115x36x156mm, complete with heavy duty power lead, cigar plug, AC outlets socket. Auto overload shutdown, auto shock circuit shut down, auto input over voltage shutdown, auto input under voltage shut down (with audible alarm), auto temp control, unit shuts down if overheated and sounds audible alarm. Fused reversed polarity protected, output frequency within 2%, voltage within 10%. A well built unit at a keen price. Just £64.99 ref AUG65.

**UNIVERSAL SPEED CONTROLLER KIT** Designed by us for the C5 motor but ok for any 12v motor up to 30A. Complete with PCB etc. A heat sink may be required. £17.00 REF: MAG17

**COMPUTER COMMUNICATIONS PACK** Kit contains 100m of 6 core cable, 100 cable clips, 2 line drivers with RS232 interfaces and all connectors etc. Ideal low cost method of communicating between PC's over a long distance. Complete kit £8.99

**VIEWDATA SYSTEMS** made by Phillips, complete with internal 1200/75 modem, keyboard, psu etc RGB and composite outputs, menu driven, autodialler etc. SALE PRICE £12.99 REF SA18

**AIR RIFLES.** 22As used by the Chinese army for training purposes, so there is a lot about! £39.95 Ref EF78. 500 pellets £4.50 ref EF80.

**PLUG IN POWER SUPPLY SALE FROM £1.60** Plugs in to J3A socket with output lead, three types available. 9vdc 150mA £1.50 ref SA19, 9vdc 200mA £2.00 ref SA20, 6.5vdc 500mA £2 ref SA21.

**VIDEO 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 100' range! (tune TV to a spare channel) 12v DC op. Price is £15 REF: MAG15 12v psu is £5 extra REF: MAG5P2

**\*FIBRE CORDLESS MICROPHONE** Small hand held unit with a 500' range! 2 transmit power levels. Reqs PP3 9v battery. Tuneable to any FM receiver. Price is £15 REF: MAG15P1

**\*MINIATURE RADIO TRANSCENERS** A pair of walkie talkies with a range up to 2km in open country. Units measure 22x5x155mm. Including cases and earp'ces. 2xPP3 req'd. £30.00 pr. REF: MAG30

**\*FM TRANSMITTER KIT** housed in a standard working 13A adaptor! the bug runs directly off the mains so lasts forever why pay £700? or price is £15 REF: EF62 (dit) Transmits to any FM radio.

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

**TALKING COINBOX STRIPPER** COMPLETE WITH COIN SLOT MECHANISMS originally made to retail at £79 each, these units are designed to convert an ordinary phone into a payphone. The units have the locks missing and sometimes broken hinges. However they can be adapted for their original use or used for something else?? SALE PRICE JUST £2.50 REF SA23

**GAT AIR PISTOL PACK** Complete with pistol, darts and pellets £12.95 Ref EF82B extra pellets (500) £4.50 ref EF80.

**6"X12" AMORPHOUS SOLAR PANEL** 12v 155x310mm 130mA SALE PRICE £4.99 REF SA24.

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

**MIXED GOODIES BOX**  
**MIXED COMPONENTS WEIGHING 2 KILOS**  
**YOURS FOR JUST £6.99**

**4X28 TELESCOPIC SIGHTS** Suitable for all air rifles, ground lenses, good light gathering properties. £19.95 ref R/7.

**RATTLE BACKS** Interesting things these, small piece of solid perspex like material that if you try to spin it on the desk it only spins one way! In fact if you spin it the "wrong" way it stops of its own accord and goes back the other way! £1.99 ref GIJ01.

**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

**HYPOTHERMIA SPACE BLANKET** 215x150cm aluminised foil blanket, reflects more than 90% of body heat. Also suitable for the construction of two way mirrors! £3.99 each ref OL/04.

**LENSTATIC RANGER COMPASS** Oil filled capsule, strong metal case, large luminous points. Sight line with magnifying viewer. 50mm dia, 86gm. £10.99 ref OJK604

**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.

**TALKING WATCH** Yes, it actually tells you the time at the press of a button. Also features a voice alarm that wakes you up and tells you what the time is! Lithium cell included. £7.99 ref EP26.

**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"x.75". Can pay for itself in just one day! £79.95 ref EP3.

**SANYO NICAD PACKS** 120mmx14mm 4.8v 270 mAh suitable for cordless phones etc, Pack of 2 just £5 ref EP78.

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

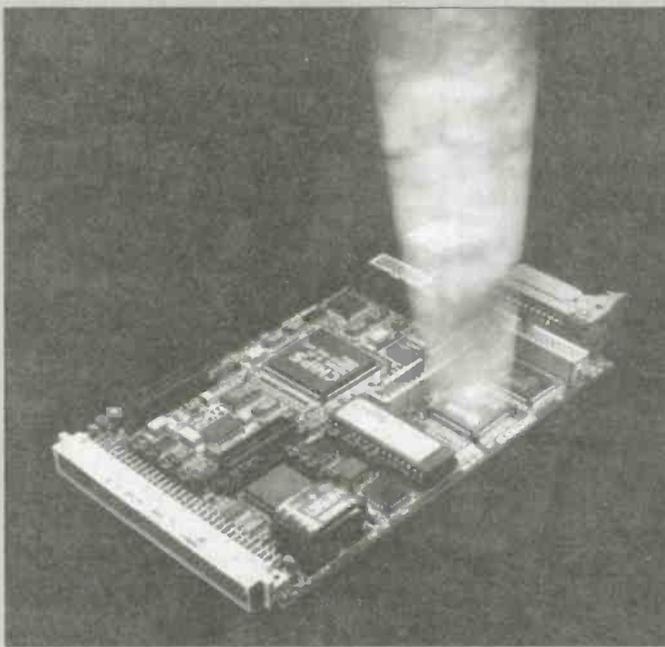
**STEREO MICROSCOPES BACK IN STOCK** Russian, 200x complete with lenses, lights, filters etc very comprehensive microscope that would normally be around the £700 mark, our price is just £299 (full money back guarantee) full details in catalogue. Ref 95/300.

**SOLAR POWERED CAR VENTILATOR** Simply fits along the top of the glass in a side window and provides a constant supply of fresh air in hot sunny conditions! keeps your car cool in summer. £19.95 ref svent.

## WE BUY SURPLUS STOCK FOR CASH FREE CATALOGUE

**100 PAGE CATALOGUE NOW AVAILABLE, 45P STAMP OR FREE WITH ORDER.**

## New from Arcom



Arcom has launched the fastest Eurocard STEbus PC AT-compatible available. Called SCIM486SX, it is based on the power 486slc processor and provides a single-board solution to the most demanding embedded DOS and Windows applications.

The new board packs a 50MHz CPU with over 10Mbytes of RAM and Flash EPROM onto a compact 100 x 160mm single Eurocard. The hardware architecture delivers computational performance benchmarked at up to 40% faster than a full 32-bit 486DX CPU running at 33MHz - but at a price designed to attract OEMs and control system designers.

In addition to offering a powerful and economic foundation for a host of realtime and embedded industrial control and instrumentation applications, the board provides a rugged platform for running advanced software applications - such as Visual BASIC - in aggressive environments.

The Texas Instruments 486slc CPU at the heart of SCIM486SX delivers exceptional Intel 486-compatible performance thanks to design features such as five pipelined stages in the instruction execution path, and an 8kbyte, 32-bit, 2-way set-associative cache. The processor is combined with a Chips & Technologies, chipset to provide full PC AT compatibility.

The memory array offers IC sites for populations of up to 8Mbytes of zero wait-state dynamic RAM, 128kbytes of battery-backed static RAM and 2Mbytes of Flash EPROM. This can be extended by a further 8Mbytes of RAM using the board's SCIM

mezzanine local bus expansion facility - providing the capacity to run very large applications efficiently and/or operating systems such as UNIX. Other onboard hardware includes a site for a maths co-processor, IDE and floppy disk controllers, keyboard interface, real-time clock and watchdog timer, loudspeaker output, and COM1, COM2 and LPT1 ports. A serial-organised 256-byte E2PROM is additionally provided for fail-safe retention of BIOS configuration data and other information such as hardware/software version and issue.

SCIM86SX's combination of PC functionality and realtime-oriented hardware is more than adequate for many embedded DOS/Windows applications. But if greater functionality is required, then three expansion routes provide exceptional configuration flexibility.

The main STEbus interface - implemented via the reliable 2-part DIN41612 connector - includes full multi-master arbitration, allowing the construction of very high performance systems with parallel processing using up to 21 backplane slots.

The SCIM local expansion interface bus provides a means of closely matching the onboard hardware to the industrial requirement, to minimise system board count and costs. I/O is routed via a 50-way ribbon-cable header connector with a pin-out conforming to the industry-standard SCS signal-conditioning system. This secondary expansion route is a de-facto standard and offers access to a range of heavy-duty, real-world interfaces with features such as screwdriver-connect terminations, allowing users to integrate the isolation and conditioning functions essential for 'true' industrial computer systems.

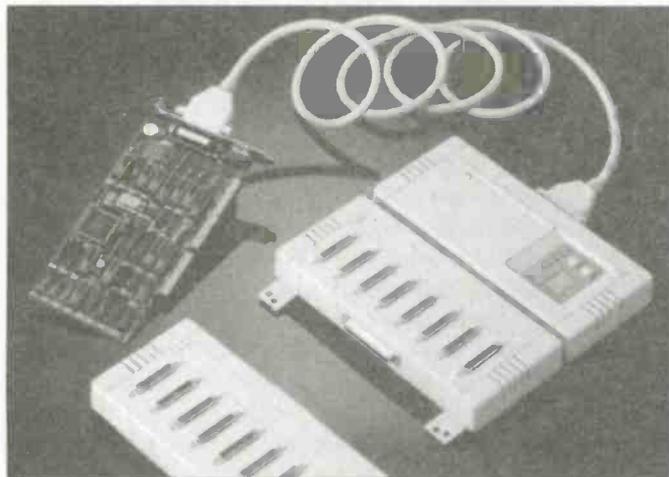
SVGA graphics is available in the form of a plug-on mezzanine module. This approach provides cost and flexibility advantages, minimising board costs for systems which do not require a man-machine interface, or allowing users to select the optimum form of display driver for the industrial application rather than being restricted to the usual CRT output. Arcom offers a choice of LCD, plasma or electro-luminescent SVGA drivers.

Because SCIM486SX is fully PC AT-compatible, applications software can be developed on the board itself. This greatly speeds the real-time systems design process, allowing debug to take place directly on the target hardware. When development is complete, Arcom offers a support package called SiliconDrive which allows software to be blown into ROMdisk/RAMdisk, for operation in harsh industrial environments where conventional disks are unsuitable.

The new board uses the same core architecture as a number of earlier 486slc- and 386sx- based STEbus modules, Arcom's most popular target boards over the last 3-4 years, and will also run code developed for Arcom's range of low-cost 80188-based controllers. This compatibility provides a plug-in upgrade path for more than 5,000 systems throughout the UK and Europe.

For further details contact Arcom Control Systems Ltd, on +44 1223 411200.

## Latest from IMS



IMS has announced a new generation of PC multi-function data acquisition and control cards. Codenamed the PCL-818 Series, these cards incorporate multiple functions on a compact, half-size PC plug-in card. This high level of functional integration has been achieved by merging the board's functionality on a single ASIC chip which combines high accuracy and reliability with low cost, size and power consumption.

The 818 series spans a number of cards ranging from 40KHz up to 330KHz sampling speeds, with features including 16 channels of 12-bit A/D conversion, D/A conversion, 16 digital inputs, 16 digital outputs and a counter/timer. The range is specifically designed to suit users' requirements from low-cost applications to high-speed, high performance applications.

All the cards include on-board ACS (Automatic Channel Scanning) enabling full-speed, multi-channel DMA controlled sampling. At the high end of the range the cards also incorporate on-board 1KB FIFO buffers for high throughput sampling, particularly for Windows applications. A high gain card (1000x amplification) is also included in the range for direct sensor connection to low signal sensors, such as thermocouples, thereby dispensing with the need for an external signal amplifier. On board CJC is also provided specifically for thermocouple measurement.

IMS also announced a new multi channel intelligent sensor-to-computer interface module for remote measurement and control. Codenamed the ADAM-4017, this module can be supervised by a host computer over a standard RS-232/485

network. Fitted with an on-board microprocessor, the module is also able to monitor sensors autonomously and report back measured readings or interrupt under alarm conditions.

The 4017 module provides 8 channels of differential analogue inputs with a high precision 16-Bit A/D converter suitable for measuring both voltage and current sensor outputs. The module is ideal for applications where the measurement/sensing points are some distance away from the supervisory computer. By digitising the measurement at the sensorpoint the module avoids the common shortfalls of long cable runs carrying sensor signals back to a central supervisory computer. Furthermore, by operating over an RS485 link this further simplifies cabling down to a single pair of wires which can be daisy-chained from module to module.

The 4017 module is enclosed in a rugged hardened plastic shell, with various mounting configurations supported, including panel or DIN rail mounting, with plug-in, screw-terminal connectors simplifying installation, expansion and repair. The Module is designed to accommodate unregulated power supplies, commonly used in the industry, from +10 to +30 VDC.

Last but not least, IMS has also introduced a new intelligent PC-based multi-port RS232 serial controller. Codenamed the PCL-747, this comprises a PC Bus (ISA) plug-in card with an associated external CPU module. The 747 provides modular expansion upto 32 RS232 serial ports, offering unprecedented serial port expansion for a desktop PC normally limited to standard PC COM1..COM4 serial ports.

The 747 and its associated CPU module incorporate an on-board 40Mhz TMS320C25 processor to handle the processor intensive serial communications, supporting baud rates of up to 38,400 bps on every port. An integral 1/2 Megabyte memory buffer provides temporary buffering of transmit and receive data to and from the host PC. The 747 modular design allows expansion in 8 port steps by the addition of UART modules which plug directly into the external CPU module. Up to 4 UART modules may be connected, providing 32 serial ports in total. The 747 is supplied with the PC-ComLIB utility software which includes DOS and Windows drivers, as well as programming library supporting most of the common high level languages (C, Pascal, Basic, Assembly, Clipper, etc.)

The 747 is ideal for applications requiring communications with multiple serial devices such as PLC interfacing, remote instrumentation and display, data communications modems, point of sale terminals and many more.

For further information, contact IMS on 01703 771143.

## New PCI/C44 addresses new markets for board-level DSP

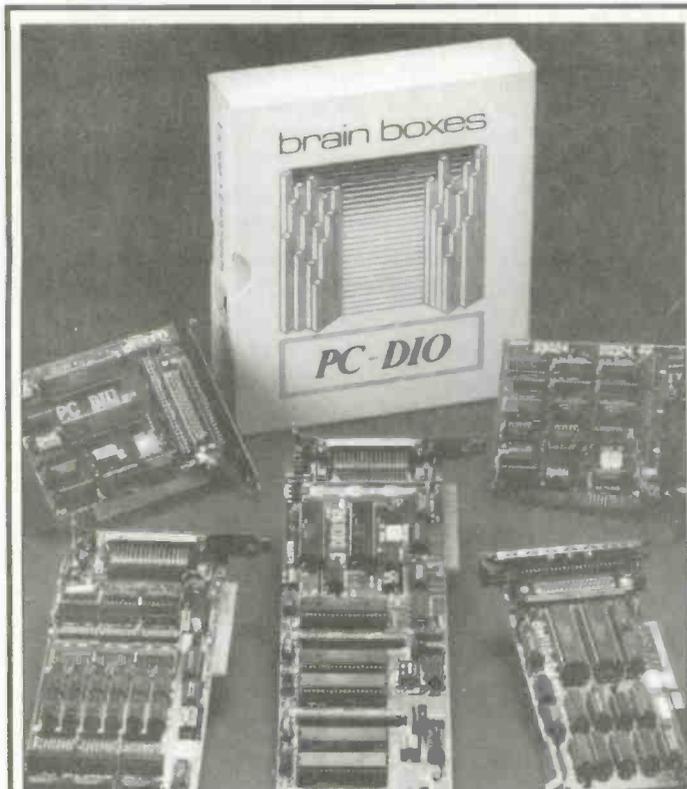
The new PCI/C44 from Loughborough Sound Images is a fast, multi-processing DSP engine. It combines the power of Texas Instruments' TMS320C4x floating point DSP with the high throughput of the PCIbus. This allows the PCI/C44 to address pre-press and medical imaging applications, multi-channel telecom products and high performance instrumentation. The board can be populated with up to four TMS320C44 processors, to operate at 50 or 60 MHz.

The PCI/C44 sports 2 MByte of shared SRAM. This enables high-speed data transfers between the host and the DSPs. In addition, each processor has up to 4 MByte of local, zero wait state SRAM. The PCI/C44 also features LSI's open standard DSPLink-2 interface. This allows off-board I/O expansion through a range of multi-channel analogue and digital I/O

boards. Interprocessor communication links operating in excess of 80 MByte/s per processor simplify multiprocessor system implementation. An on-board JTAG test bus controller is mapped to the PCI Local Bus to provide a comprehensive debug facility.

Much development and application software is already available for the PCI/C44. Software from LSI's existing C40 ISA boards is upwards compatible with the new board, and a wide range of off the shelf DSP algorithms are available. Texas Instruments' TMS320C44 DSP itself is well supported, with application development software available from TI and other parties.

For further information contact: Loughborough Sound Images, on Tel:+44 1509 634444



## DIO with DLL!

Responding to customer demand from Windows users, Brain Boxes have announced that they will bundle their Windows DLL with all their digital input output PC interfaces from 1st October.

The range of cards offer up to 192 high-speed, high-current TTL compatible, digital input/output lines; they use the popular Intel 8255 P.P.I. chip, which provides the core I/O logic for the interfaces. Each chip has 24 input output lines that are controlled by reading and writing data to the chip's four registers.

Every card has a choice of base addresses, dip switch selectable, and a range of interrupts.

These high-speed interfaces are now fully available to Windows users, priced from as little as £79, which includes 270pp of informative advice and suggestions, disks, example circuits, and fully explained sample programs in the most popular languages.

Uses include high-output current control applications such as driving relays or LEDs, interfacing BCD inputs or outputs, detecting key presses or contact closures, generating fast TTL pulses, driving non-standard parallel devices etc.

The 48 and 192 line cards offer a choice of IDC or 'D' type connector.

Opto isolated versions of the card are also available.

For further information, contact Brain Boxes on 0151 220 2500

## 60 Million Samples per Second

Strategic Test recently announced the availability of the CompuScope 6012, an IBM PC/AT compatible ISA bus card capable of performing a 12 bit A/D conversion on one input at sampling rates up to 60 MSPS (Million Samples Per Second) and two simultaneous inputs at 30MSPS with a bandwidth of 30MHz.

Manufactured by Gage Applied Sciences of Canada, the CompuScope 6012 is supplied with free GageScope software which enables users to operate the card like an oscilloscope without writing a single line of programming code. As a low-cost alternative to digital oscilloscopes, it allows users to store, analyse and print their data and convert it to an ASCII format for export to spreadsheets and mathematical software packages without the traditional inconvenience of data transfer via RS232 or GP-IB interfaces provided by stand-alone instruments.

Applications for the CompuScope 6012 include cellular communications, receivers, LIDAR, imaging, non-destructive testing, ultrasonic testing, laser doppler anemometry, high end video, CCD testing, vibration analysis, laser diode characterisation, impact testing, etc.

Software drivers for C, Pascal, BASIC, LabWindows and LabView are available, together with a Windows 3.1 DLL, for users who want to integrate the CompuScope 6012 as part of a custom test system. Data can be transferred from the 6012 to the PC's extended memory at rates up to 1.5 MWord per second on a 80486 based system using the software drivers provided by Gage.

The standard card is supplied with 512k of on-board SRAM for signal storage; however this can be expanded to 8M samples which is a feature unique to the CompuScope 6012 and allows recording of long transient signals or fast repetitive acquisitions.

Other key specifications of the compuScope 6012 include 62dB SNR, -61dB THD, programmable input gain, auto-calibration, programmable input coupling, internal or external trigger capability and an ergonomic human interface. Multiple cards can be used in a Master/Slave configuration to achieve 60MSPS, 12 bit sampling on up to 8 simultaneous channels, with a common clock and trigger.

Auto-calibration is an essential feature of any multi-MHz waveform capture system. Temperature changes on the A/D board can cause offset and gain drift due to the relatively high thermal coefficients of resistors and trim pots. Gage have developed an auto-calibration method with a very low (20 ppm/C) thermal coefficient which allows the offset and gain of each input channel to be controlled in real-time, under software control.

For further information contact: Strategic Test & Measurement Systems Ltd on Tel: 01734 795950

## Intelligent I/O & PLC

Cambridge Microprocessor Systems Ltd has introduced a new low-cost industrial controller which provides full signal conditioning on each of 12 opto-isolated, non-polarised inputs and 4 isolated voltage-free outputs. The card can be programmed in Ladder Logic, 'C', or both, the latter offering full deterministic control of the I/O but providing the flexibility of 'C'. When used as a PLC, the user can select the scan time required - for fast applications this can be as low as 500  $\mu$ s - and still provide full communications and networking; the default is 10 ms.

The makers claim that, at £95 in quantity, this is the highest spec'ed lowest cost controller available today. The specification includes: 16/32 bit CPU 68000 compatible up to 1 Mbyte of EPROM and 512 Kbytes of SRAM plus EEROM, two fast hardware timer/counters, on-board PSU, expansion options, I2C or Mbus, RS232 or RS485 with full networking and remote I/O protocols such as MODBUS etc. The latter can also be used for remote programming and re-programming as well as interfacing to most SCADA packages and Visual Basic. A low-cost radio option is also available for remote locations and remote networking.

For more information contact CMS on 01371 875644

# It's all on ONE CD!

Electronics & Micro Software

Over **250**  
megabytes  
of shareware software

Yours for only  
**£30**  
(+ P&P + V.A.T.)

### A wealth of information on ONE disk!

- Microcontroller shareware utilities and applications software for most popular micros including PIC's, 8051's, Zilog & Motorola - Assemblers, C/Basic/Forth compilers, IIC & LCD drivers, software UARTS, FAQ sheets etc. etc.
- Commercial CAD package demos - e.g. Circuit Simulation, PCB/Schematic design- Spice for Windows, Super Filter, Protel etc.
- Internet Electronics & Micro Newsgroups- 2500+ articles
- PC Shareware- Windows 95 applications, Internet News/Mail readers & Web-browsers, GIF's, text/hex editors etc.

### To place your order

Telephone:  
(01204) 492010  
FAX:  
(01204) 494883  
Int. dialling code  
(UK +44 1204)

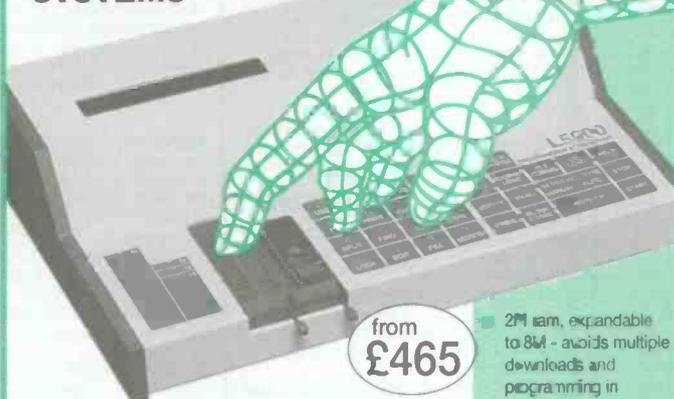
**For professional engineers  
& keen enthusiasts alike!**



229 Greenmount Lane, Heaton, Bolton.  
Lancs BL1 5JB. ENGLAND  
E-mail: sales@equintec.demon.co.uk

## PORTABLE PROGRAMMER & EMULATOR

**PROGRAMS  
EPROMS/FLASH TO 40  
PINS WITHOUT ADAPTORS  
EMULATES 8 & 16 BIT  
SYSTEMS**



from  
**£465**

its an easy touch  
for anyone

Ideal for R&D or small volume production. ISO 9002 manufacture and strict use of manufacturers algorithms guarantees reliable programming.



### Lloyd Research Ltd.

7 & 7a Brook Lane, Warsash, Southampton,  
Hampshire SO31 9FH England.  
Tel: +44 (0)1489 574040.  
Fax: +44 (0)1489 885253.

- 2M ram, expandable to 8M - avoids multiple downloads and programming in blocks
- Set programming & emulation for 16 bit systems.
- Tactile memorane with individual keys for all major functions.
- Supports sector protect/ unprotect feature or 2BF010/040.
- Fast download. 15 seconds for 1M bit Intel file.



# DEVELOPMENT AND PRODUCTION SOLUTIONS

- Gang Programmers
- Development Programmers
- Universal Cross Assembler
- Package Converters
- Development Tools
- Emulator Pods + Adapters

**GANG PROGRAMMES  
NEC 78/75PXXX  
MOTOROLA 68HC  
HITACHI H8, PICS  
SGS AND INTEL MICROS**



**ELECTRONICS Ltd**

Park Road Centre, Malmesbury, Wiltshire SN16 0BX UK  
Tel: 01 666 825663 Fax: 01 666 825141  
e/mail 1004473124@compuserve.com Web: http://ourwaic.compuserve.com/homepages/mqp

### Distributors

UK  
Electospeed 01703 644555  
Farnell 01152 636311  
France 1 69 41 28 01  
Germany 089/4-60 20 71  
Ireland 01 2800395  
Italy 02 92 10 35 54  
Singapore (65) 292 0253



**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! £6/5et. Ref F/XP1.

**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. £4/5et Ref F/TKE1.

**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. £15/5et. 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. £10/5et 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. £5/5et 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. £10/5et Ref F/CVL1.

**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. £6/5et Ref F/V59.

**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. £8/5et 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. £8/5et 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. £12/5et 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. £6/5et Ref F/ANTIK.

**ULTRASONIC BLASTER PLANS** Laboratory source of sonic shock waves. Blow holes in metal, produce 'cold' steam, atomize liquids. Many cleaning uses for PC boards, jewelry, coins, small parts etc. £6/5et 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. £6/5et Ref F/HGA7.

**ANTI DOG FORCE FIELD PLANS** Highly effective circuit produces time variable pulses of acoustical energy that dogs cannot tolerate. £6/5et Ref F/DG2.

**LASER BOUNCE LISTENER SYSTEM PLANS** Allows you to hear sounds from a premises without gaining access. £12/5et Ref F/LLIST1.

**CRAWLING INSECT ROASTER PLANS** Harmless high frequency energy pulses destroy pests as they crawl into the energy field. £4/5et Ref F/RCR1.

**LASER LIGHT SHOW PLANS** Do it yourself plans show three methods. £5 Ref F/LLS1.

**PHASOR BLAST WAVE PISTOL SERIES PLANS** Handheld, has large transducer and battery capacity with external controls. £6/5et Ref F/PPS4.

**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. £5/5et 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!** £5/5et 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. £8/5et 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.

## WOLVERHAMPTON BRANCH NOW OPEN AT WORCESTER ST W'HAMPTON TEL 01902 22039

**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. £7 Ref 1001.

**ELECTRONIC SIREN KIT** Impressive 5 watt power output. Ideal for car/bike alarm etc. 6-12v dc max current 1A, 1.2kHz £6 Ref 1003.

**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 microphone 8-30vdc. At 25-30v you will get nearly 2 watts! £12 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. £15 Ref 1013.

**MOSQUITO REPELLER KIT** Modern way to keep midges at bay! Runs for about a month on one 1.5v battery. £7 Ref 1015.

**3 CHANNEL SOUND TO LIGHT KIT** Wireless system, mains operated, separate sensitivity adjustment for each channel, 1.200 w power handling, microphone included. £14 Ref 1014.

**MOTORBIKE/CYCLE TREMBLER ALARM KIT** Adjustable sensitivity, preset alarm time, auto reset. Could be connected to horn etc. £12 Ref 1011.

**0-5 MINUTE TIMER KIT** adjustable, will switch up to 2A mains. Perfect for alarms, photography, etc. £7 Ref 1020.

**4 WATT FM TRANSMITTER KIT** Small but powerful FM transmitter, 3 RF stages, microphone and audio preamp included. £20 Ref 1028.

**STROBE LIGHT KIT** Adjustable from 1-60 hz (a lot faster than conventional strobes). Mains operated. £16 Ref 1037.

**ULTRASONIC RADAR KIT** Ideal as a movement detector with a range of about 10 metres, automate your cat flap! 12v dc. £15 Ref 1049.

**LIQUID LEVEL DETECTOR KIT** Useful for tanks, ponds, baths, rain alarm, leak detector etc. Will switch 2A mains. £5 Ref 1081.

**COMBINATION LOCK KIT** 9 key, programmable, complete with keypad, will switch 2A mains, 9v dc operation. £10 Ref 1114.

**PHONE BUG DETECTOR KIT** This device will warn you if somebody is eavesdropping on your line. £6 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! £8 Ref 1135.

**FUNCTION GENERATOR KIT** Produces sinusoidal, saw tooth and square waves from 20-20kHz, separate level controls for each shape. Will produce all 3 together. 24vac £16 Ref 1008.

**3 CHANNEL LIGHT CHASER KIT** 800 watts per channel, speed and direction control supplied with 12 LEDs (you can fit triacs 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.

**VOX SWITCH KIT** Sound activated switch ideal for making bugging tape recorders etc, adjustable sensitivity. £8 Ref 1073.

**INCAR SOUND TO LIGHT KIT** Put some atmosphere in your car with this mini 3 channel sound to light. Each channel has 6 LEDs. £10 Ref 1086.

**7W HI FI AMPLIFIER KIT** Useful, powerful, ideal for audio systems, Intercoms etc. 12-18vdc £7 Ref 1025.



Check out our  
WEB SITE

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

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

**METAL DETECTOR KIT** Range 15-20cm, complete with case, 9vdc. £8 Ref 1022.

**SINGLE CHANNEL SOUND TO LIGHT KIT** Mains operated, add rhythm to your party for just £8 Ref 1006.

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

**GUITAR PREAMP KIT** Complete with tone controls, small enough to fit in any guitar, based on TL082 IC, 9-12vdc £8 Ref 1091.

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

**TELEPHONE AMPLIFIER KIT** Very sensitive amplifier which uses a pickup coil (supplied) will let you follow a conversation with out holding the 'phone. £11 Ref 1059.

**HUMIDITY METER KIT** Builds into a precision LCD humidity

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

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

MAIL ORDER TERMS: CASH, PO OR CHEQUE

WITH ORDER PLUS £3 P&P PLUS VAT.

PLEASE ALLOW 7-10 DAYS FOR DELIVERY PHONE ORDERS

WELCOME (ACCESS, VISA, SWITCH, AMERICAN EXPRESS)

TEL: 01273 203500

FAX 01273 323077

E-mail [bull@pavilion.co.uk](mailto:bull@pavilion.co.uk)

meter, 9 ic design, pcb, led display and all components included. £49

**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

**DIVING RODS** Expensive technology cannot challenge the fool proof art of water diving, passed down from generation to generation. Seeing is believing. Use in the home, garden, countryside or desert. It's divinely simple! £4.99 a pair Ref E/3.

**HUGE BUBBLE MAKING KIT** You'll be amazed at the size of the bubbles you can achieve with this bubble making kit. Once you have got the knack it is possible to make bubbles of up to 40 feet long. £11.99 Ref E/9.

**FM CORDLESS MICROPHONE** This unit is an FM broadcasting station in miniature, 3 transistor transmitter with electret condenser mic + fet amp design result in maximum sensitivity and broad frequency response. 90-105mhz, 50-1500hz, 500 foot range in open country! PP3 battery required. £15.00 Ref 15P42A.

**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 GI/R20

**STETHOSCOPES** A fully functioning stethoscope for all those intricate projects. Enables you to listen to motors, pipes, heartbeats, walls, insects etc. £6 Ref MAR6P6.

**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. £39.99 Ref NIK39.

**SHOP WOBBLERS!** Small assemblies designed to take D size batteries and 'wobble' signs about in shops! £3.99 Ref SEP4P2.

**OMRON ELECTRONIC INTERVAL TIMERS.**

\*\*\*\*\*NEW LOW PRICES TO CLEAR!!!\*\*\*\*\*

Miniature adjustable timers, 4 pole c/o output 3A 240v,

HY1230S, 12VDC adjustable from 0-30 secs. £4.99

HY1210M, 12VDC adjustable from 0-10 mins. £4.99

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

HY2460M, 24vAC adjustable from 0-60 mins. £2.99

HY243H, 24vAC adjustable from 0-3 hours. £2.99

HY2401S, 240v adjustable from 0-1 secs. £4.99

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

HY24060M, 240v adjustable from 0-60 mins. £6.99

**DRINKING BIRD** Remember these? hook onto wine glass (supplied) and they drink, standup, drink, standup etc! £4 each Ref EF1

**SOLAR POWER LAB SPECIAL** You get TWO 6"x6" 6v 130mA solar cells, 4 LEDs, wire, buzzer, switch plus 1 relay or motor. Superb value kit just £5.99 REF: MAG6P8

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

**PLUG IN ACORN PSU** 19v AC 14w. £2.99 Ref MAG3P10.

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

**9v DC POWER SUPPLY** Standard plug in type 150ma 9v DC with lead and DC power plug, price for two is £2.99 Ref AUG3P4.

**13.8V 1.9A** psu cased with leads. Just £9.99 Ref MAG10P3

**INFRA RED REMOTE CONTROLLERS** Originally made for hi spec satellite equipment but perfect for all sorts of remote control projects. Our clearance price is just £2 REF: MAG2

**MAINS CABLE** Precut black 2 core 2 metre lengths ideal for repairs, projects etc. 50 metres for £1.99 Ref AUG2P7.

**COMPOSITE VIDEO KIT.** Converts composite video into separate H sync, V sync, and video. 12v DC. £8.00 REF: MAG8P2.

**UNIVERSAL PC POWER SUPPLY** complete with flyleads, switch, fan etc. 200w at £20 REF: MAG20P3 (265x155x125mm).

**GYROSCOPE** About 3" high and an excellent educational toy for all ages! Price with instruction booklet £6 Ref EF15.

**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 FLYTRAP KIT** Grow your own carnivorous plant with this simple kit £3 Ref EF34.

**TWEETERS** 2" diameter good quality tweeter 140R (ok with the above speaker) 2 for £2 REF: MAG2P5 or 4 for £3 REF: MAG3P4

**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 (deal for experimenters! 30m 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. £44.95 Ref MAG45.

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

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

**FLYING PARROTS** Easily assembled kit that builds a parrot that actually flaps its wings and flies! 50 mm cage £6 Ref EF2.

**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! £7.99 Ref R/9.

**BALLON MANUFACTURING KIT** British made, small blob blows into a large, longlasting balloon, hours of fun! £3.99 Ref GI/E99R

WE BUY SURPLUS STOCK FOR CASH

FREE CATALOGUE

100 PAGE CATALOGUE NOW  
AVAILABLE, 45P STAMP OR FREE  
ON REQUEST WITH ORDER.

# The AP ELECTRONICS Route to Musical Happiness

## EXPERIMENT

With different interconnecting and loudspeaker cables  
With Soniclink custom designed mains cables  
By changing resistors and capacitors  
With larger power supplies  
By applying simple modifications to improve your circuits  
By bypassing high value capacitors with higher quality lower values  
Purchased from the AP ELECTRONICS CATALOGUE

## LEARN

From your experiments  
The features which give the best sound quality.  
From knowledge gained through reading AP PERFORMANCE AUDIO

## MODIFY

Use the knowledge gained from experimentation  
And from tips published in AP PERFORMANCE AUDIO  
To rebuild your own amplifiers  
To improve the sound quality of your system  
To get greater enjoyment from your favourite music.

## BUILD

Build your own hifi equipment  
From the excellent range of AP ELECTRONICS kits

## DESIGN

Design the equipment of your dreams  
Make your dream come true  
With kits & parts purchased from the AP ELECTRONICS Catalogue

**AP ELECTRONIC, 15 Derwent Business Centre, Clarke St, Derby DE1 2BU**  
**Tel: +44-1332-674929 Fax: +44-1332-298836**

----- cut out -----

**TO: AP ELECTRONICS, 15 Derwent Business Centre, Clarke St, Derby DE1 2BU**

Please send me

**AP ELECTRONICS CATALOGUE** (UK/EC £4.95, Export £6.95) .....

**AP PERFORMANCE AUDIO 1966** (Min 3 issues) (UK/EC £5, Export £10) .....

I enclose cheque/P.O. .... payable to "AUDIOKITS" or please debit

My Credit Card ..... Exp ...../.....

FULL NAME .....SIGNATURE.....

ADDRESS .....

POST CODE & COUNTRY .....

# Digital Hard Drives



*Nick Hampshire takes a look at how new technologies being developed by IBM are rapidly expanding data storage capacities*

**E**veryone who owns and uses a PC will be familiar with the fact that data and programmes are primarily stored on magnetic disk. There are two basic types of magnetic disk data storage systems; the so-called floppy or removable disk and the fixed or hard disk. Both basically function in the same way, but the fixed disk has much larger capacity.

Floppy disks usually have data capacities ranging from a few hundred kilobytes to a couple of megabytes. The average hard disk on a brand new PC will, on the other hand, probably now have a capacity of about 540Megabytes. In this article, we will be concentrating on hard disks; however, the basic recording technology is the same for both types of drive.

The hard disk drive was first developed by IBM in 1956 and was known as the RAMAC (or Random Access Method of Accounting and Control). This massive floor-standing drive unit contained no less than 50 disks, each 24 inches in diameter and capable of storing 100Kbytes of data, thus giving RAMAC what was, at the time, the enormous total storage capacity of 5Mbytes.

Hard disk drive technology continued to develop at a steady rate until the late 1970s when another IBM development, the Winchester drive, was used with early microprocessor-based computer systems to create the forerunners of today's personal computers. Since then, PC hard disk capacity has steadily grown from 10Mb to 20Mb, 100Mb, and now 500Mb plus is commonplace.

Today, every PC sold, whether a portable or a desktop, will

have an inbuilt hard drive, creating a global demand for well over 100million such drives per annum. The mass production of such drives, coupled with the relentless application of technology, has meant that the unit price of a drive has remained virtually unchanged despite an enormous increase in average drive capacity.

This means that if we look at a graph of hard disk storage capacity over time we can see that between 1956 and 1990 the maximum drive capacity was increasing at about 30% per annum but, in 1991, this suddenly increased to an annual rate of over 60% per annum. Today, companies like IBM are already producing 3.5 inch disk drives, the same physical size as those used in the average PC but, with a capacity of 10Gigabytes, at this rate you could have a 100Gigabyte drive in your PC by the year 2000 at no more cost than a current generation 1Gigabyte drive.

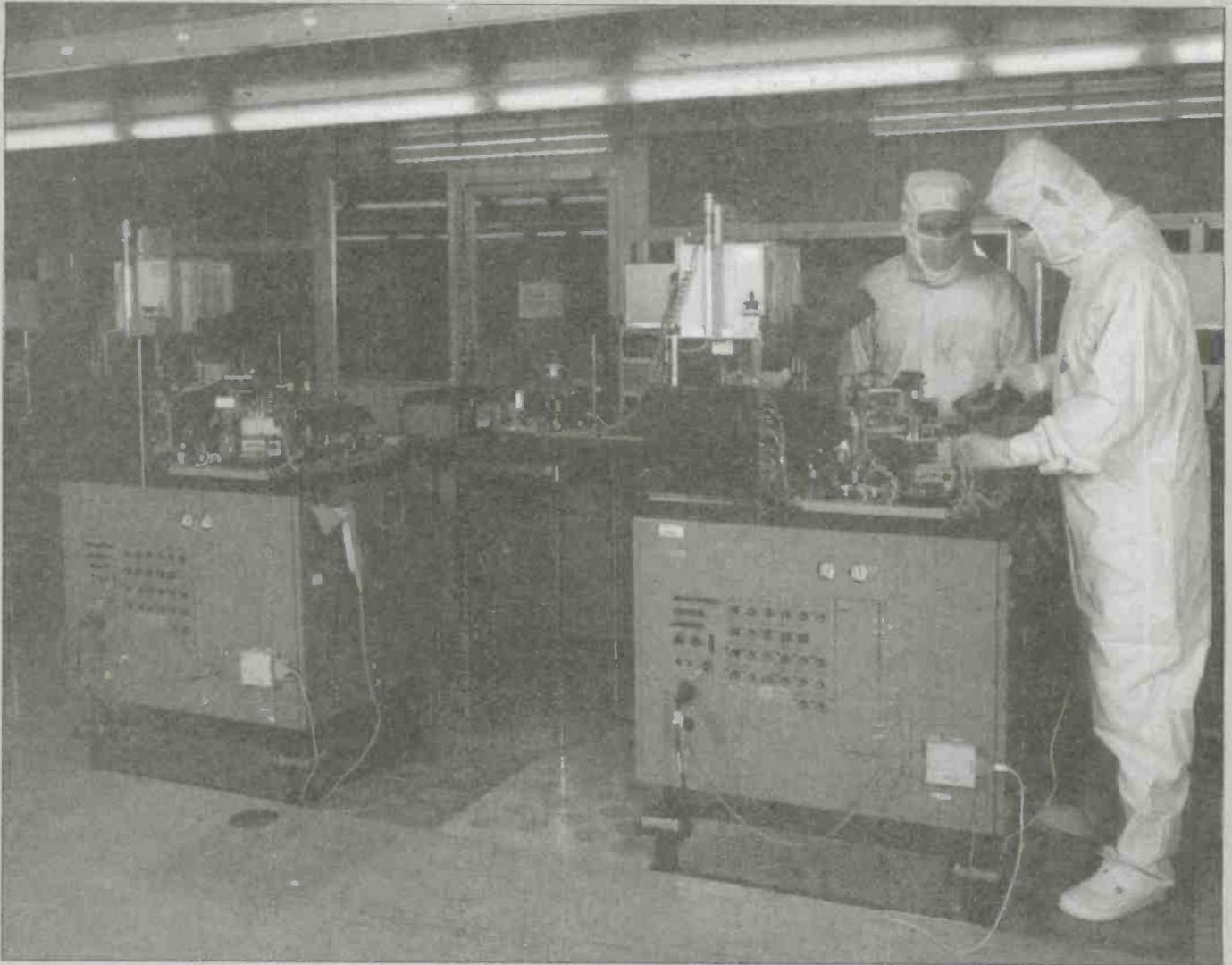
If you are wondering how much data storage that actually is, then just think that you can store one hour of full motion video in about 850Mbytes, so that is enough storage for over 117 hours of your favourite films. Furthermore, the technology will not stop there; already under development are techniques which will push the increase in drive storage capacities forward at this rate until well into the next century. In the rest of this article, we will take a look at some of these technologies.

### **The basics of hard drive operation**

To understand some of the problems involved in designing and building very high capacity disk drives, it is essential to begin

IBM disk drive manufacture in an A100 clean room





**Automated testing of IBM disk drives**

with a look at the basic physics employed in every magnetic disk drive. All drives consist of a rapidly rotating disk coated with a magnetically sensitive coating, such as a very thin film of finely powdered iron oxide.

Writing data on the disk involves the use of an electromagnet mounted on a moveable arm that can track back and forth across the surface of the disk in a radial direction. This electromagnet is then used to generate a magnetic field on a very small area of the disk. This field will align the magnetically sensitive particles in the coating in a particular direction, a direction which can be reversed by altering the direction of current flow in the electromagnet. The magnetic domain will remain set in a particular direction until altered by another write operation.

The data can be read from the disk by simply reversing the process. When the small magnetic domains on the disk coating pass under the coils of the electromagnet they will generate a very small current, the direction of which depends on the polarity of the domain.

This process is fundamentally the same as that employed to record music on a common magnetic tape, but with one major difference; the bits recorded on a disk are small spots where the magnetic field has totally saturated the area. In other words, it is either off or on. But on a tape, the level of saturation varies with the wave form being recorded, thus allowing it to store a variable analogue level rather than small dots. This technique is not used on disk drives because small dots are easier to precisely read

and write at very high speed.

Having said this, all the early disk drives used basically the same type of analogue electronics as a tape recorder, with the exception of driving the record head in a way which totally saturated the coating. Such drives are usually referred to as analogue disk drives.

However, in order to increase the amount of data stored on a disk, without actually increasing the disk size or the number of disks in a drive, it is necessary to decrease the spot size and thus pack more spots onto a given area. This is known as the areal density, and we have seen this figure increase by a factor of ten in the last five years to a current level of 0.86Gigabits per square inch of disk surface and, by the year 2000, this figure should be in the region of 10Gigabits per square inch.

Greater areal densities mean smaller spots that are closer together, and to achieve this has meant reducing the head size and the distance between the head and the platter. This, in addition to increasing the sensitivity of the read head because smaller spots mean weaker induced fields. In order to increase areal density, research has thus concentrated in three areas - head miniaturisation, better disk coatings and improved read electronics.

The result has been the development of what is generically known as the digital disk drive.

### **Reliably storing data on disk**

If there is one thing a magnetic disk drive must do, it is to store



both used to store data bits with a logic '1' value, the areas with no defined polarity store the logic '0' bits. This technique has two virtues; it permits higher data density, but most importantly it allows the disk to be self-timing. This is possible because two successive logic '1' bits will be stored as two successive domains of opposite polarity (though, in practice, special RLL coding ensures that every '1' is separated by at least one '0' and up to seven '0's). This self timing allows servo-control techniques to ensure that variations in disk spin speed will not cause any slewing of the points on a track where the signal coming from the read head is sampled. It also allows the system to automatically compensate for the fact that the amount of track

data reliably over a long period and with repeated access. Nobody will want to use a drive which loses a percentage of the data stored on it. Nobody wants to try retrieving some important document that has been the result of hours of slaving away over a hot computer only to find that every few words there is a letter which has mysteriously changed.

What users demand from their disk drive is very high reliability over several years of continuous use. Given the enormous amount of data which is being stored on modern disk drives, ensuring this reliability is no easy task for the designers.

The data is stored on a disk drive as tiny magnetic domains located in a series of concentric tracks. Rotation of the disk allows every domain on a given track to pass under the head and, by moving the head across the radius of the disk, it is possible to position the track, and thus read/write data on every track on the disk.

The magnetic domains on each track are created by the electromagnet in the write head. When current flows through this electromagnet coil in one direction, the domain written on the disk's magnetic coating is aligned one way. By switching the direction of current flow in the coil, the domain that is written will have the opposite magnetic polarity.

This means that the magnetic coating on the disk can have three states; one with no defined magnetic polarity, and the other two with defined but opposite magnetic polarities. Intuitively, one would think that it was the two opposite magnetic polarity domains that are used to store logic 1, and 0 bits but, in practice, this is not the case.

In modern disk drives, the two opposite polarity domains are

occupied by a given domain on an outer track is much longer than that occupied by a similar domain on an inner track (this is because fast random access of data is very important on magnetic disk drives and this requires the use of what is referred to as constant angular velocity. This means the use of concentric tracks which, in a very simplified system, would each store the same number of bits, as opposed to the spiral constant linear velocity track found on a record or CD where the bit spacing along the track is always the same).

The system electronics connected to the read head is designed to sample each domain area twice as the disk rotates. The servo control mechanism which is part of that circuitry will adjust the sampling rate to closely match the domain spacing on the track. This saves any complex control of drive motor speed and rotational position, and also ensures that the sampling electronics can accurately detect the peak of any magnetic domain and thus count the bits along the track.





## Encoding data

As areal densities increase, the size of individual magnetic domains has to decrease. This means weaker induced fields in the read head and the probability that domains can start to overlap one another. The result can be a certain ambiguity as to whether the data stored at a particular point is a logical zero or a logical one. This increasing level of 'noise' within the data is one of the major problems facing magnetic disk drive designers as they attempt to put more and more data onto a disk.

The earliest techniques revolved around the use of error correction codes, or ECCs, such as the very widely used Reed Solomon code. The function of these codes was to help the hardware to reconstruct the original data where any errors resulting from 'noise' had occurred.

On later generations of drive, this technique was improved by use of a further level of coding referred to as Run Length Limited, or RLL, coding. This is, as we have already seen, used to ensure that not too many '1's or '0's fall in succession. To do this, extra bits are added where necessary, in accordance with the coding formulae of the specific RLL method being used. It is a technique which greatly increases reliability, particularly with respect to the elimination of clock drift, but it does have the drawback that it can increase the amount of data stored on a disk by up to 50%.

The read electronics attempt to sample each domain twice (the minimum practical sampling rate). These samples are then used by so-called 'peak detection' circuits to determine whether the resultant bit is a logical '1' or '0'. However, as one puts the domains closer and closer together, there is the additional problem of domains overlapping and thus trying to get the electronics to determine exactly which peak a particular sample

belongs to. As can be seen from the accompanying diagram (Fig.1.), the wave form coming from the read head is no longer smooth, but disjointed.

The solution to this problem lay in a computational technique which was first developed by mathematicians working for NASA in order to clean up very weak signals coming from interplanetary spacecraft. It is a technique known as Partial Response Maximum Likelihood, or PRML, it has revolutionised disk drive technology and made possible the multigigabyte drives of today - and the even higher capacity drives of the coming decade.

## PRML and the digital drive

In PRML systems the data from the read channel is output as a sequence of 6-bit digital values which corresponds to the sampling voltages. This sequence of digital values is then fed into a special purpose processor chip which applies the PRML algorithm and outputs the data to the drive's data channel. This use of digital electronics is the reason why such drives are referred to as 'digital disk drives' as opposed to the older technology 'analogue disk drives'.

Simply, the PRML algorithm is designed to look at a sequence of samples and then determine whether each pair of samples belongs to the same peak or to two separate peaks. This in itself is not that revolutionary; what is, is the fact that the algorithms can adjust themselves when errors occur, a very important feature because noise will often add false peaks as a result of skewing the samples.

To more closely understand how PRML works, look at Fig.2. This shows the rather noisy sequence of samples obtained from the read wave form shown in Fig.1. In this system, normal

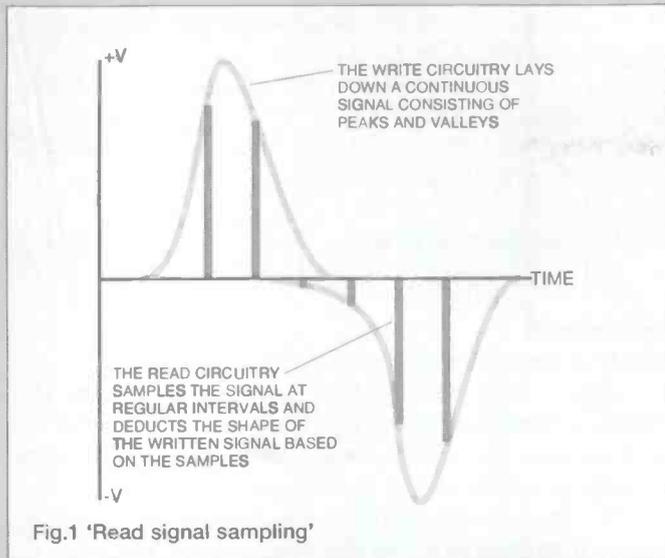


Fig.1 'Read signal sampling'

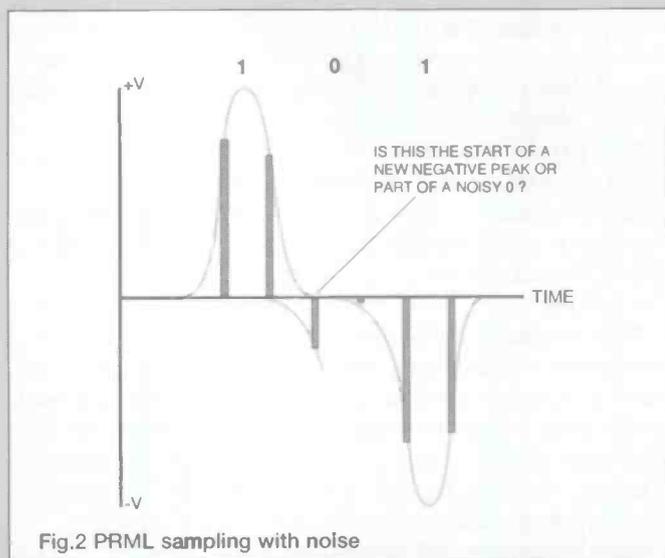


Fig.2 PRML sampling with noise

detectable peak values for a logical '1' would be either +3.5volts or -3.5volts with a permissible error of about 0.5 volts. Whilst a logical '0' would be 0volts again with a permissible error of 0.5volt.

The samples shown in this diagram actually represents a '101' bit pattern but, as can be seen, the third sample has rather an ambiguous value of -1.5volts, more than '0' but less than '1'. The question is: is this sample the beginning of a new negative peak which has been attenuated? Or is it a noisy sample caused by overlapping peaks? In other words, is the bit pattern '101' or '1101'? (of course, the system would reject this interpretation because the peaks will always alternate between positive and negative, but this would still not ensure that the correct bit sequence could be determined).

Whereas the analogue peak detection system simply matched voltages to thresholds in order to determine the presence or absence of peaks, PRML will not determine whether a given sample is a peak until it has received perhaps five or six subsequent samples. Only then will it compute the peaks by means of a method involving calculating the partial errors which occur with the interpretation of each sample as well as those preceding and following it.

The addition of very high-speed PRML processing electronics into modern disk drives has thus enabled areal density to be increased enormously and should, given improvements in both processing hardware and PRML software, allow continued increases

in density at 60% per annum for at least another ten years.

However, this is not the only advantage of using PRML. The fact that the software can be made to be self-adaptive means that it can be individually tuned to optimise the behaviour of each drive. This overcomes the slight variations between units that are inevitably introduced during manufacturing. This factor should help minimise failure rates, much to the users' delight, and manufacturing reject rates which should not only please manufacturers but also help keep drive prices down.

### The year 2000 and technology limitations

Researchers at companies like IBM are confident that they can continue increasing areal densities on magnetic disk drives using current technology until about the year 2000. By then we should see densities of up to 10Gigabits per square inch and maximum 3.5inch format disk drive capacities of around 100Gigabytes.

However, as the heads get smaller to match the smaller magnetic dot size, the read back signal also decreases. As it gets smaller, it eventually reaches a level where the amount of noise in relation to the signal makes it impossible to accurately extract the data. With conventional MR head technology, engineers expect to reach this point in about four years' time.

The acceleration in development of technology means that there is less and less time to develop new technologies if the momentum is to be continued. It is not surprising therefore that IBM, who are probably the world's technology leaders in hard disk drives, have already designed a new head which overcomes these problems and will allow continued development until about 2005.

The new head technology developed at IBM's huge Almaden Research Centre in San Jose, California, is known as the Giant MR, or Spin Valve Head. This head is based upon very advanced physics and is at least five times more sensitive than the MR head, thus allowing a further considerable decrease in both head dimensions and magnetic dot size.

The Giant MR head should, according to current research, enable engineers to produce drives with areal densities of between 20 and 30Gigabits per square inch, which will equate with 3.5inch format drives having a capacity of about 1000Gigabytes. Not surprisingly there is an enormous R&D effort currently being expended by the major disk drive producers to achieve this target.

This research is also looking at improving the PRML techniques, the read electronics and the magnetic coating on the disks. Already, as far as the disks are concerned, designers are moving away from aluminium disks to glass disks which - surprisingly - are more robust and permit a much smoother and thinner magnetic coating.

However, as we approach about 2005/6, disk drive designers will, assuming a continued 60% annual increase in areal density between now and then, reach a physical limit to any further increase. This limit is known as the super paramagnetic limit and is reached when the bit size equals the smallest magnetic domain in any known material. This means that magnetic disk drives will not be able to have areal densities above about 80Gigabits per square inch.

Of course, in order to produce magnetic disk drives with areal densities as high as 30Gigabits per square inch will require - in addition to further development of existing technologies - the creation of a lot of new technologies, such as new types of spindle motor and head actuators.

As the distance between tracks, and the individual bits on a track, becomes smaller, so conventional motors and actuators will prove unable to deliver the very smooth and fine movements necessary. The solution lies in an entirely new technology known as micro-mechanics. A technology which uses semiconductor

manufacturing techniques to construct mechanical devices - indeed whole machines which are truly microscopic in size.

Micro-mechanical components for the disk drives of the future are already being developed by IBM and others. Probably the first application will be the use of an actuator mounted on the head arm which will finely adjust the position of the head and thus allow it to be very accurately positioned over very narrow tracks on the disk.

The ultimate goal is to use micro-mechanics for virtually all the mechanical components of a disk drive, including drive motor, head actuator and even the disk itself. The aim is the production of ultra-miniature drives, with very high capacity, which are little bigger than a conventional IC package.

Indeed, IBM are already some way down the line in developing such drives and, at the recent Comdex show in Las Vegas, they unveiled a prototype one inch disk drive that made extensive use of micro-mechanics. Within a few years, such drives, capable of storing at least several hundred Megabytes of data, will be commercially available. It is envisaged that they will be used in devices such as digital cameras, personal digital assistants, Internet connectable mobile phones, etc.

### Beyond the magnetic disk.

The super-paramagnetic limit may impose an upper boundary on the areal density, and thus the total storage capacity, of magnetic disk drives, but there are plenty of other data storage technologies waiting in the wings. Contenders are multi-layer optical disks, 3-D holographic memories and, right at the very top, the ability of the atomic force microscope to store data by moving individual atoms.

The AFM is probably a very long way off from any practical implementation, but we could well see multi-layer optical disks and holographic memories in use commercially within the next couple of years.

Already we are familiar with CD-ROMs; these hold about 640Megabytes of data but, by stacking two or more layers of data containing tracks one above the other and then reading them using an optical system which can focus on one layer at a time, it is possible to greatly increase the storage capacity of such disks. It is also possible to decrease the spot size, and thus increase the amount of data stored on a disk, if we can also decrease the wavelength of the light beam used to read the data. Hence the quest for a blue, or ultra-violet, semi-conductor laser.

IBM have demonstrated a blue semiconductor laser based around a frequency doubler crystal and have also recently demonstrated a multi-layer disk. These two technologies should make it possible to store tens of Gigabytes of data on a CD-ROM type disk by the end of the century. These are technologies which are applicable to both read only and read/write type disks.

However, there is a practical limit to the number of layers and also a limit on dot size imposed by the wavelength of light. This means that, as with magnetic disks, there is an upper limit to the data storage capacity of optical disks which employ conventional storage techniques. But this limit can be overcome by taking a fundamentally different approach; the use of holography.

Holographic data storage devices, whether based on a rotating disk or an optically scanned block should, in theory, be capable of storing hundreds of gigabytes of data, and what is even more important randomly accessing and retrieving that data at rates of Gigabits per second.

At the moment, holographic memories only exist as experimental systems and there are still problems with finding a reliable storage medium which is stable enough to keep the data for a long time, not to mention the development of a sensitive enough read detector. However, a couple of small California start-

up companies are expected to launch holographic memories within the next year. These are 3-D holographic disks based around a 100 micron thick polymer film and capable of storing data at a density ten times that of a CD. One of them is even working on a trillion bit storage device - that's 200 times the data stored on a conventional CD-ROM.

All photos courtesy of IBM

### MR heads

The MR or magneto resistive head was one of the key technologies behind the introduction in the early 1990s of the first 1Gigabyte 3.5inch hard disk drive. It has enabled designers to greatly increase areal densities while at the same time substantially reducing the number of head and disk components.

Higher areal densities and fewer components have made it possible to produce very small disk drives for use in portables (these are usually 2.5inch format drives). This is because fewer components mean that the drive needs less power to operate and, of course, can be made much smaller. These factors have brought about an explosion in demand for both portable systems and high capacity desktop systems.

The MR head was developed by IBM at their Almaden Research Centre in San Jose, California, and first used in a commercial product in 1991. Such heads are now used in all very high capacity drives and IBM are currently producing over 100 million MR heads per annum all of which go into IBM manufactured drives.

The individual head measures no more than a few square millimetres and is less than a millimetre thick. It is mounted at the end of a thin and very flexible actuator arm which moves the head radially across the surface of the rotating disk. The flat area of the head is very carefully machined with special grooves to create an air bearing which ensures that the head floats at just 2 or 3 micro inches above the surface of the disk (this is very close and equivalent to between 200 and 300 atomic spacings).

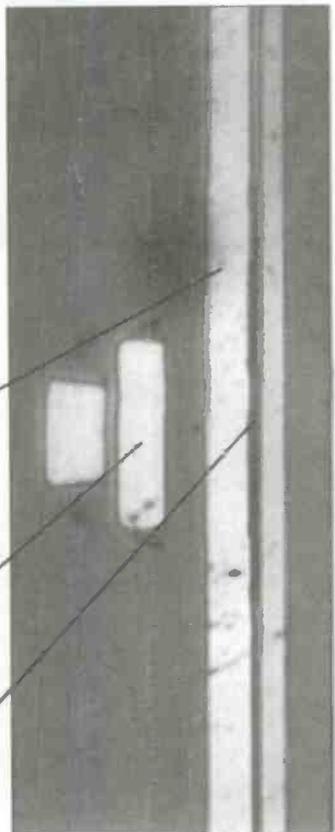
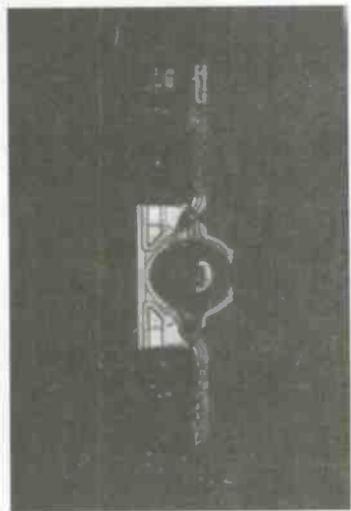
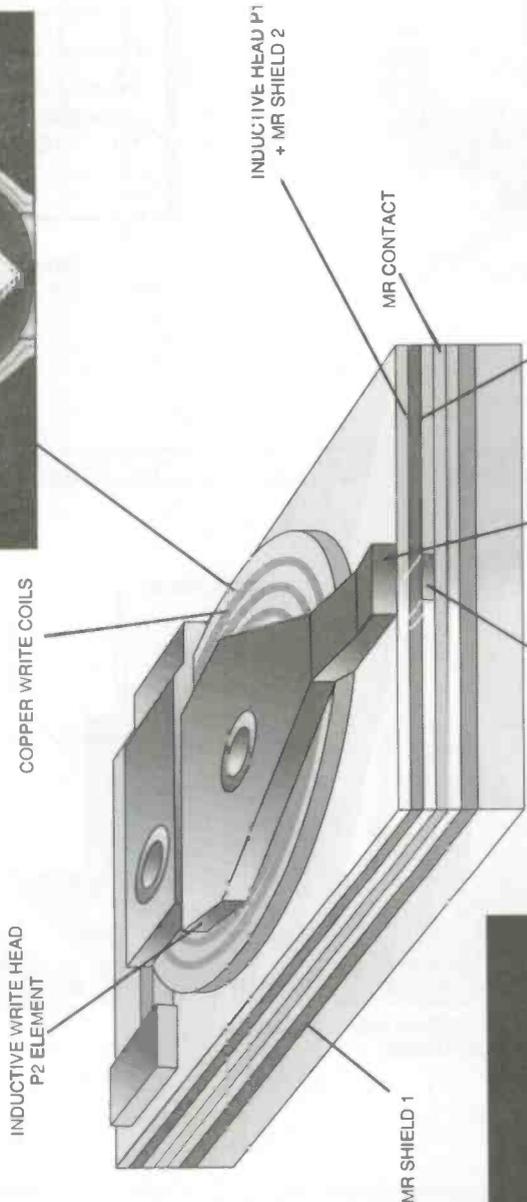
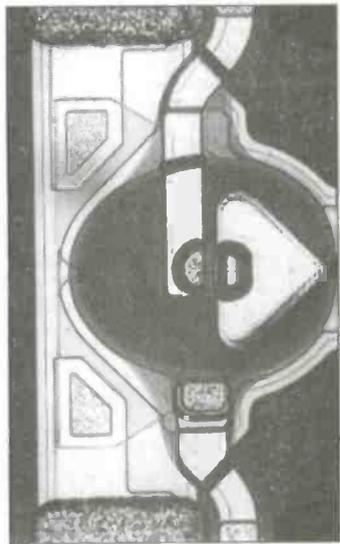
The actual read/write heads are fabricated using thin film technology on the vertical face at one end of the head (see the photomicrograph on this page). The MR head's basic design consists of a separate read and write element which are formed over each other and sharing common material layers. The write element is a thin film inductive head. The read element is a thin alloy film, usually NiFe, which exhibits a change in resistance in the presence of a magnetic field, the MR effect.

This optimised design not only has the smaller geometry required for high areal density disks but it is also much easier to build than conventional inductive heads that must perform both read and write functions. This is because the design requires fewer copper coils, material layers, photolithographic masking operations, and head tolerance controls. The result is higher processing yields, greater reliability and reduced cost.

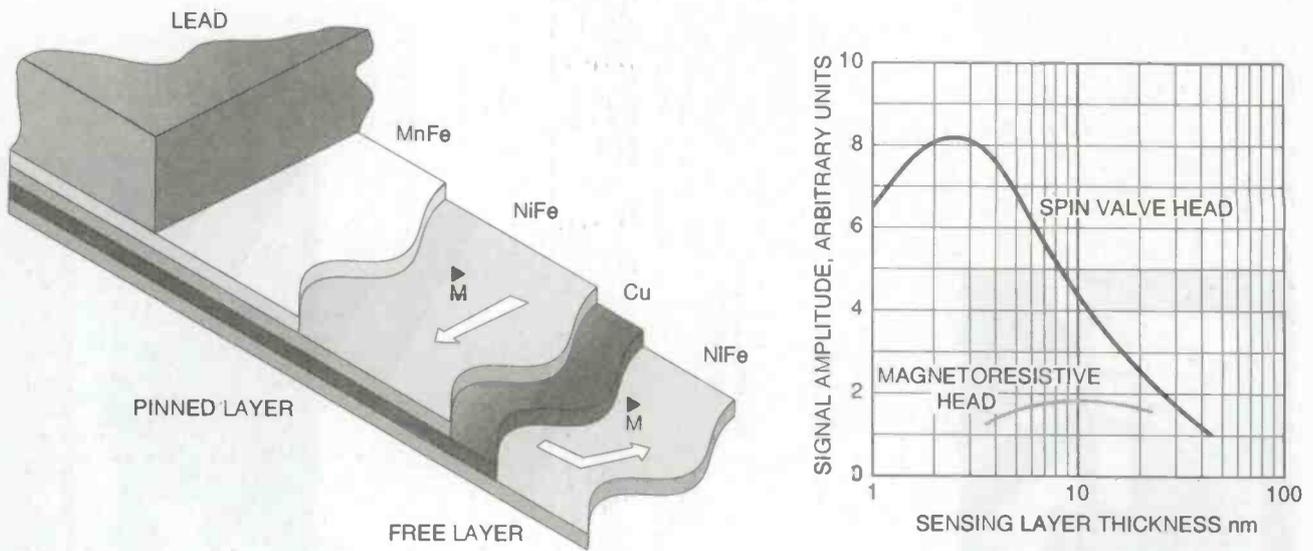
Note that the shielding layers are used to protect the MR element from other magnetic fields. The second shield also functions as one pole of the inductive read head, thus giving rise to the term 'merged MR head'.

The main diagram (fig.3) accompanying this text box is an idealised 3-D representation of a merged MR head. The bulk of the head with its air bearing grooves is not shown; what the diagram represents is the end of the head with the thin film read and write structures. The 3-D view is looking at the head from the plane of the rotating disk.

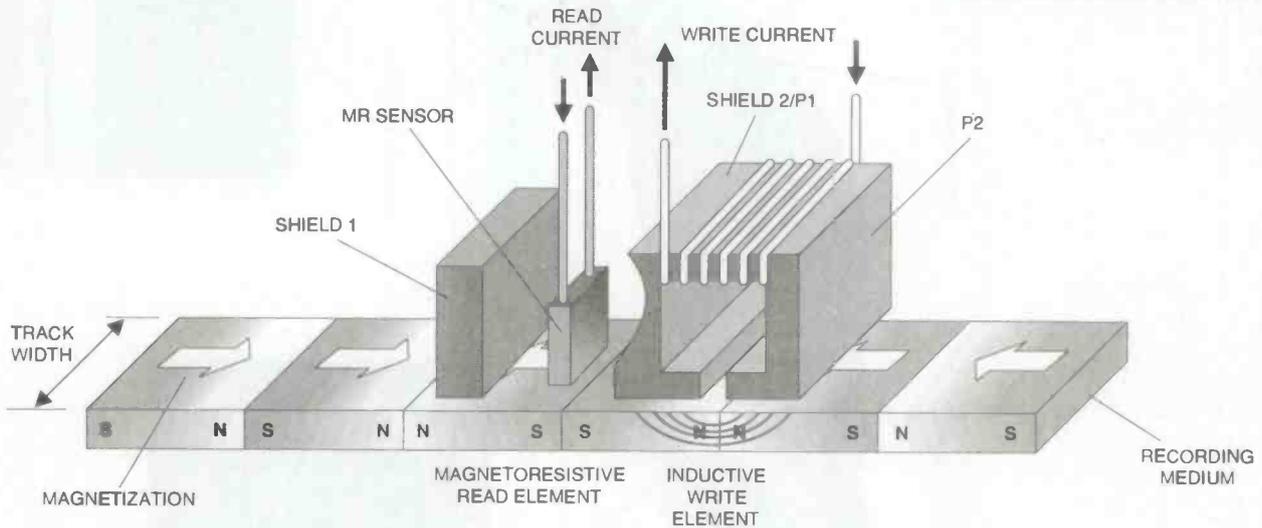
The way that this head works is shown in the diagram above (fig.5). It shows the inductive element writing bits of



(fig.3)



(fig.4)



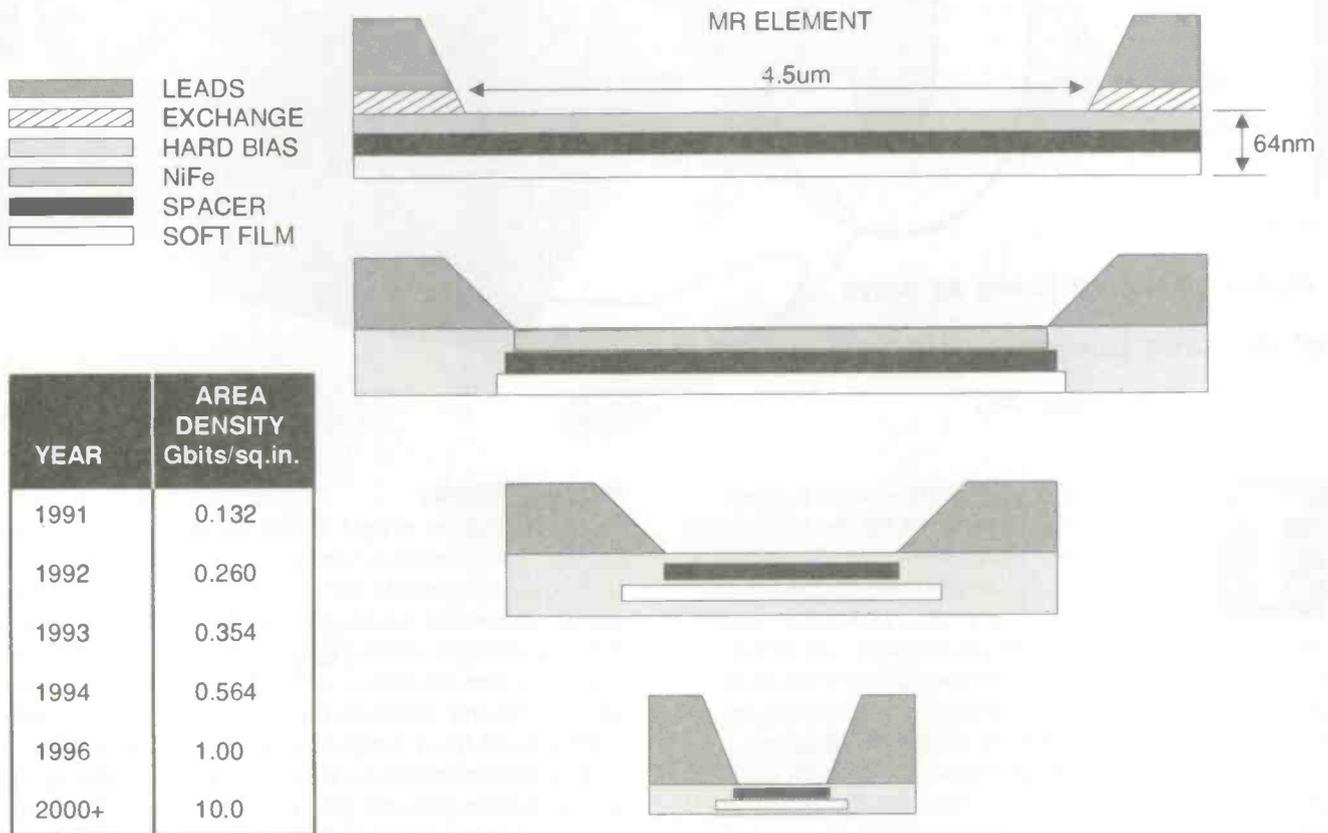
(fig.5)

information as magnetically biased regions within radially concentric areas, or tracks, that are subsequently read by the MR sensor. The presence of a magnetic transition, or flux reversal, between bits causes the magnetisation in the MR sensor to rotate. This rotation can be detected directly as a resistance change by a precision amplifier, which then produces a stronger signal that relays the information to the disk drive's electronics channel.

As areal densities approach 1Gigabit read head noise starts to become a problem. In the current top range drives produced by IBM, the MR element is a strip of Nickel Ferrite just 300Angstroms thick. The problem with making such a head is how to stabilise the magnetic domains so as to

produce a clean, noise-free read back signal.

What IBM have done, in a patented technique, is produce what is known as a 'soft adjacent layer', or SAL, biased MR sensor structure. What this means is that by passing electricity through the MR sensor they can create a magnetic field that interacts with the magnetisation of the underlying soft film. This transverse biasing ensures that the magnetic rotation of the MR film occurs at an optimum angle with respect to the sense current, producing the preferred linear-responsive MR signal. To maintain the MR sensor's stability and to suppress magnetic domain noise, a longitudinal bias is also applied by an additional structure, the exchange-bias, or hard-bias, layer.



(fig.6) Reduction in MR head size

By scaling down MR heads (fig.6), it should be possible to increase areal densities to about 10Gigabits per square inch. This will be achieved by using progressively thinner magnetic films together with narrower MR elements. However, around the year 2000, designers expect to reach a limit to further reduction in size and thus a limit to further increase in areal densities.

The year 2000 is less than 2000 days away; little enough time to develop a new technology, so it is hardly surprising that IBM have already developed their technology which will succeed MR and allow them to push towards the ultimate boundary in magnetic disk technology, the so-called super paramagnetic limit. This is dictated by the physics of magnetic recording and lies at an areal density of just over 100Gigabits per square inch. A limit which developers expect to reach in about 2010.

The IBM technology designed to succeed MR is known as a 'Giant MR' or 'spin valve head' (fig.4), where spin valve refers to the direction of electron spin. In this type of head, the MR stripe is replaced with a multi-layer structure which form two MR stripes, a cobalt layer whose magnetic domains are firmly pinned in one direction by the bias film, a very thin copper spacer, and a

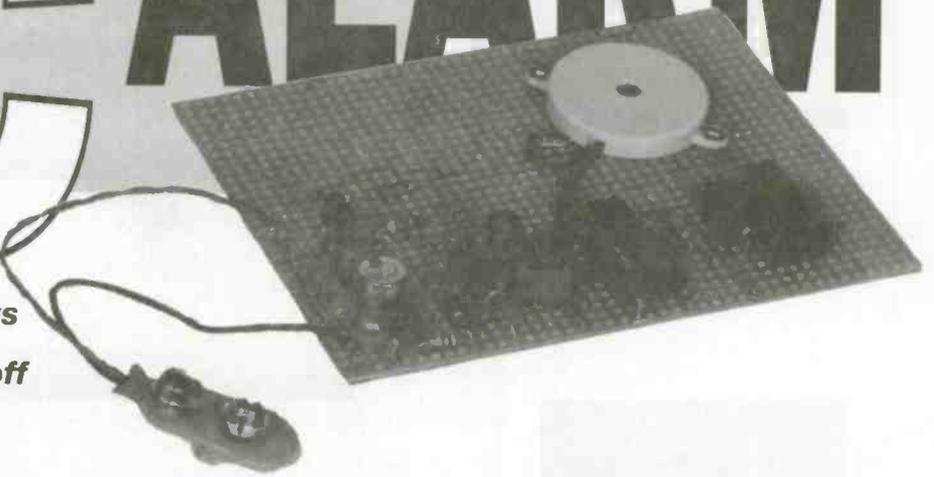
second MR layer made from nickel ferrite whose magnetic domains are free to rotate one way or the other as the transitions pass under the head.

If the magnetic domains in the pinned layer are aligned in opposite directions to the free layer, the electrical resistance is high. If they are aligned in the same direction, it is much lower. Therefore, as the transitions pass under the head, the magnetic vector in the free layer rotates one way or the other, thus changing the resistance. Read back signals from the Giant MR head are some five times higher than current MR heads and thus able to cope with the very small magnetic domains found in high areal density disks.

The above short review of disk drive head technology shows how the creation of the head unit is a fusion of advanced physics, and some really leading edge manufacturing technologies. It is this fusion coupled with an ongoing enormous investment in research, development and manufacturing capabilities which will ensure that the data storage capacity of magnetic disks will continue to increase at a compound growth rate of 60% until at least the year 2010. After that, we are probably looking at the use of entirely new technologies such as bulk holographic memories.

# PC ALARM

**Robert Penfold looks at ways of stopping thieves making off with your PC**



**T**heft of all sorts seems to have been a growth industry in recent years, but the rise in computer thefts has been particularly steep. Sometimes a large number of computers are stripped of their memory modules and micro-processors in well planned raids. More usually though, complete computers are removed, together with any expensive peripherals such as laser printers and modems, in relatively quick, small-scale raids. Some disappear as a result of opportunist crime.

Any premises which contain expensive computer equipment should obviously have the usual security measures to make life difficult for would-be burglars. With larger electronic goods such as computers, it is possible to provide increased security by fitting them with their own built-in alarm. Thieves could still make off with the goods, but they would presumably be reluctant to carry off computers that were producing a loud alarm sound! A built-in alarm should certainly be sufficient to see off opportunist thefts.

The simple alarm featured here is intended for use with PCs and it simply plugs into any unused expansion slot. However, as the circuit is completely self-contained, and is not dependent on the PC for power, there should be no difficulty in adapting it to suit other computers and (possibly) other major items of computer equipment.

Under standby conditions, the alarm consumes no significant power, and it can therefore be powered from a PP3 size battery for the "shelf-life" of the battery. For modern high-quality batteries, this is usually a few years. If the PC is moved, the alarm is triggered by a "trembler" switch, which is a form of mercury switch. Once triggered, the alarm can only be switched off by opening up the computer and disconnecting the alarm circuit from the battery. The alarm sound is a piercing frequency modulated tone provided by a ceramic resonator.

## How It Works

The block diagram of Fig.1 shows the general make-up of the PC alarm. As pointed out previously, the trembler switch is a form of mercury switch. With a normal mercury switch there are two electrodes in a roughly half-filled reservoir of mercury. With the switch at some angles the mercury touches both electrodes and provides a contact between them. At other angles, only one electrode is touched by the mercury and there is no electrical connection between the electrodes.

A trembler switch is a variation on this arrangement. They vary somewhat from one type to another, but the general scheme of things is to have two intricately shaped electrodes at the centre of a slightly less than half-filled reservoir of mercury. If the switch is held still, the mercury will fail to touch both electrodes, regardless of the switch's orientation. However, the mercury only just fails to bridge the electrodes when the switch is stationary, and it only takes slight movement to send waves through the mercury that result in the switch closing momentarily.

Although this alarm will work properly using an ordinary mercury switch, a trembler switch is the more convenient in use. With an ordinary mercury switch it essential to mount the switch so that it is switched off, but only just. Then, hopefully, any movement will cause it to close at least momentarily. A trembler switch can be mounted with any orientation, and will give the desired effect.

The trembler switch drives a simple latch circuit. A momentary switching action from the trembler switch results in the latch being activated, and it then turns on an electronic switch. Even when the trembler switch returns to the "off" state, the electronic switch remains switched on. The electronic switch is used to activate a simple audio alarm generator circuit which provides a frequency modulated



Fig.1. The PC alarm block diagram



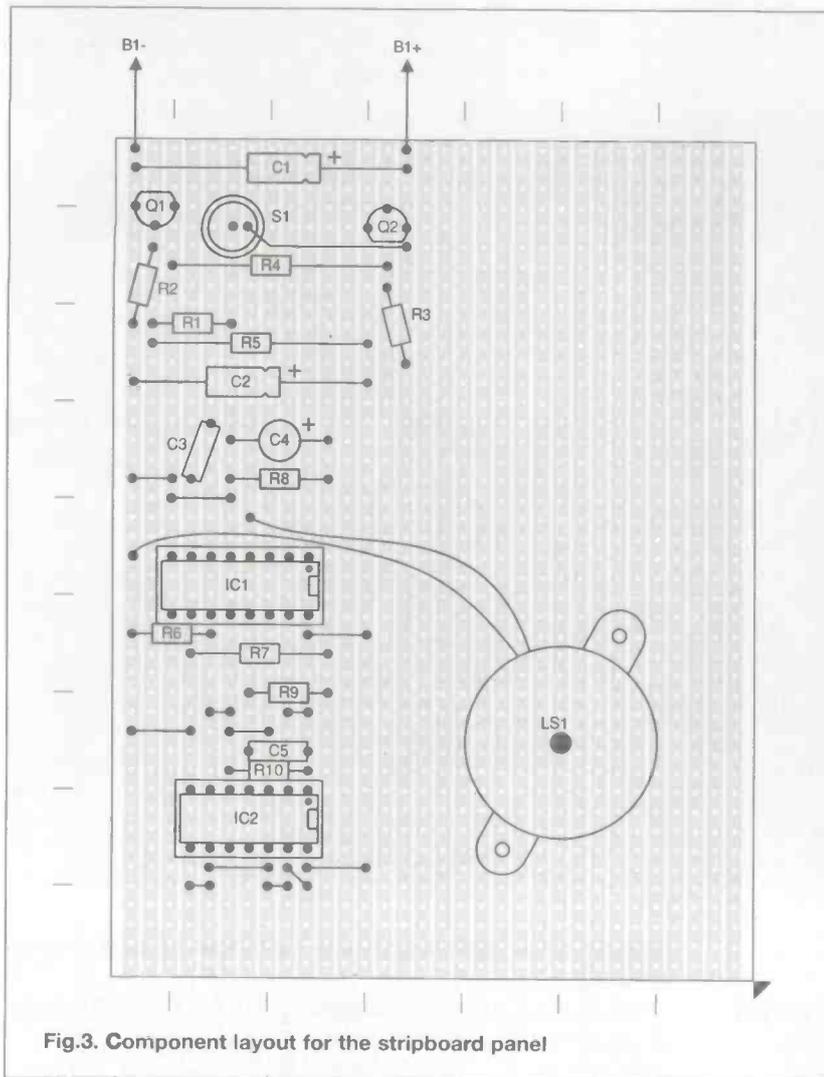


Fig.3. Component layout for the stripboard panel

switched off. R5 does provide a base current to TR1 when S1 is activated and TR2 switches on. R2 will hold TR1 in the "on" state even when S1 opens again and TR1 is no longer supplied with a base current via S1 and R1. Thus, TR1 and TR2 hold each other in the "on" state, and the required latching action is obtained.

There is a potential problem with this type of latch circuit in that it is extremely sensitive, and easily triggered by electrical noise. Inside the average computer there is likely to be quite a high level of electrical noise. The values of the resistors in the circuit, particularly R2 and R3, have been made quite low in value in order to keep the sensitivity of the latch quite low. This should avoid problems with spurious triggering each time the computer is switched on or a disk drive is accessed!

A CMOS 4046BE "micro-power" phase locked loop (IC1) is used as the basis of the alarm generator. In this case only the v.c.o. section of the 4046BE is utilized, and no connections are made to the other stages. C3 and R6 are the timing components, and the modulation signal is applied to the v.c.o.s control input at pin 9. LS1 is the ceramic resonator, which provides very high efficiency at the fairly high output frequency range of IC1 (around 1.5 to 4kHz).

The low frequency modulation signal is provided by a simple astable circuit based on two of the four 2 input NOR gates in IC2. C5 and R10 are the timing components, and they set the operating frequency at around three to four hertz. The other two gates of IC2 are unused, but their inputs are connected to the positive supply rail to prevent spurious

operations. The lowpass filtering is provided by R9 and C4. R8 attenuates the modulation signal slightly, and prevents an excessive amount of modulation. The modulation signal is coupled to IC1 via protection resistor R7.

The alarm generator should work quite well with the specified component values, but it is often worthwhile "tweaking" one or two circuit values in order to obtain optimum results from the particular ceramic resonator you are using. In this case it might be possible to obtain a higher sound level by altering the value of R6 so as the give an output frequency range that precisely matches the optimum response of the resonator.

The quiescent current consumption of the unit is negligible, since the only current flow is leakage through C1, TR1, and TR2. This should be less than one microamp. Only about 8 milliamps is consumed when the alarm is activated. A PP3 size battery is able to supply these modest needs. The battery life is equal to the battery's shelf life, and it might be worthwhile using one of the "high power" varieties which have very long shelf lives.

### Construction

The stripboard component layout for the PC alarm is shown in Fig.3. The board has 43 holes by 32 copper strips. This must be cut from one of the larger standard sizes in which the board is sold. Cut along rows of holes and then file the rough edges to a neat finish. Then make the 24 breaks in the copper strips, as detailed in the underside view of the board (Fig.4). The breaks can be made using the special tool, or using a hand-held twist drill bit of about 5 millimetres in

diameter. Make sure that the tracks are properly cut across their full widths, but do not cut so deeply into the board that it becomes damaged.

Then start adding the components and link-wires, working methodically across the board. The link-wires are made from 22 or 24 s.w.g. tinned copper wire or, as they are all quite short, the trimmings from the resistor and capacitor leadout wires may well suffice.

S1 is an unusual component which has just one leadout wire. This wire is soldered to the board in the normal way. The other connection is made to S1's metal casing and a short insulated lead is used to connect the case to the appropriate point on the stripboard panel. The case seems to be made from a metal that readily accepts solder and there should be no difficulty making this connection provided the case and the end of the leadout wire are tinned with solder first.

The 4001BE and 4046BE are CMOS integrated circuits, and as such are vulnerable to static charges. They must be fitted in holders, but should not be plugged into their holders until all the soldered connections have been completed. Both devices should be supplied in some form of anti-static packing and they should be left in their packing until it is time to fit them onto the board. Try to handle the pins as little as possible and avoid any obvious sources of static electricity.

LS1 must be a cased ceramic resonator, and not a non-cased resonator or an ordinary moving coil loudspeaker. A non-cased resonator will give too little sound output and the circuit has insufficient output current to drive an ordinary

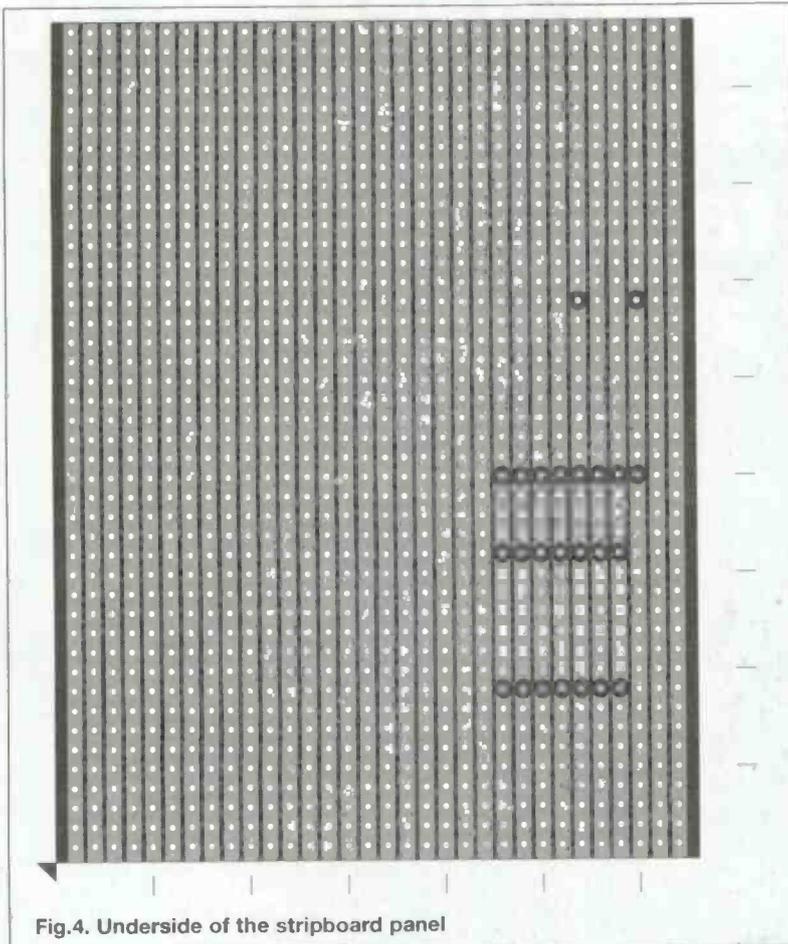


Fig.4. Underside of the stripboard panel

loudspeaker at reasonable volume. The leadout wires will probably red and black, but this is not a polarised component and it can be connected to the board either way round.

On the prototype LS1 is mounted to the circuit board. Most type require 8BA fixings, but some take 6BA bolts. The retailer's literature should give details of the mounting requirements. Obviously there will be some loss of sound level with the resonator inside the computer. Many computers have fairly open cases which still allow plenty of sound to pass through to the outside world. With computers that have cases which are largely sealed-up it would be better to mount LS1 on the exterior of the case. A couple of insulated extension leads will then be needed in order to connect LS1 to the circuit board.

The board is designed to plug into an unused expansion slot. The columns of holes on the right-hand side of the board (as viewed in Fig.3) fit into the expansion slot, but it might be necessary to file the board down slightly in order to get it to fit into the edge connector. Also, the copper strips must be removed from the part of the board which fits into the edge connector. This can be done by carefully cutting them away with a modelling knife. Alternatively, the board can simply be "Blu-Tacked" to (say) one side of the power supply box.

The battery can be fitted to the circuit board in the vacant area to the side of LS1. It can be fixed in place with a blob of "Blu-Tack" or a double-sided adhesive pad. Obviously, care has to be taken when connecting the battery, or you might vibrate the board and trigger the alarm. The vibration switch is not highly sensitive, and I found it quite easy to get the alarm up and running.

There is potentially a more difficult problem in that some computers require a fair amount of wrestling in order to get the outer casing back on. With such computers it could be

difficult to get the outer casing in place without triggering the alarm. Also, some computers are used in positions where they tend to get the occasional knock, which could obviously result in a lot of false alarms. Having to occasionally remove the computer's outer casing, reset the alarm by disconnecting the battery and then reconnecting it again and then replace the outer casing is clearly not a very satisfactory state of affairs.

The solution to the problem is to fit an on/off switch on the rear of the case. Most PCs have some blanking plates on the rear panel, covering unused cutouts for D type connectors. It should be possible to mount a small switch on one of these. For obvious reasons, a key-switch is preferable to ordinary slider switches, toggle types, etc.

### Testing

Initially the unit should be tested outside the computer. When the battery is connected the alarm should not sound, but it should do so almost immediately if the unit is moved. Note that it takes a second or so for the capacitor in the lowpass filter to get up to its normal working charge voltages and for the alarm sound to settle down properly. If the unit works properly, install it in the computer and give it a final check before replacing the computer's outer casing.

## PARTS LIST

### Resistors

(0.25 watt 5% carbon film)

R1	3k9
R2	1k
R3	2k2
R4	1k5
R5,R6,R7	10k (3 off)
R8	680k
R9	820k
R10	1M

### Capacitors

C1	10u 25V axial elect
C2	2u2 50V axial elect
C3	1n polyester
C4	4u7 50V radial elect
C5	220n polyester

### Semiconductors

TR1	BC549
TR2	BC559
IC1	4046BE
IC2	4001BE

### Miscellaneous

S1	Vibration switch (Maplin UK57M)
B1	9 volt (PP3 size)
LS1	Cased ceramic resonator
	0.1 inch pitch stripboard 43 holes by 32 strips, battery connector, 14-pin d.i.l. i.c. holder, 16-pin d.i.l. i.c. holder, wire, solder, etc.

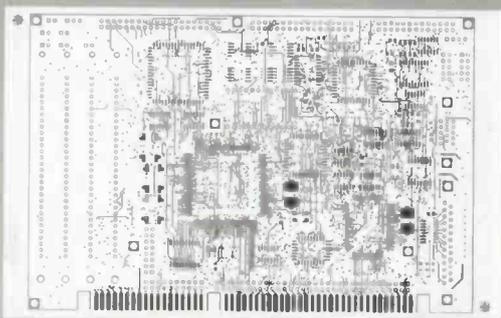
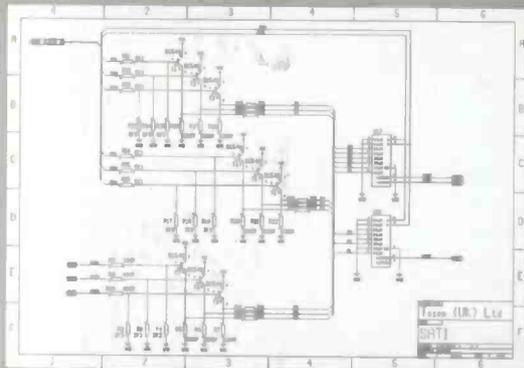
**Is your PCB design package not quite as "professional" as you thought? Substantial trade-in discounts still available.**

## Board Capture

*Schematic Capture Design Tool*

- Direct netlist link to BoardMaker2
- Forward annotation with part values
- Full undo/redo facility (50 operations)
- Single-sheet, multi-paged and hierarchical designs
- Smooth scrolling
- Intelligent wires (automatic junctions)
- Dynamic connectivity information
- Automatic on-line annotation
- Integrated on-the-fly library editor
- Context sensitive editing
- Extensive component-based power control
- Back annotation from BoardMaker2

**£395**



## Board Maker

*BoardMaker1 - Entry level*

- PCB and schematic drafting
- Easy and intuitive to use
- Surface mount and metric support
- 90, 45 and curved track corners
- Ground plane fill
- Copper highlight and clearance checking

**£95**

*BoardMaker2 - Advanced level*

- All the features of BoardMaker1
- Full netlist support- BoardCapture, OrCad, Schema, Targo, CadStar
- Full Design Rule Checking both mechanical and electrical
- Top down modification from the schematic
- Component renumber with back annotation
- Report generator- Database ASCII, BOM
- Thermal power plane support with full DRC

**£395**

## Board Router

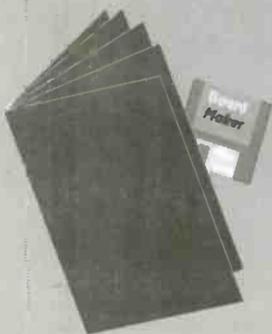
*Gridless re-entrant autorouter*

- Simultaneous multi-layer routing
- SMD and analogue support
- Full interrupt, resume, pan and zoom while routing

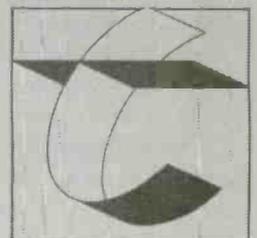
**£200**

*Output drivers - Included as standard*

- Printers - 9 & 24 pin Dot matrix, HPLaserjet and PostScript
- Penplotters - HP, Graphtec & Houston
- Photoplotters - All Gerber 3X00 and 4X00
- Excellon NC Drill and Annotated drill drawings (BM2)



For further information contact  
**Tsien (UK) Limited**  
 Aylesby House  
 Wenny Road, Chatteris  
 Cambridge, PE16 6UT  
 Tel 01354 695959  
 Fax 01354 695957  
 E-mail [Sales@tsien.demon.co.uk](mailto:Sales@tsien.demon.co.uk)



**tsien**



**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

Gould OS3000/ADVANCE 3000 - 30MHz Dual ch.....	£200
Gould 5110 - 100MHz Intelligent oscilloscope.....	£850
Hewlett Packard 1740A, 1741A, 1774A, 100MHz dual ch.....	from £350
Hewlett Packard 1707A, 1707B - 75MHz 2ch.....	from £275
Hewlett Packard 1980B - 100MHz, 2 Channel, HPIB Prog'ble.....	£750
Hewlett Packard 54201A - 300MHz Digitizing.....	£1750
Hewlett Packard 54501A - 100MHz - Digitizing 4 channel.....	£1950
Hewlett Packard 54100D - 1GHz Digitizing.....	£4500
Kikusui COS 6100 - 100MHz, 5 Channel, 12 Trace.....	£475
Lecroy 140 - 100MHz - D.S.O.4 Channel.....	£2950
Nicolet 3091 - LF D.S.O.....	£1100
Phillips PM 3315 - 60MHz - D.S.O.....	£750
Phillips 3211, 3217, 3240, 3243, 3244, 3261, 3262 (2ch + 4ch).....	from £125 to £350
Phillips PM 3295A - 400MHz Dual Channel.....	£1950
Phillips PM 3295 - 350MHz Dual Channel.....	£1500
Tektronix 468 - 100MHz - D.S.O.....	£800
Tektronix 2213 - 60MHz Dual Channel.....	£425
Tektronix 2215 60MHz dual trace.....	£450
Tektronix 2235 Dual trace 100MHz (portable).....	£800
Tektronix 2335 Dual trace 100MHz (portable).....	£750
Tektronix 2225 - 50MHz dual ch.....	£450
Tektronix 464/466 - 100MHz An storage.....	from £350
Tektronix 465/465B - 100MHz dual ch.....	from £350
Tektronix 475 - 200MHz Dual Channel.....	£475
Tektronix 7313, 7603, 7613, 7623, 7633, 100MHz 4 ch.....	from £300
Tektronix 7704 - 250MHz 4 ch.....	from £650
Tektronix 7904 - 500MHz.....	from £850
Tequipment D68 - 50MHz Dual Channel.....	£200

Other scopes available too

### SPECTRUM ANALYSERS

Advantest 4133B - 100KHz - 20 GHz.....	£6995
Alltech 727 - Spec. Analyser 22.4 GHz with Alltech 70727 - Tracking Generator (10KHz - 12.4 GHz).....	£2000
Advantest 4133B - 10KHz - 20GHz with External Keyboard.....	£7995
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).....	£6750
Hewlett Packard 182T with 8559A (10MHz - 21GHz).....	£3750
HP 3582A - 25KHz Analyser, dual channel.....	£2500
Hewlett Packard 35601A - Spectrum Analyser Interface.....	£1000
Hewlett Packard 8754A - Network Analyser 4 - 1300MHz.....	£3250
Hewlett Packard 853A with 8559A - (0.01 - 21GHz).....	£4250
Hewlett Packard 8565A - (0.01 - 22GHz).....	£4000
Hewlett Packard 141T + 8552B + 8555A - (10MHz - 18GHz).....	£1600
Hewlett Packard 8756A - Scalar Network AN (10MHz - 18GHz).....	£2250
Hewlett Packard 8505A - Network Analyser (500KHz - 1.3GHz).....	£4000
Hewlett Packard 3562A Dual Channel Dynamic Sig. Analyser.....	£7500
Hewlett Packard 8590A 15 10KHz-1.5 GHz.....	£4350
Marconi 2370 - 110MHz.....	£995
Marconi 2371 - 30KHz - 200MHz.....	£1250
Polrad 641-1 - 10MHz - 18GHz.....	£1500
Rohde & Schwarz - SWOB 5 Polyskop 0.1 - 1300MHz.....	£2500
Schlumberger 1250 - Frequency Response Analyser.....	£2500
Tektronix 2710 9 KHz - 1.8 GHz.....	£4250
Tektronix 496P - 9KHz - 1.8GHz (Programmable).....	£4500

### MISCELLANEOUS

ANRITSU ME 462B DF/3 Transmission Analyser.....	£3000
Anritsu MG642A Pulse Pattern Generator.....	£1500
Datalab DL 1080 Programmable Transient Recorder.....	£350
Datron 1061 - Precision Multimeter.....	£650
Dyanpert TP20 Intellipace - Tape peel Tester - immaculate condition.....	£1950
E.I.P. 548A - Frequency Counter (26.5 GHz).....	£3500
EIP 331 - Frequency counter 18GHz.....	£700
Farnell SSG-520 Signal Generator (520 MHz).....	£400
Farnell TTS 520 Transmitter Test Set.....	£400
Farnell TSV 70 MkII Power Supply (70V-5A or 35V-10A).....	£200
Ferrogaph RTS-2 Audio Test Set with ATU 1.....	£500
Heiden 1107 - 30V-10A Programmable Power Supply (IEEE).....	£650
Hewlett Packard 4953A - Protocol Analyser.....	£2995
Hewlett Packard 3437A System voltmeter.....	£350
Hewlett Packard 3456A Digital voltmeter.....	£850
Hewlett Packard 5420A Digital Signal Analyser.....	£350
Hewlett Packard 8011A Pulse gen. 0.1Hz-20MHz.....	£500
Hewlett Packard 8620C Sweep oscillator mainframe.....	£400
Hewlett Packard 8750A Storage normaliser.....	£375
Hewlett Packard 8684A 5.4GHz to 12.5GHz Sig-Gen.....	£3500
Hewlett Packard 5356A - 18GHz Frequency Converter head.....	£450
Hewlett Packard 432A - Power Meter (with 478A Sensor).....	£275
Hewlett Packard 435A or B Power Meter (with 8481A/8484A).....	from £750
Hewlett Packard 3438A Digital multimeter.....	£200
Hewlett Packard 6181C D.C. current source.....	£150
Hewlett Packard 3711A/3712A/3791B/3793B Microwave Link Analyser.....	£3500

Hewlett Packard 5385A Frequency Counter - 1GHz - (HP1B) with OPTS 001/003/004/005.....	£995
Hewlett Packard 6623A Triple output system power supply.....	£1950
Hewlett Packard 3586A Selective level meter.....	£1750
Hewlett Packard 3325A - 21MHz Synthesiser/Function Gen.....	£1500
Hewlett Packard 8152A - Optical Average Power Meter.....	£1250
Hewlett Packard 8158B - Optical Attenuator (OPTS 002 + 011).....	£1100
Hewlett Packard 3488A - HP - 1B Switch control unit (various Plug-Ins available).....	£650
Hewlett Packard 3581C - Selective Voltmeter.....	£900
Hewlett Packard 8660D - Synthesised Sig Gen 10 KHz-2.6 GHz.....	£P.O.A.
Hewlett Packard 4192A - L.F. Impedance Analyser (5Hz - 12MHz).....	£8000
Hewlett Packard 4261A - L.C.R. Meter (Digital).....	£500
Hewlett Packard 4271B - L.C.R. Meter (Digital).....	£900

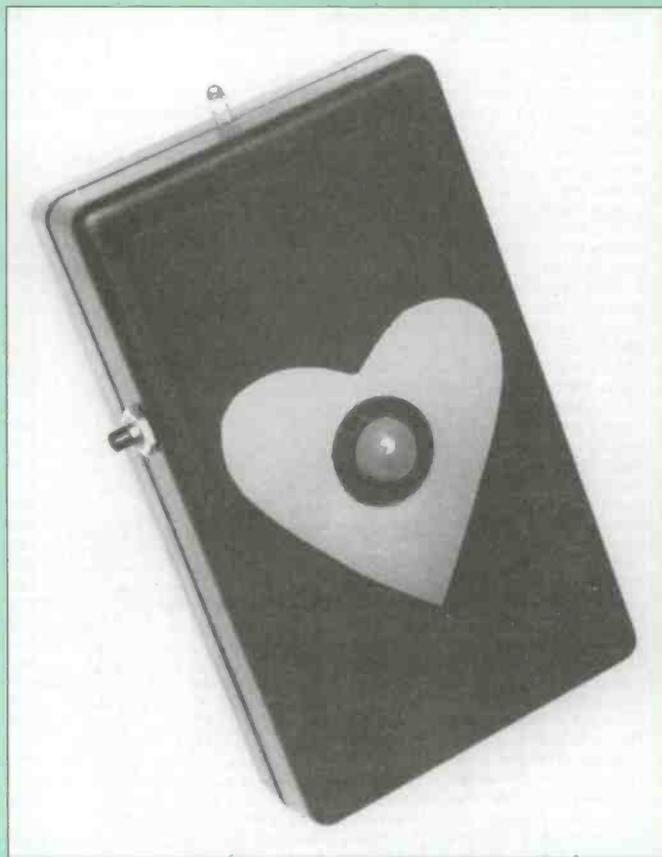
### HEWLETT PACKARD 6261B Power Supply 20V-50A £500 Discount for Quantities

Hewlett Packard 4342A - 'Q' Meter.....	£995
Hewlett Packard 4954A - Protocol Analyser.....	£3500
Hewlett Packard 8116A - Pulse/Function Generator (1MHz - 50MHz).....	£2750
Hewlett Packard 8349B - Microwave Broadband 'Amplifier' (as new) 2 - 20GHz.....	£4700
Hewlett Packard 8350B - Sweep Oscillator Mainframe (various Plug-Ins available) extra.....	£2650
Hewlett Packard 8656A - Synthesised Signal Gen (100KHz - 990MHz).....	£1750
Hewlett Packard 8683A - Microwave Signal Gen (2.3 6.5GHz).....	£3500
Hewlett Packard 8901B - Modulation Analyser (150KHz - 1300MHz).....	£4250
Hewlett Packard 8903A - Audio Analyser (20Hz - 100KHz).....	£2600
Hewlett Packard 3455A 61/2 Digit M/Meter (Autocal).....	£750
Hewlett Packard 4948A - (TMS) Transmission Impairment M/Set.....	£2000
Hewlett Packard 8601A - Generator/Sweeper (110 MHz).....	£300
Hewlett Packard 8165A - 50 MHz Programmable Signal Source.....	£1650
Hewlett Packard 3746 A - Selective Level Measuring Set.....	£1750
Hewlett Packard 6002A - Autoranging P.S.U. 50V - 10A.....	£650
Hewlett Packard 8403A - Modulator.....	£500
Hewlett Packard 334A - Distortion Analyser.....	£300
Hewlett Packard 339A - Distortion Measuring Set.....	£1500
Hewlett Packard 5314A - (NEW) 100MHz Universal Counter.....	£250
Hewlett Packard 5350B - (NEW) 20GHz - Microwave Freq. Counter.....	£2500
Hewlett Packard 3708A Noise + Interference Test Set.....	£8500
Hewlett Packard 6623A - Triple Output system P.S.U.....	£1950
Hewlett Packard 3581C Selective Voltmeter.....	£900
Krohn-Hite 2200 Lin/Log Sweep Generator.....	£995
Krohn-Hite 4024A Oscillator.....	£250
Krohn-Hite 6500 Phase Meter.....	£250
Marconi 2432A 500MHz digital freq. meter.....	£200
Marconi 2337A Automatic dist. meter.....	£150
Marconi - 2019A - 80KHz - 1040MHz - Synthesised Signal Generator.....	£1950
Marconi 2305 Modulation Meter.....	£200
Marconi 2871 Delta Comms Analyser.....	£1750
Marconi 6500 Automatic Amplitude Analyser.....	£200
Phillips PM 5167 100MHz function gen.....	£200
Phillips PM 5565 - Waveform Monitor.....	£200
Phillips PM 5567 - Vectorscope.....	£600
Phillips PM 8226 - 6 Way Pen Recorder.....	£550
Phillips 5190 L.F. Synthesiser (G.P.I.B.).....	£800
Phillips 5390 Programmable R/F Signal Gen (1020 MHz).....	£1250
Phoenix 5500A - Telecomms Analyser with various Interface Options.....	£2500
Racal Dana 9242D Programmable PSU 25V-2A.....	£300
Racal Dana 9246S Programmable PSU 25V-10A.....	£400
Racal Dana 3100 40-130MHz synthesiser.....	£750
Racal 1992 - 1.3GHz Frequency Counter.....	£850
Racal Dana 9081 Synth. sig. gen. 520MHz.....	£550
Racal Dana 908A Synth. sig. gen. 104MHz.....	£450
Racal Dana 9303 True RMS/R/Level meter.....	£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 9301A - True RMS R/F Millivoltmeter.....	£300
Racal 9921 - 3GHz Frequency Counter.....	£450
Rohde & Schwarz - Scud Radio Code Test Set.....	£995
Rohde & Schwarz SUF 2 Noise Generator.....	£300
Schlumberger S.I. 4040 Stabilock - High accuracy 1GHz Radio Test Set.....	£5950
Schlumberger 4923 Radio Code Test Set.....	£1500
Schlumberger 2720 1250 MHz Frequency Counter.....	£500
Systron Donner 1702 Synthesised Sig. Gen 1GHz.....	£990
Systron Donner 6054B or D 18GHz or 24GHz Freq. Counter.....	from £800
Tequipment CT71 Curve Tracer.....	£250
Tektronix TM5003 + AFG 5101 Arbitrary Function Gen.....	£1750
Tektronix 1240 Logic Analyser.....	£750
Tektronix 1480 Waveform Monitor.....	POA
Tektronix 651 HR Monitor.....	POA
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 576 - Curve Tracer (with Test Fixture).....	£1250
Tektronix AM503 + TM501 + PG302 - Current Probe Amplifier.....	£995
Tektronix PG506 + TG501 + SG503 + TM503 - Oscilloscope Calibrator.....	£1995
Tektronix CG5001 - Programmable Oscilloscope Calibrator Generator.....	£7500
Time 9811 Programmable Resistance.....	£600
Time 9814 Voltage Calibrator.....	£750
Wayne Kerr B905 - Precision L.C.R. Meter.....	£850
Wiltron 560 Scalar Network Analyser.....	£800

**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**

# Love FINDER

*With St Valentine's day on its way, here is a project from Terry Balbirnie that will deduce your passion ration*



**T**his device will probably not tell you how much someone loves you. However, it 'seems' to do so and this can make it great fun to use at a Valentine's Day party.

The circuit is housed in a small box with a red heart motif on the front (see photograph). The plastic case has a clip which enables it to be attached to the clothing so that it may be carried prominently while walking around. It also has a convenient battery compartment accessible from the outside. In the centre of

the "heart" is a large LED (light-emitting diode). There is also a push-to-make switch and a small sensor protruding through a hole in the side.

When the push-button switch is operated, the LED glows green - this indicates "cold heart". The sensor is held against the palm of the person to be "tested". After a while, the colour may remain green (with the obvious message which this conveys) or it may become slowly yellow, orange - or even red!

## Be truthful

In reality, the device works by responding to the subject's skin temperature. There is probably some truth in the observation that, when tested, a loving subject would become hot and flustered with a rising skin temperature. The uncaring one will remain cool and collected. However, the response is likely to be clouded by various unpredictable external factors. The sensitivity is such that the entire transition from green to red occurs over a very narrow temperature range which may be adjusted between 1 degrees C and 3 degrees C approximately.

@B: The LED at the centre of the "heart" is a tri-colour device. Although it appears as a single unit, it actually contains two LEDs side by side - one red and one green - housed in a milky white translucent package. With the correct operating current flowing through the green section only, the appearance will be obviously green. As a little current is now allowed to flow through the red one, the colour "warms" and becomes yellowish. With equal current in both sections, the appearance will be yellow. This is because red and green are primary colours. When light of these colours are mixed in the translucent plastic, they produce light of the secondary colour, yellow. When the current in the green LED is reduced, the yellow colour becomes orange and, with no current flowing in the green one and normal current in the red, the display will be red.

## Circuit description

The circuit diagram for the Love Finder circuit is shown in figure 1. The sensor itself consists of negative temperature coefficient thermistor R1. This component has a resistance which falls as its

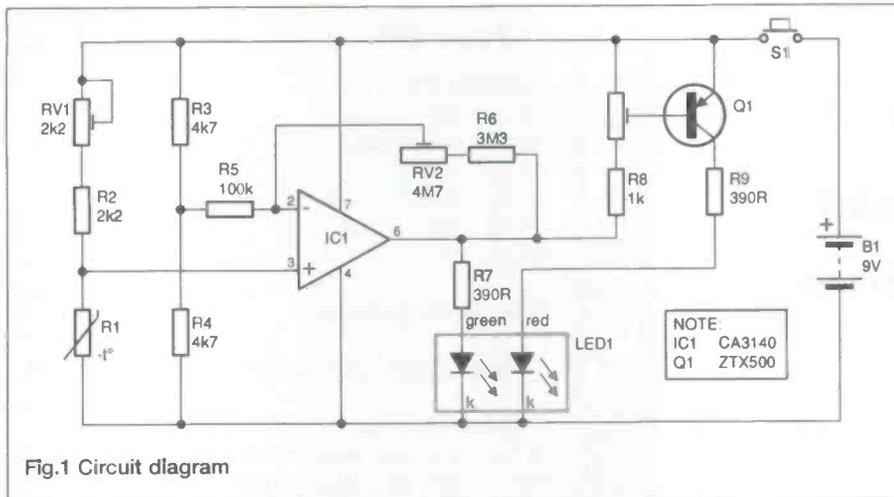


Fig.1 Circuit diagram

200mV) which is amplified by IC1 will therefore be relatively large and the voltage provided at the op amp output, pin 6, will be correspondingly high. The green LED section connected to it via current-limiting resistor R7 will therefore be lit. At higher temperatures, the differences between the inverting and non-inverting input voltage will decrease and this will be reflected in a reduced voltage appearing at pin 6. The green LED will therefore turn off gradually. Since the voltages applied to both inverting and non-inverting inputs are derived from potential dividers, they will fall in sympathy as the battery ages. Thus, the operating conditions will remain unchanged.

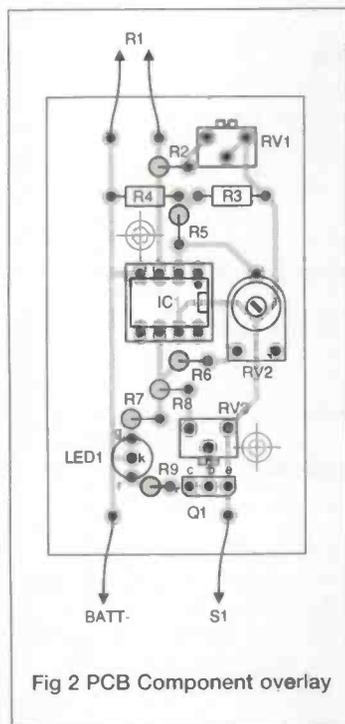


Fig 2 PCB Component overlay

temperature rises and vice-versa. The average skin temperature is likely to be a little below blood temperature - probably around 34 degrees C. Under these conditions, the thermistor will have a resistance of some 3k $\Omega$ . Although the temperature-resistance response is non-linear, over the small range considered, the change will be 130 ohms per degree Celsius approximately. The main section of the circuit is based on operational amplifier IC1 and associated components. This is connected as a form of differential amplifier. Thus, it will amplify the difference in voltage which exists between the inverting (-) and non-inverting (+) inputs. The

amplifying factor is set by the values of fixed resistor R6 in conjunction with preset potentiometer RV2 and, with the values specified, may be adjusted between 30 and 80 times approximately. Adjustment to RV2 will determine the range of temperature over which the LED will go through the entire colour change. At minimum adjustment this will be 1 degree and, at maximum, 3 degrees approximately.

Thermistor R1 forms the lower arm of a potential divider. The upper arm consists of fixed resistor R2 in conjunction with preset potentiometer RV1. This combination of resistors is connected across the 9V battery B1. The potential divider action provides a certain voltage around one-half that of the battery at the op amp non-inverting (+) input, pin 3, with RV1 sliding contact adjusted to mid-track position. As the temperature of R1 rises, its resistance will fall and this will be reflected in a falling voltage across it and hence at IC1 pin 3. At the same time, a fixed voltage is applied via R5 to the inverting input, pin 2, by the potential divider consisting of equal-value resistors R3 and R4. This will be nominally one-half of supply voltage - that is, 4.5V. Note that R5, R6 and RV2 will have little effect on this voltage.

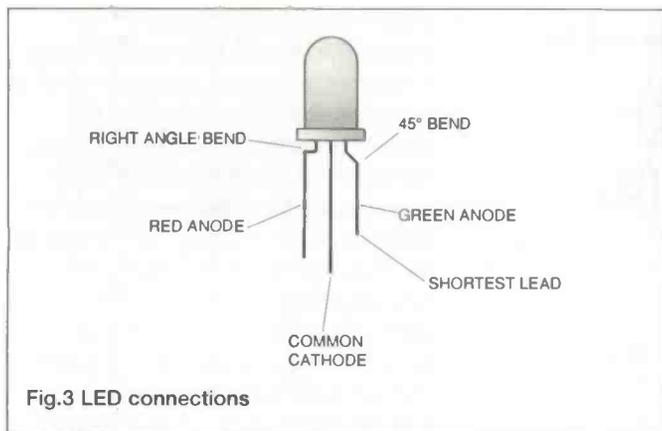
Preset potentiometer RV1 will be adjusted so that when the thermistor is cool, the voltage at pin 3 will lie some way above that at pin 2. The difference in voltage (probably in the region of

### Smooth changes

On rising temperature, the falling voltage gap referred to above will result in a rising voltage between the positive rail and IC1 pin 6. This voltage is scaled down by the potential divider action of fixed resistor R8 and preset potentiometer RV3 and applied between base and emitter of transistor Q1. Since Q1 is a pnp transistor (rather than the more usual npn type), at a certain temperature it will turn on and the red LED section in the collector circuit will begin to operate through current-limiting resistor R9. With suitable adjustment to RV3, there will be an overlap where both red and green LED sections are on simultaneously. The effect is that, on rising temperature, the colour changes smoothly through green, yellow, orange and red.

Some readers may wish to test the wise saying 'cold hands, warm heart'. For this, the colour changes need to occur in the opposite sense - that is, red to green on rising temperature. To do this it is only necessary to reverse the LED connections so that the red section operates as the green one and vice-versa.





## Construction

Construction of the Love Finder uses a single-sided printed circuit board (pcb) The topside component layout for this is shown in figure 2.

Begin by drilling the two mounting holes in the positions indicated (these will probably not be needed if the specified box is used). Next, solder the i.c. socket in place but do not insert the i.c. itself yet. Follow with the resistors including the preset potentiometers. Note that some resistors are mounted flat on the board while others are soldered vertically. Solder the thermistor end leads to the pads marked "R1". Bend them so that the thermistor lies horizontally and pointing away from the circuit panel (see photograph).

Add the transistor Q1, observing the orientation - the "flat" faces RV3 position i.e. the emitter connects to the positive line. Those used to working with npn transistors will find this strange. Take note of the lengths of the LED leads - the green (g) anode (positive) has the shortest one while the common cathode (k) is in the centre. Cut them all to a length of 15 mm and solder them in position so that the base stands 10 mm above the circuit panel. If the identification of the red and green anode leads is "lost", note that they are bent differently near the body - see figure 3. For "standard" operation, the orientation is as shown in figure 2. For the 'cold hands, warm heart' mode of operation, this should be reversed - that is, the green (g) and red (r) anode leads should be connected in the opposite sense. Shorten the PP3 battery connector leads to a length of 5 cm and solder the negative (black) one to the position marked "Batt -" on the circuit panel. Solder a 5 cm piece of light-duty, stranded, connecting wire to the point labelled "S1".

## Preparing to box

If using the specified box and the rear-mounted clip is to be used, begin by drilling the holes to attach it. Pilot holes, partially drilled, will be found on the inside rear panel. Drill these to the correct size and mount the clip using the two self-tapping screws provided. Measure the position of the thermistor and file a groove in the centre between the upper and lower sections of the box so that the leads may pass to the outside (see photograph). Drill a hole in the side for the push-to-make switch. If using the specified box, the clip-type battery terminals should be discarded and the battery snap connector used instead. This will avoid problems with possible polarity-reversal.

Taking note of the LED position on the pcb, drill the hole in the front panel for the clip which will secure it. This should be somewhere along the centre line of the box. Decorate the lid of the box around this hole with the heart motif or some alternative as desired. In the prototype unit, a heart was cut out of thin red card. When the LED clip is engaged, this should be sufficient to hold the circuit panel and motif in position. If the circuit panel is not

# PARTS LIST

## Components

### Resistors

R2	2k2
R3, R4	4k7 (2 off)
R5	100k
R6	3M3
R7, R9	390
R8	1k

All 0.25W 5% carbon film.

R1 Bead thermistor resistance at 25 degrees C, 4k7.

### PH:Potentiometers

RV1	2k2 min. vert. preset.
RV2	4M7 min. horiz. preset.
RV3	22k min. vert. preset.

## Semiconductors

IC1	CA3140 op. amp
Q1	ZTX500 pnp silicon transistor.
D1	10 mm Tri-Colour LED

## Miscellaneous

B1	9V PP3 alkaline battery
S1	Sub-miniature push-to-make switch.

Printed circuit board.

Case size 103 x 62 x 23 mm

8-pin d.I.I. socket,

PP3-type battery clip

Stranded connecting wire

Solder m

Materials for heart motif etc.

## BUY LINES

Most of the components for the Love Finder are readily available. The thermistor was obtained from Maplin, order code FX21X. The LED was also a Maplin stock item, order code UK29G. The switch used must be a sub-miniature type or it may be difficult to mount it in the side of the box. These are also available from Maplin, order code JM01B. The special case referred to in the text is a Maplin item, order code KC95D although other plastic boxes could be used providing they are of sufficient size.

reasonably secure, drill holes and use thin fixings through the holes in the circuit panel. Use a little glue on the motif if necessary. Make small adjustments to the LED and thermistor leads so that, when the LED snaps into its clip, the two sections of the case will fit together correctly with the thermistor end leads passing through the slot filed for the purpose. Make any adjustments as necessary. If there is any possibility of the thermistor leads touching, use some insulation on them.

Before unpacking the i.c. and handling its pins, touch something which is earthed - a water tap, for example. This will remove any static charge which may have accumulated on the body. This could otherwise damage IC1 because it is a CMOS component. Insert IC1 with the correct orientation. Refer to figure 4, mount the switch and complete the internal wiring.

## Getting started

It is now necessary to adjust presets, RV1, 2 and 3 for correct operation. It will be helpful to have an assistant available when doing this. With the circuit panel removed again, adjust RV1 fully

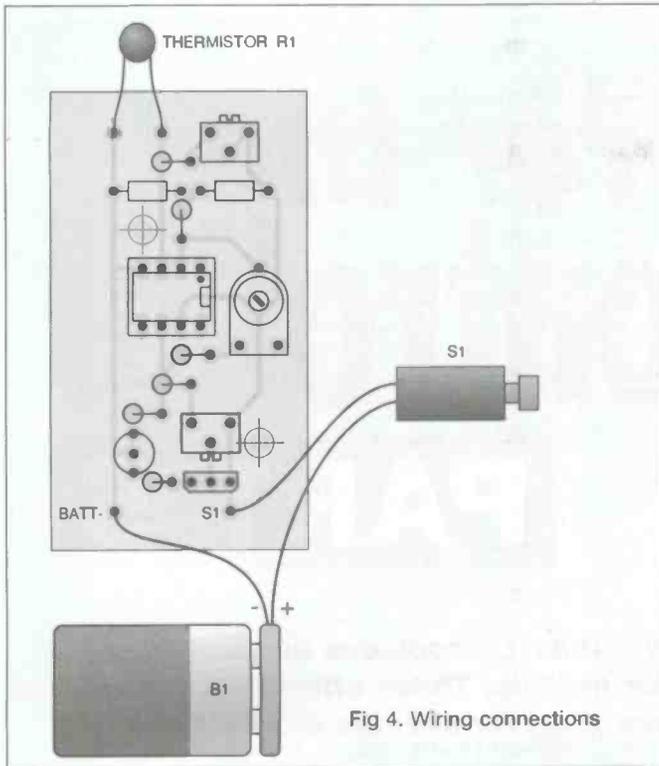


Fig 4. Wiring connections

clockwise (as viewed from the left-hand edge), adjust RV2 to mid-track position and RV3 fully-clockwise (as viewed from the right-hand edge). Connect the battery.

Use an elastic band or piece of Sellotape to keep S1 pressed so that both hands are free. The green LED section should now be on. If the hands are not already hot, rinse them in warm water so that they feel as warm as they could be

naturally and dry them carefully. Press the palm against the thermistor and wait for two minutes for the temperature to stabilise. Now, adjust RV1 slowly anti-clockwise until the green LED just goes off - there should be no other colour showing. This should occur with RV1 sliding contact adjusted to approximately mid-track position (RV1 provides a range of 25 degrees to 35 degrees C approximately). Next, keeping the thermistor warm, adjust RV3 anti-clockwise until the red LED comes on and adjust it a little further. This "little further" will determine the degree of overlap between green and red operation - that is, the range over which yellow shows. Remove the palm and observe how the LED returns smoothly through red, orange, yellow and green. Repeat this a few times and make small adjustments as necessary. Replace the circuit panel and assemble the two sections of the case using the self-tapping screws.

### I need you

Before using the device at a party, it will be best to give it a short period of trial using a few "dummy" subjects and make further small adjustments for best effect. It may be necessary to adjust RV2 to provide a wider or smaller operating temperature range Fully-clockwise will provide a range of about 1 degree C and fully anti-clockwise, about 3 degrees. However, mid-track position was found to work well in tests using the prototype unit.

When operated from cold, the first test may take a long time - this may be regarded as part of the fun. If subsequent tests are made in fairly quick succession, the warm thermistor will need less time to reach its final temperature.

This device may not help you to find your perfect partner but it will certainly be fun to use. Good luck!

Radio - Tech

## Radio - Tech Limited

Professional Suppliers of High Performance Radio Data Modules to Industry Throughout the World!



Official Holtek IC Distributors

HOLTEK  
Encoders, Decoders, Regulators,  
Microcontrollers, Telephone, Speech

SAW & Crystal Controlled Transmitters, Receivers & Transceivers, Synthesised & Spread Spectrum Transceivers, Test Jigs & Evaluation Boards, 2<sup>8</sup> > 3<sup>10</sup> Data Encoders & Decoders, Antenna and More!

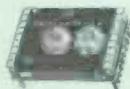
#### APPLICATIONS:

- Remote control systems
- Wire free PC-PC modems
- Remote Cable Free Monitoring
- Wire free security alarms
- Remote Meter Reading
- Industrial Process Control
- Lone Worker & Social Alarms

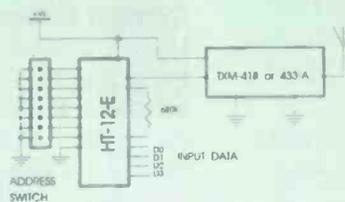
All our 173.225MHz, 173.250MHz and 418MHz modules are DTI Type Approved and Licence Exempt within the UK !!!!

Wire Free PC - PC Links, Hand Held Terminals and EPOS.

MPT1340  
40K Bps



Just add a RS232 Driver, Some Simple Logic & Terminal Software. Only £49.95 each. Development Kits £149.95 and Packet Controllers Board £79.95. Also Available on 433.92MHz

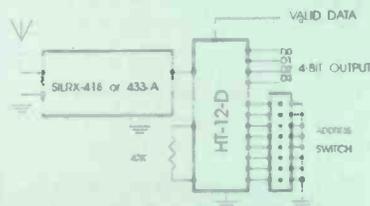


**SIMPLICITY:** Just add the HT-12-E Encoder and HT-12-D Decoder at £1.25 each to make a 200M range 4-Channel remote control system for only £39.50 !

### NEW for '96: Plug and Play Evaluation Boards

418MHz		+	OR	
433MHz	Transmitter			
403MHz	Transmitter			
173MHz	TXM-418-A			
184MHz	Transmitter	+		
0.25mW	Transmitter			
10mW	TXM-173.225			

Just add the TX or RX of Choice !  
Transmitter Eval Board From £29.95  
Receiver Eval Board From £39.95



Our all new White Catalogue is out now !  
Send A4 29p SAE or Telephone/Fax London for a Free Copy NOW!

Orders: Prices exclude carriage and VAT. Radio - Tech Limited, Overbridge House, 41 Weald Hall Lane, Thornwood Common, Epping, CM16 6NB England. Telephone, Credit Card & Export Orders Welcome.  
Tel: Sales 0181-368-8277 Fax 0181-361-3434, Int +44 1992 57 6107 Fax +44 1992 56 1994



# BASIC *for the* PIC controller

## PART 5

*The developer of this unique project, Robin Abbott, concludes his look at some other versions of the ETI PIC based controller module. These offer the user a range of additional options which make them ideal for specific applications*

**I**n this final part of the ETI PIC BASIC series, we'll take a look at the most advanced PIC used for the BASIC language so far. This is the PIC16C64 and PIC16C74. Throughout this article we'll look at the 16C64 but all the features of the 16C64 are also available in the 16C74. Enhancements for the 16C74 to cover its serial port capabilities and A/D converters will be available in later software upgrades. The 16C74 is a superset of the 16C64. Enhancements for the 16C74 to cover its serial port capabilities (using interrupt driven asynchronous communications) and A/D converters will be available in later software upgrades. Again, the circuit board used for the 16C64 is suitable not only for running ETI PIC BASIC, but also as a general purpose controller board for a wide variety of applications.

### The PIC16C64

The 16C64 is one of the more recent PIC devices. It contains 2K words of program memory, 128 bytes of RAM for user programs and a wide range of peripheral devices. These are as follows:

- \* 8-bit real time clock counter
- \* 16-bit real time clock counter
- \* Pulse width modulation output
- \* Event timer
- \* 8-bit interface to external microprocessor
- \* Synchronous serial port/I2C interface

Note that the I2C interface on the 16C64 only offers slave support and so unfortunately does not offer an enhancement to performance for driving the I2C EEPROM used in ETI PIC BASIC.

### 16C64 BASIC General features

The 16C64 version supports all the features of the 16C57 and 16C58 shown in the last two articles, as well as some additional commands and facilities. The circuit board supports two 8-pin I2C devices, and the additional socket is used for an

optional static RAM device which allows an extra 256 bytes of space for variables (which may be stored in arrays). The internal architecture of the 24LC16 device which is supported by the other ETI PIC BASIC versions prevents use of the extra I2C device, and so the 16C64 version only supports the 24LC65 (8Kx8) EEPROM. External I2C devices are supported on a peripheral I2C bus and two new commands IIREAD and IIWRITE. The PWM output of the 16C64 may be used for D/A conversion at up to 10-bit resolution and the extended 16-bit timer is available for use with internal clocks, or with an external crystal. The other peripheral devices of the 16C64 are also supported, with the exception of the synchronous serial port which uses the same pins as those used by the EEPROM and static RAM.

### Circuit Diagram

Figure 1 shows the circuit diagram of the 16C64 version of BASIC. Port C is used on the processor for BASIC's support circuitry, as this is the port used by most of the peripherals on the 16C64. The same serial port circuit as that used for previous versions of BASIC is also used for the 16C64 on the upper bits of port C. R3 is provided for future programming of modes and should be left open circuit for current BASIC versions. The EEPROM and static RAM are supported on port C pins RC3 and RC4. The static RAM is an 8-pin device, the Philips 8570, 256 x 8 static RAM. Although at around 2p per byte this must be one of the most expensive RAM devices currently available, it does have the advantage of the I2C interface. The RAM is optional.

The EEPROM IC2 is connected to be at address 0 on the IIC bus and the static RAM is at address 1. This is achieved by using the A0, A1 and A2 pins of the I2C devices. As these devices are specifically supported by the EEPROM and RAM support routines of PIC BASIC then only the LC65 and 8570 or compatible devices may be used in these sockets at present.

The brown out reset circuit now has an external reset capability. If the reset pin is taken high then the MCLR pin of the processor will drop to ground and reset the processor. If

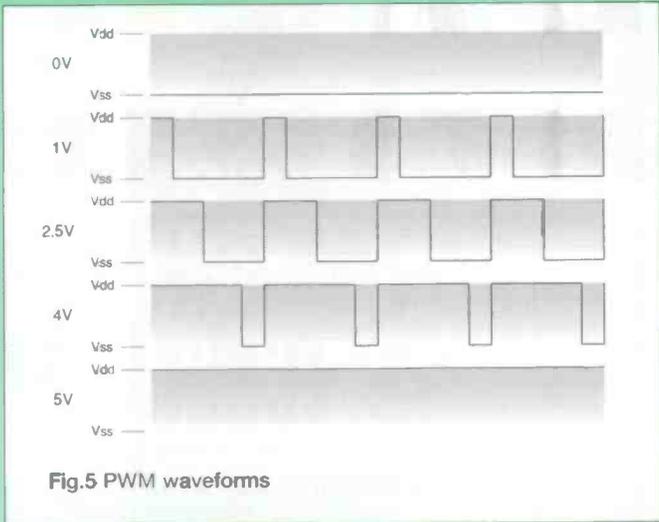
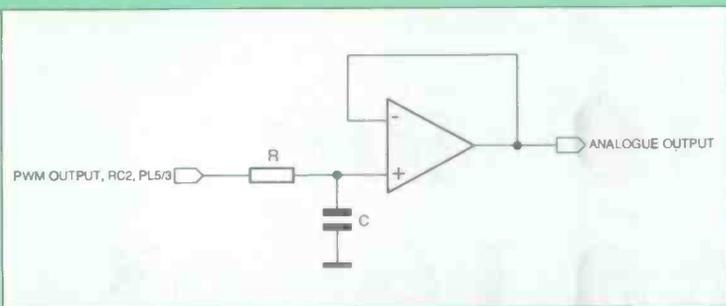


Fig.5 PWM waveforms

the pin is taken low then the brown out reset circuit will be disabled. This latter mode must not be used when running the BASIC version of the 16C64

The peripheral I2C bus is supported on pins RA3 and RA4 for SCL and SDA respectively. These are further described below. RC0 and RC1 are the external oscillator pins and may be connected to an additional low frequency crystal as described in the time section below. RC2 is the PWM output pin which may be used as a digital to analogue converter. This is also described below.

There are three external connectors for I/O. PL3 is a 16-pin DIL socket which hosts port A and port E together with the external reset line. PL4 is the 20-pin IDC connector which hosts port B and port D together with the external RTCC input

for the 8-bit internal timer. This connector is pin compatible with the connector on the 16C57 version (although that connector hosts port B and port C). Finally, a 3-pin header supports the bottom three bits of port C.

### Construction and testing

Figure 2 shows the PCB overlay. Use sockets for IC1, IC2

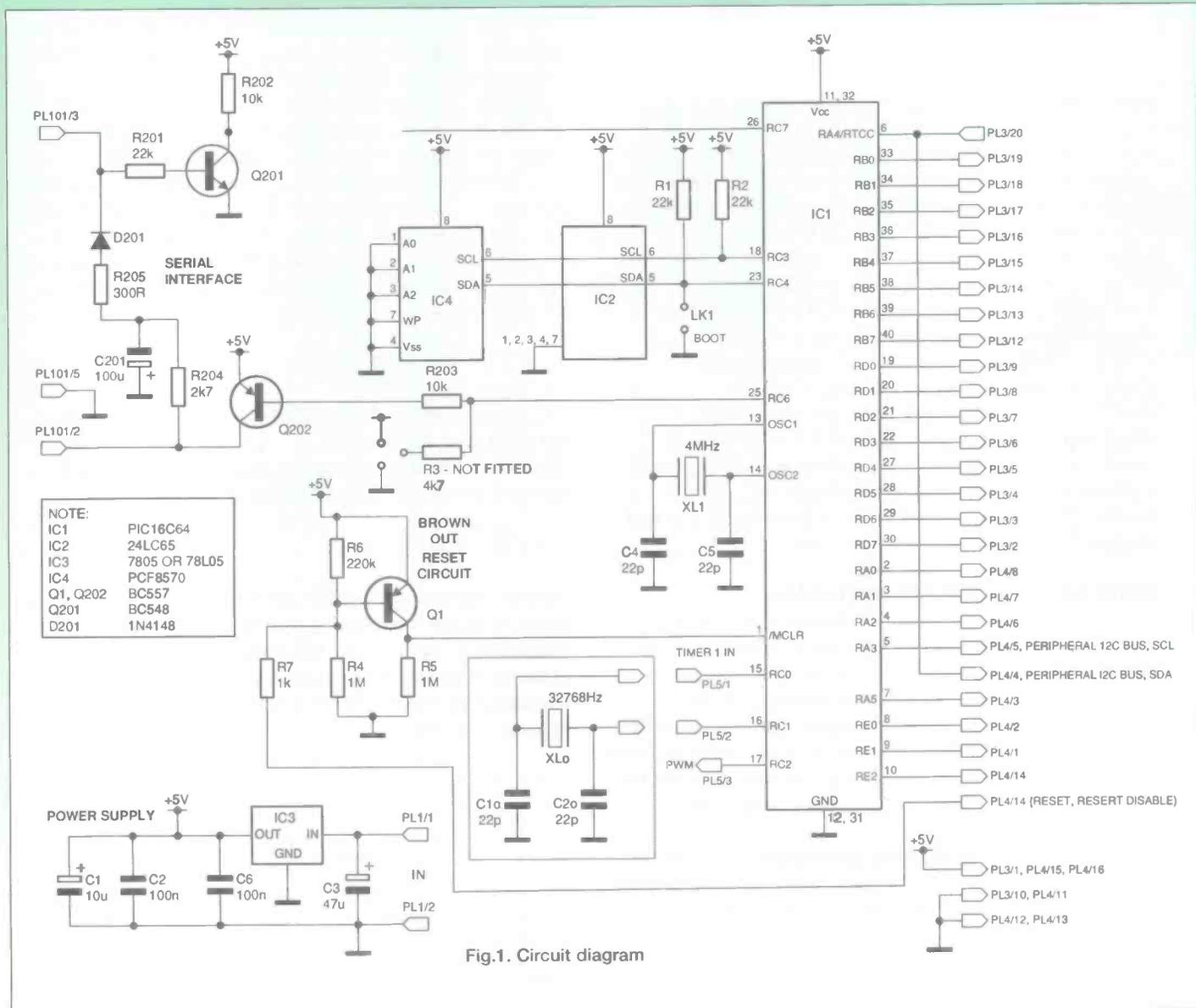


Fig.1. Circuit diagram

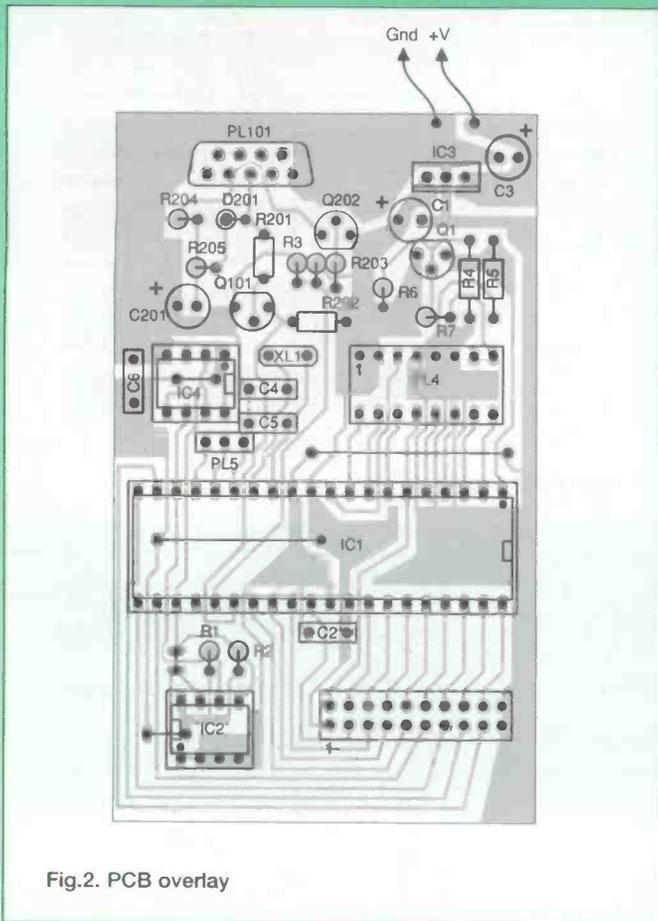


Fig.2. PCB overlay

and IC4. There are only two links to be fitted, one under IC1 and one to the left of IC1; fit these first. Follow the links with the horizontally mounted resistors, then the IC sockets, the other resistors, capacitors, IC3, and the remaining components and connectors. IC3 is the power regulator; a 78L05 or 7805 may be used dependant on power consumption of peripheral circuitry. IC3 may be removed altogether if an external regulated supply is available.

Before inserting any ICs, connect the power supply and check the voltages on the power supply pins of IC1, IC2 and IC3. Power down and insert these ICs (note that the orientation of IC2 is opposite to that of IC4), power up, connect to the PC as shown in previous articles and use the development software to confirm the operation of the module. The module will check for the presence of IC4 and will report it to the development program.

### External static RAM variables

I considered using an automatic scheme for allocating external RAM variables (when the internal RAM is used up then the external RAM is used automatically). However, I rejected this idea because it is not sufficiently flexible. External RAM variables are much slower than internal RAM variables and so the user should decide which variables need the speed. Such variables are likely to be index counters for loops (for  $i=1$  to 20 : next  $i$ ), or other frequently used variables.

An external static RAM variable is declared using the DIM statement with a .X after the variable name. All external static RAM variable is always 16 bits long. For example:

```
dim a.X,b[8].X
```

This declares a as being a 16-bit variable using external RAM, and b as being an array of eight 16-bit variables. a and b may now be used in the same way as any other variable.

### Use of the Peripheral I<sup>2</sup>C bus

The peripheral I<sup>2</sup>C bus is supported on port A. Figure 3 shows an example connection to an IIC device, the A/D and D/A converter chip, PCF8591. In this case, the 8591 has been wired to be at address 0 on this bus by connecting pins A0, A1 and A2 to ground. Please note that the I<sup>2</sup>C bus is likely to be on a length of several centimetres of cable and so the pull up resistors are specified as 4K7. If operation is unreliable (if acknowledgement bits cannot be read from devices on the bus), then these resistors may be reduced to 1K.

There are two new functions to support the I<sup>2</sup>C bus.

These are the IIREAD and IIWRITE functions. Each of these commands takes a definition value. The definition value specifies whether a start bit, stop bit and acknowledgement are to be sent, and is made up of any combination of the following values:

- START - Sends a start bit before any transfer
- STOP - Send a stop bit after the transfer
- ACK - Sends an acknowledgement bit (low) at bit 9 of the transfer.

If no stop bit is specified, then the bus will be left in a state where SDA is high and SCL is low. If a stop bit is specified, then both SDA and SCL will be left high.

The IIWRITE function has the syntax IIWRITE(value,def). value is the 8-bit value which will be written to the device; def is the combination of values which specify the actions described above. The IIWRITE function returns the state of the acknowledgement bit returned by the I<sup>2</sup>C device, which will be 0 for an acknowledgement or 1 otherwise. For example, the following line will write the value 90hex to the bus and put the returned acknowledgement into the variable ack. A start bit will be sent before the value, and no stop bit will be sent.

```
ack=IIWRITE(90h,START)
```

The IIREAD command reads 8 bits from the bus and returns the value read. For example, to read 8 bits into the variable data, and to send an acknowledgement and a stop bit, the following line of BASIC could be used:

```
data=iiread(STOP+ACK)
```

Detailed operation of the 8591 is beyond the scope of this article; however, the following lines of BASIC show a function called AREAD which reads A/D converter channel number 1 of the 8591 connected in figure 3 and returns this value. This routine leaves the peripheral I<sup>2</sup>C bus in the idle state with both SCL and SDA high.

```
func aread()
  dim r:8
  porta=0ffh
  trisa=27h ; 0
  iiwrite(90h,START) ; 1
  iiwrite(0,0) ; 2
  iiwrite(91h,START) ; 3
  r=iiread(ACK) ; 4
  r=iiread(STOP) ; 5
  return r ; 6
end
```

Line 1 addresses the 8591 with a start bit and its address. Line 2 sets the control byte of the 8591 to read channel 1 as a single ended input with the analogue output disabled. Line 3 writes another start bit and the read address of the 8591. Line 4 reads the A/D converter and line 5 reads it again. The reason for this dual read is that each read access to the 8591 returns the value last converted by the A/D converter on the previous read access. Finally, the value read is returned.

This routine is a simple example of the use of the peripheral I<sup>2</sup>C bus, a realistic use of the 8591 could be written far more efficiently; interested readers are referred to the 8591 data sheet which is available from Farnell.

### Overview of operation of 16-bit timer

The PIC16C64 has three timers. Timer 0 is similar to that on other PICs and can be read or written through the RTCC variable. Timer 2 is used for the PWM module and the event capture module.

Timer 1 is a 16-bit timer which is extremely flexible. It offers the facilities for counting from an external source, or using the internal microprocessor clock divided by 4. In addition, the PIC16C64 contains the oscillator circuitry to enable a crystal to be directly connected to the chip for timer1. The variable timer1 represents the current value of the timer and may be assigned or read. Thus, to reset timer1, the following line may be used :

```
timer1=0
```

The variable t1con is used to control the timer. There are a number of values which may be added together to control the timer. These are as follows:

- tmr1on - This value must be specified to turn the timer on.
- tmr1cs - This selects the source for the timer. If this value is specified then the source of the timer will be the external input on pin RC0, otherwise the internal oscillator will be used which is the microcontroller clock divided by 4.
- t1insync - This value, if specified, disables the synchronisation circuitry. Normally, it should not be specified; it is only provided for advanced users.
- t1oscen - This value, if specified, enables the external crystal oscillator circuitry; see the description below.
- t1ps1, t1ps2, t1ps4, t1ps8 - These values specify the prescaler for the timer. If t1ps2 is specified, for instance, then the clock is divided by 4 before being applied to timer1.

Thus to enable timer1 and to set it to use the external crystal oscillator and, to divide its frequency by 4, the following line should be used:

```
t1con=tmr1on+tmr1cs+t1oscen+t1ps4
```

The external crystal oscillator uses the RC0 and RC1 pins. It is intended for crystals of less than 200KHz frequency, such as 32768Hz watch crystals. Figure 1 shows how to connect a crystal to these pins, only an additional two capacitors are required.

An interrupt is generated when the timer1 register overflows. To action this interrupt then interrupts must be enabled. In the 16C64 the intcon variable is used to enable interrupts as shown for the 16C84 in the earlier article. However, as the 16C64 has a wide range of interrupt sources, then two variables are used to control them. The first is the intcon variable controlled by the ei() function as

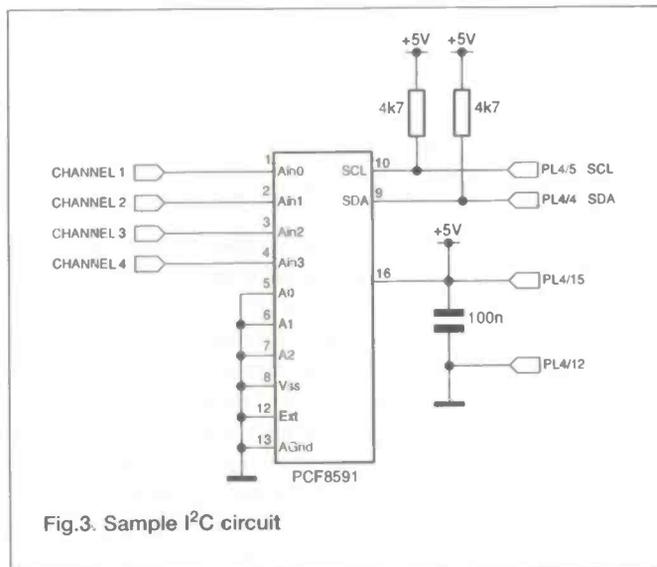


Fig.3. Sample I<sup>2</sup>C circuit

before; the second is the peripheral interrupt enable variable pie1. To set interrupts on a peripheral device, the interrupt must be enabled by setting pie1, followed by the ei() function. This can be done using the following code :

```
pie1=tmr1ie ; Enable timer 1
interrupts
ei(pei+gie) ; Enable peripheral
interrupts
```

The use of interrupts is shown in more detail in the documentation supplied on disk.

The example code in Figure 4 shows a complete stop watch which prints minutes and seconds on the terminal. It uses a 32768KHz watch crystal as shown in Figure 1. It is stopped by pressing the Escape key when the terminal window is open.

### Use of Pulse Width Modulation

Pulse Width Modulation or PWM is a technique for control of analogue devices from digital circuitry. This is achieved on a single output pin which has a digital clock which is of much greater frequency than the rate of change of the desired output voltage. The duty cycle of this clock is then changed so, for an output voltage which is half the digital high voltage, the duty cycle is 50% high to 50% low. For a voltage which is 10% of the digital high voltage, the duty cycle is 10% high to 90% low. This is illustrated in Figure 5a.

The digital clock may now be filtered and buffered to drive an analogue output. In the 16C64, the digital output pin for PWM is RC2. This can drive low current devices directly (for example, an LED), but is best used through a filter, or can drive devices such as small motors with no additional filtering; however, buffering must be provided in this case.

The 16C64 supports PWM to a resolution of 8 or 10 bits. The control of the PWM mode involves five variables in the 16C64 and can be quite complex to program. Fortunately most of these variables can be set to default values for simple applications. We'll look at the simple use of PWM in this article. This will offer 8-bit resolution and a set frequency of 3.91KHz to provide an output voltage which can vary between 0 and 5V in 0.02 Volt steps.

PWM mode uses timer 2 and requires the 16C64 capture/pwm control register to be set to PWM mode. The frequency of the PWM output is set with the period register PR2. The RC2 pin must be set to drive as an output. This

can all be achieved in four lines of BASIC code at the top of the program as follows:

```
trisc=trisc&0fbh      ; 1
pr2=0ffh              ; 2
t2con=trm2on          ; 3
ccplcon=ppwmmode     ; 4
```

Line 1 sets the drivers on port C to be their current values, except for bit 2 which is set low to drive on pin RC2. Line 2 sets the frequency of output of timer 2 to its maximum value which gives 8-bit resolution. Line 3 turns timer 2 on in the same way as the control register for timer 1. Finally, line 4 sets the 16C64 capture/compare/pwm module to PWM mode. Following this, the output voltage will be set to 0V.

Now to set the output voltage. Set this to a value between 0 and 255 to set the PWM output voltage between 0 and 5V. For example, the following code loop will generate a 10-step ramp waveform with a period of 1S. The 4 lines shown above should be included before this loop.

```
while(1)
  for i=0 to 9
    wait(100)
    ccpr1l=28*i
  nextw
end
```

### Other peripheral devices

The other peripheral devices of the 16C64 are supported by variables in BASIC which represent the registers in the device. These are not documented here, but the data sheet for the 16C64 should be consulted for further details. The only peripheral not supported is the synchronous communications and I<sup>2</sup>C module.

### Device sourcing

The PCF8591 is available from FARNELL on 0113 263 6311.

The author is prepared to program 16C64 devices for £15.00, or can provide a programmed 16C64 (4MHz) for £28.00. The latest version of PICBASDE will also be required for these devices which handles extended BASIC and the extra variable types needed for the 64/74 series. Please send payment, an SAE, a blank FORMATTED disk (if the latest version of PICBASDE is required) and a blank device (if required) to Robin Abbott, 37 Plantation Drive, Christchurch, Dorset. BH23 5SG.

The author can be contacted by e-mail on CIS at 100023,535, or via the internet at robin.abbott@dial.pipex.com

There is a support interest group for ET1 PIC Controller BASIC on a bulletin board called the Astronomers' Den which is on 01942-831925.

### Program

```
include "util.inc"
typesub interrupt()
dim secs.8,mins.8,tflag.1

timer1=0                ; Reset timer
tflag=0                 ; Flag to show 2 seconds
has passed
piel=tmr1e              ; Enable timer 1
interrupts
ei(pei+gie)             ; Enable peripheral
interrupts
tlcon=tmr1on+tmr1cs+tloscen+t1ps1 ; Enable
timer 1
secs=0
```

```
mins=0
tflag=1
```

```
while(serin(defserin,100)27) ; Run until the
escape key
  if (tflag) then
    serout('\r',ds)
    prtnum(mins) : serout(':',ds)
    prtnum(secs)
    tflag=0
  endif
wend
ei(0) ; Disable interrupts
monitor() ; and return to monitor
```

; Interrupt subroutine, called every 2 seconds

```
sub interrupt()
  secs=secs+2
  if (secs=60) then secs=0 : mins=mins+1
  tflag=1
  pir1=0 ; Clear interrupt in
software
end
```

## PARTS LIST

### Resistors

R1,2	22K
R3 (not fitted)	4K7
R4,5	1M
R6	220K
R7	1K
R201	22K
R202	10K
R203	22K
R204	2K7
R205	300R

### Capacitors

C1	10uF 16V Electrolytic
C2,6	100n, Ceramic
C3	47uF 10V Electrolytic
C4,5	15pF, Ceramic
C201	100F 10V Electrolytic

### Semiconductors

IC1	PIC16C64
IC2	24LC65 or compatible
IC3	7805 or 78L05
IC4(optional)	PCF8570
TR201	BC548
TR1,TR202	BC557
D201	1N4148

### Other

XL1	4.000MHz crystal or ceramic resonator
PCB	
PL101	9 Pin D socket
PL3	20 Pin IDC connector
PL4	16 Pin DIL socket
PL5	3 Pin header link
LK1	0.1" link with jumper
IC sockets	8 Pin x2, 40 pin x1
Veropins	2
Heatsink	IC3, optional

**Next Month....**  
Robin Abbott takes detailed look at the I<sup>2</sup>C bus and its use.

## ETI PIC Programmer and PIC BASIC projects

### Basic Project - from £15.00 (inclusive)

The ETI PIC BASIC project offers a well featured BASIC language running in real time directly on a PIC Microcontroller. Up to 2000 lines of BASIC is stored on 2K or 8K EEPROM. Full featured development program runs under Windows 3.1, 3.11, and '95.

A module is available for the 16C57 version which features a 9600bps serial interface, 16 lines of programmable I/O, 4MHz crystal, and 24LC16 2Kx8 EEPROM on a small PCB (55 mm x 80 mm).

- 16C57 module kit - £27.00
- 16C57 pre-built module - £33.00
- 16C57 chip programmed with enhanced BASIC £15.00
- 16C58 chip programmed with enhanced BASIC £21.00
- 16C64 chip programmed with enhanced level 2 BASIC £25.00

Full instructions, latest development software and documentation on 3.5" disk are included. (Printed documentation - add £5.00). 16C57 and 16C58 versions operate with 2K or 8K EEPROMs (selected by external resistor). 16C64 version operates with 8K EEPROM and optional external static RAM.

### PIC Programmer - kit £35.00, pre-built £45.00

Version 2 of the ETI PIC programmer Programs 16C54/55/56/57/58, 16C64, 16C71/74, 16C84. Operates over serial link to a PC. Includes all components, PCB and programmed PIC, plus Windows and DOS software and latest versions of Microchip's assembler and Simulator on 3.5" disk. ZIF sockets not included (these are not essential and may be added later)

Add £7.50 for a serial cable to link either project to the PC. Add £3.00 for Postage, Packing and Handling, all orders which are held in stock will be sent by return, first class post. Send a cheque/PO payable to:

### Forest Electronic Developments,

10 Holmhurst Avenue, Christchurch, Dorset, BH23 5PQ.  
Sales queries, 01425-275962, Technical queries, 01425-274068  
Visit our web site at <http://www.ibmpcug.co.uk/~gawarner/>

## IIE PC Application Projects

Master your computer - Release its power

Projects use PRINTER or SERIAL ports - No need to open your PC

Expand printer ports to 24 I/O lines

**CENTRONIC 24 LINE I/O CARD**

K04 Kit: £27 Assembled: £38

Expand serial ports to 24 I/O lines

**RS232 24 LINE I/O CARD**

K04 Kit: £31 Assembled: £43

16 ch, 12 bit AD with variable gains

(10,100 and 1000) plus 8 output lines

**PRECISION DATA LOGGER**

K15 Kit: £65 Assembled: £90

Drive up to 3 stepper motors with 8 digital

I/O lines plus 11 analogue inputs (8 bit AD)

**VERSATILE STEPPER MOTOR BOARD**

K09 Kit: £35 Assembled £50 (1 driver)

Connect your pc to the real world smartly.

**'POCKET' CENTRONIC DATA LOGGER**

K16 Kit: £47 Assembled: £55

Create a robot of your own *I can walke, turn, 'speak' and ....*

**THE CENTRONIC MOBILE ROBOT**

K01 Kit: £33 Assembled: £48

**CENTRONIC EXPLORER KIT** £17

**RS232 EXPLORER KIT** £18

**PC RADIO LINK (pair)** £75

**HEART BEAT RATE MONITOR** £33

**SMART MAINS CONTROLLER** £75

Please ask for latest catalogue

Prices in pound sterling and VAT included. Add £3 P&P in UK (£6 abroad)

and make cheque payable to 'Innovative Interfacing Ent.' Send your order to:

IIE, 58 Lamport Court, Manchester M1 7EG, U.K. Tel/Fax: +44-(0)161-272-8279

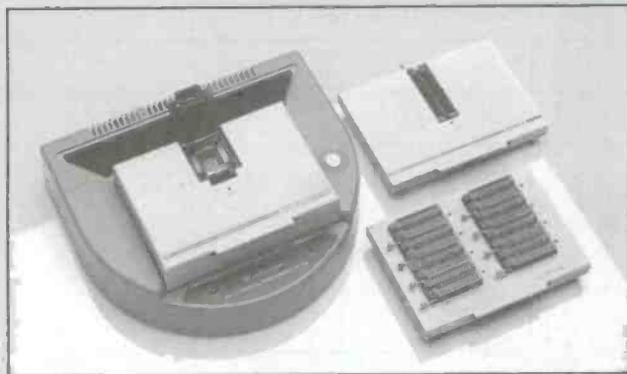
## ★★ FOR SALE ★★

DEFENCE & AEROSPACE INDUSTRY  
ELECTRONIC EQUIPMENT & COMPONENTS ALL HIGH QUALITY SURPLUS  
MANY SPECIALS. WE STOCK 1000 +  
ITEMS & IF WE DON'T STOCK IT WE MAY  
BE ABLE TO GET IT FOR YOU

PLEASE WRITE OR PHONE FOR LISTS  
OR REQUIREMENTS

**MAYFLOWER ELECTRONICS**  
48 BRENDON ROAD,  
WATCHET, SOMERSET, TA23 0HT  
TEL (01984) 631825 FAX 634245

# Programming Solutions



## Multi-Device Programmer

- ◆ EPROMs, E<sup>2</sup>PROMs, Flash EPROMs, Serial E<sup>2</sup>PROMs, PLDs, GALs, PEELs, EPLDs, MACHs, & WSI PSDs Micros - Intel, Microchip, Motorola, Zilog
- ◆ Fast programming algorithms.
- ◆ Connects direct to pc printer port.
- ◆ Simple full colour software.
- ◆ No expensive adapters.

ONLY  
**£325**

Prices exclude VAT & Delivery

**SMART**  
COMMUNICATIONS

2 Field End • Arkley • Barnet • Herts • EN5 3EZ • England  
Telephone +44 (0)181 441 389-0 Fax +44 (0)181 441 1843

## Universal Programmer

- ◆ Uses standard pc printer port works with notebook and handbook pc's
- ◆ Pin driver expansion can drive up to 256 pins.
- ◆ Supports over 2000 IC's - 3 and 5 volt devices. EPROMs, E<sup>2</sup>PROMs, Bipolars, Flash, Serial EPROMs over 150 microcontrollers, WSI/Philips PSDs, PLDs, EPLDs, PEELs, PALs, GALs, FPGAs including MACH, MAX, MAPL & Xilinx parts
- ◆ Universal DIL (up to 48 pins), PLCC and gang PACs
- ◆ Powerful full colour menu driven software.
- ◆ Approved by AMD, TI, NatSemi, etc...
- ◆ Tests TTL, CMOS and SRAM devices (including SIMMS)

ONLY  
**£595**

## Eprom Programmer

EPROMs, E<sup>2</sup>PROMs, Flash and 8748/51 micros.  
Fast programming algorithms. Simple colour menu operation.

ONLY  
**£139**

**EMULATORS • SIMULATORS • COMPILERS • ASSEMBLERS**  
**PROGRAMMERS • 8051 8085 28 68020 77C82 80C552**  
**320C25 68HC11 6301 6502 87C751 65816 280 6809**  
**PIC 7720 MIPS etc.**

# the VIDEO CHECK

**Bart Trepak's project will stop your children watching too much T.V.**

Until quite recently, the domestic television was regarded by most people as a pleasant diversion from everyday cares and a source of relaxation or, at worst, a waste of time which could be better spent reading books, pursuing sports or simply talking to other people. The steady increase in the number of available channels due to the introduction of satellite and the longer broadcasting hours of the terrestrial channels, however, seems to have been accompanied by a steady decline in the number of worthwhile programs to watch; so much so, that some MPs and at least one minister have expressed their concern at the declining standards, especially of children's programmes. One has only to watch some of the offerings on children's TV, with the seeming concentration on third-rate cartoons introduced by moronic presenters trying to act like kids, to see what they mean.

With the introduction of cable TV, it is quite possible that the standard of programmes will decline further as hard-pressed producers will have to scrape the bottom of the programme

barrel to fill an ever-growing number of channels for even longer periods at lower and lower cost. No matter how bad or boring the programmes get, however, they seem to have a mesmerising effect on some children (and adults) who seem to become quite incapable of finding anything else to do other than watching TV once it is switched on.

Those that do, often substitute the video game for the cartoon or game show and can easily spend hours making one of the Mario Brothers jump various obstacles to the sound of a mind-numbing tune. This activity has also attracted its share of condemnation from psychologists and doctors who fear that the repetitive images may cause epilepsy in some children not to mention other less obvious psychological or sociological problems.

Most worrying of all, perhaps, is the problem, highlighted by the James Bulger murder, of youngsters watching so-called "adult" movies from video tapes, some of which, it could be argued, are even unsuitable for many adults and which some researchers believe can give rise to copycat behaviour.

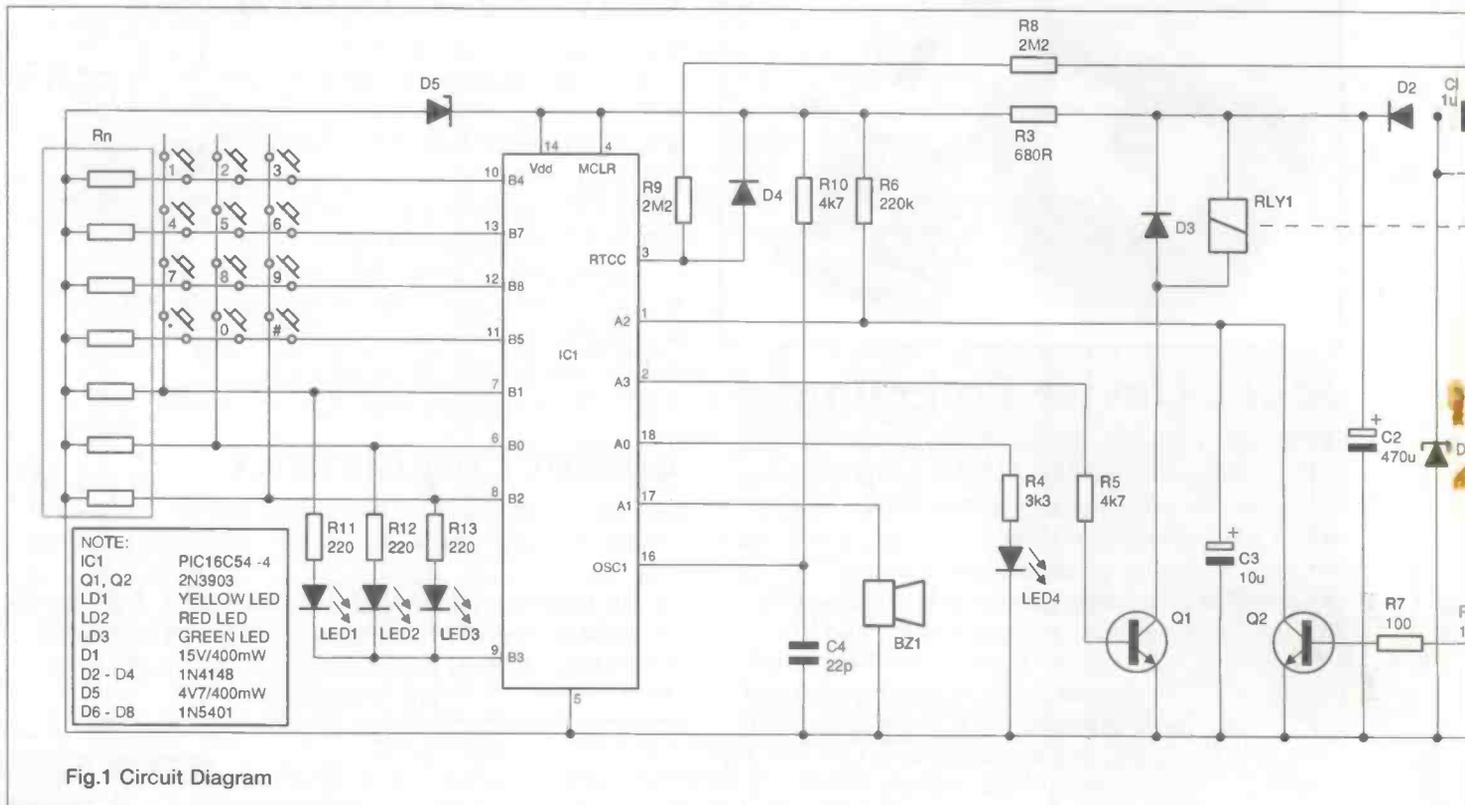


Fig.1 Circuit Diagram

Children, as every parent knows, seem to have a talent for circumventing authority and it is often difficult for parents to supervise what their children are watching or how long they spend in front of the TV. Experience has shown that once the TV is on, it is often difficult to switch it off without arguments breaking out or endless negotiations about when the evening's homework will be done if only the programme which is now on, can be watched. Often the current programme is followed by one which is even more "interesting" and the negotiations have to start all over again.

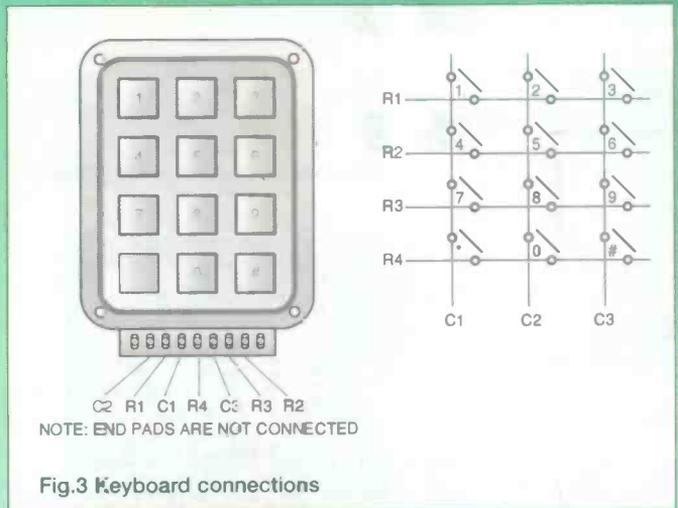
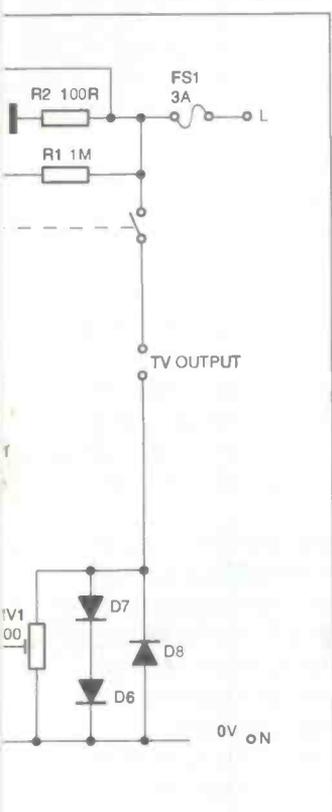
Various products have appeared on the market from time to time for disabling the video recorder by means of a lockable dummy cassette which prevents the insertion of another but this only tackles one of the problems outlined above and is more suitable as an anti-theft deterrent. A far better method would be to disable the television itself as this would make it impossible to play video games or watch unsuitable material from whatever source. The idea for this project came to me when I decided to try to wean my eight year-old son off of watching too much TV during the school holidays by simply removing the fuse from the mains plug one evening. It took him about five minutes the next morning to locate this "fault" and, helping himself to some spare fuses from my toolbox, repaired it and was watching TV before I knew what had happened! I realised that something more sophisticated was required.

## The Psychology

What was needed was a device which could be switched on and off and could control the mains supply to the television set by the parent but not by the children. Fitting a key operated switch to the TV seemed like a very low-tech idea and not all that inexpensive and when added to the inconvenience of having to carry/hide/misplace keys, it was quickly discounted. Having recently designed a digital lock using a microcontroller, I felt that this was the obvious answer to the above problem. This could easily be adapted to control a relay which could be inserted into the mains lead to prevent the TV from being switched on unless the correct code was entered. A slight

modification would be needed to ensure that once the TV was switched off, the relay would also open so that the code would need to be entered again before the TV could be switched on again. This would save the bother of having to remember to enter the code each time the TV was switched off and eliminate the possibility of forgetting to do this and leaving the TV enabled by mistake.

Unfortunately, because it is usually easier to agree on when the homework has to be done and how much time can be spent in front of the TV before the TV is switched on, rather than try to switch the TV off in the middle or even at the end of a programme, this simple scheme would do little to stop the arguments or relieve the parent from having to time the children's viewing. A timer would therefore be useful so that the viewing time could be preset with the prior agreement of all concerned after which the TV would switch off automatically without



intervention.

A further improvement could be obtained by fitting a clock instead of a simple timer. This would permit the TV to be enabled for a pre-programmed period of time between the hours of say 3.00pm and 9.00pm and leave the choice of what to watch up to the children, thus preventing the almost round the clock TV viewing which can occur during the school holidays.

Thus, if, say, a two-hour period was programmed into the unit, the TV could be used from 3.00pm to 5.00pm or from say 3.30pm to 4.00pm and again from 6.00pm to 7.30pm or any combination of times up to two hours with the unit switching off at 9.00pm even if the TV had not been on for the full two hours. This would also have the added bonus of making bedtime easier to organise. The 9.00pm deadline was chosen because this is the time before which the terrestrial channels have agreed not to broadcast programmes which may be considered unsuitable for children.

Being a responsible adult myself, I still wanted to be able to switch on the TV outside these times (so that I could monitor the programmes the TV companies were putting out and check out their suitability for children - of course) so provision for this would also have to be made. The unit has therefore been designed so that it can be switched on and off at any time simply by entering the correct code while still permitting the children to watch TV only for the allowed period.

## The electronics

So much for the psychology - now for the electronics. A keyboard would obviously be required to enable the "on" code to be entered as well as the allowed viewing period and the time of day so that the unit could keep track of the time and switch the mains supply to the TV at the appropriate times as well as automatically enabling the TV the next day. A display was also considered but it was felt that this would not really be much use other than in showing how much time had elapsed. It would also add yet another display of the time to the existing battery of displays on the video recorder, TV etc which already showed this. So, to keep the unit simple and reduce cost, this was rejected.

The time would be set as a four-digit number in the standard 24-hour format, while the allowed viewing time as a three-digit number of minutes. A display for this was not essential either. To prevent errors, the programme has been designed to accept only valid times and a maximum allowed time of 359 minutes (6 hours). The "on code" is also a four-digit number which gives good security and is short enough to

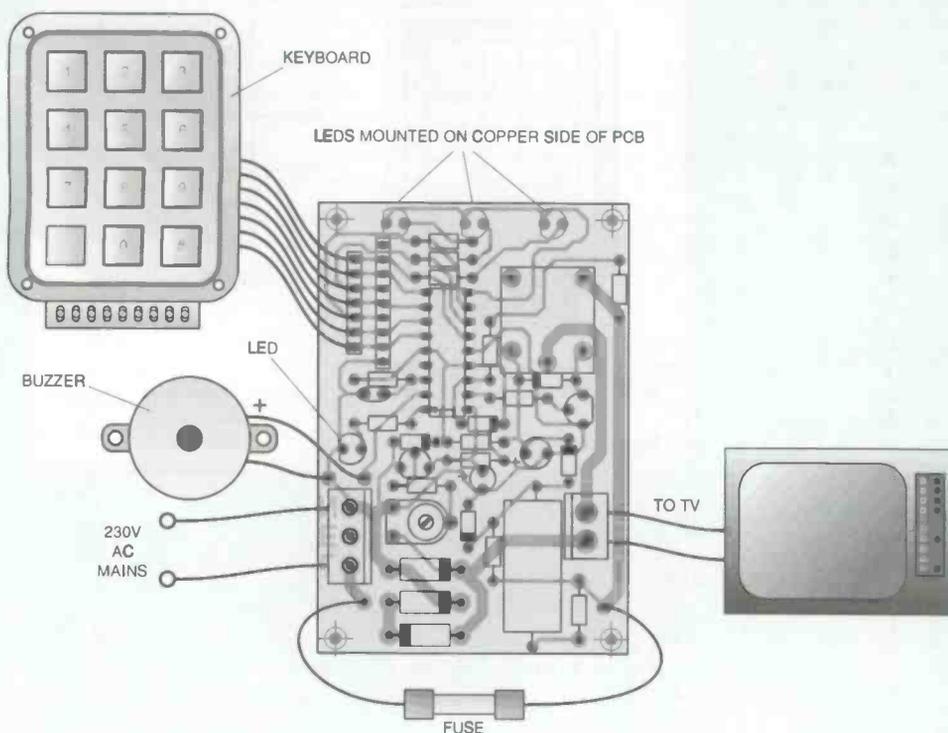


Fig.4 Videocheck wiring diagram

remember easily. All of these parameters (ie. code, viewing time and time of day) can be varied and reprogrammed at will (provided, of course, that the correct "code" is entered first) and, as long as power is maintained, they will be stored. To enable the user to ascertain which parameter is being changed during programming, three LEDs are included, together with an LED which stays on, flashes at 1Hz or goes out to indicate that the unit is working, timing or in the programme mode.

A buzzer was also considered desirable because it is apparently vitally important not to have the unit switch off without warning at a crucial point when playing some video games, especially when a high "level" has been reached. The unit has therefore been designed to give a warning bleep ten minutes before the time is due to run out and then every minute during the final five minutes so that the user is not caught unawares. The buzzer is also used to indicate that an error in setting the unit had been made such as attempting to enter a time of, for example, 26:78 or a viewing time of 475 minutes.

Since the unit is to be mounted in the mains lead, the voltage across the TV mains switch cannot be used to determine if the TV is on, so a line current sensor is required to monitor the current taken by the set. The 50Hz mains signal can, however, be utilised as a timebase for the clock and timer. Unplugging the unit from the mains socket would, of course, stop the clock and timer, so that any times set would be lost, so the unit is designed to sound the buzzer continuously when the power is re-applied to signal that there has been a power failure and any times set will have been lost. To prevent this from being turned to advantage by enterprising "young engineers", the output is switched off and the allowed viewing time is also reset to zero when the power is restored. Unfortunately, the "on code" is also lost and reverts back to the pre-programmed number so this must be kept secret to prevent the circuit being activated by switching the mains off and re-programming it with a new number. An EEPROM store

for this was considered but was felt to be an unnecessary addition, especially as most children would be unaware of this possibility of defeating the system.

As the circuit would be mounted in the mains lead, it could obviously be mains powered and a simple power supply would suffice. Because there would then be no real need to maintain isolation from the mains, therefore opto isolators for the mains inputs to the micro-controller would not be used.

### The circuit

The circuit diagram is shown in Fig 1. As we are using a micro-controller, all the clever stuff is done by this, leaving the mundane things like driving the relay and seeing if the TV is on to TR1 and TR2, resulting in a relatively simple circuit.

C1, R2, D1, D2 and C2 form a 12 V DC supply for the relay which is further reduced to 5 V for IC1 by R3 and D5. The unit needs to

"know" if the TV is switched on, to enable the period for which the TV is used to be timed. The only way of sensing this without tampering with the TV set is to sense the mains current drawn. A simple mains current detector is used, which utilises the voltage drop in two power diodes D6 and D7 to turn on transistor TR2 which keeps capacitor C3 discharged and holds input A2 of the micro-controller low when the set is switched on. The value of R6 is chosen so that the capacitor does not have time to charge up during the negative mains half-cycle when TR2 is turned off so that A2 remains low until the power is cut or the TV is switched off. D8 is necessary to allow AC to flow to the load. The voltage across the two diodes can be reduced by VR1, allowing the current level at which the TV is considered to be on, to be adjusted to enable the TV to be set to standby (when it will still be drawing some current) without the timing being continued.

The on chip oscillator frequency is defined by resistor R10 and capacitor C4. Because this is not stable enough for a clock, the mains frequency is used as a timebase and this is connected to the RTCC input via resistors R8 and R9. Diode D4 is included to prevent the voltage at this pin from exceeding the supply voltage which could damage the chip.

Most of port A is programmed as an output and is used for controlling the buzzer BZ1, the TIME RUNNING indicator LED4 and the relay RLY1 via the transistor TR1. Only port A2 is configured as an input to read the "TV on" signal from TR2 as described above.

Port B is used for reading the keyboard (arranged as a row and column matrix) and driving the PROGRAMME INDICATOR LEDs LED1 to LED3. For this, B0, B1 and B2 are programmed as outputs and are driven high in turn. B4, B5, B6 and B7 are configured as inputs and are read by the programme. If B1 is high and key 4 happens to be pressed, the read operation will result in B7 being read as high while, if key 7 had been pressed, B6 would have been read as high. Similar routines are used with the other columns driven by B0 and B2 and in this

way, the processor can determine which key, if any, has been pressed. The LEDs LED1-LED3 are driven in a similar way with B0, B1 and B2 being made high in turn and output B3 going high (+5V) when the LED is to stay off and low if it is to light.

## Programming

In its basic operation, the unit can be regarded as a simple digital clock (albeit without a digital display), with a built-in timer, which can be programmed to give an "allowed viewing time" of up to a maximum of 359 minutes (six hours). At 15:00 (3pm), the timer is loaded with the previously set "allowed viewing time" and if the TV set is switched on, the timer will count down every minute. If the TV is switched off or the code entered to permit unrestricted viewing, the counting will cease until either the set is switched on again or the code is entered again. When the count reaches zero or the time in the clock reaches 21:00 (9pm), assuming that the code has not been entered to permit unrestricted viewing, the output will switch off, cutting the mains supply to the set.

The software has been designed to enable the output to be over-ridden at any time by entering the 4-digit code, so that the TV can be enabled at any time of the day. Thus, the timing can be suspended, as can the 9:00pm switch off, by entering the preprogrammed 4-digit code to allow for special eventualities such as a TV programme over-running the 9.00pm deadline or if longer viewing times are to be permitted, without the need to re-programme the device each time. Normally, when the output is on (i.e. between 3:00pm and 9:00pm and the timer has not timed out), the TV can be switched on and off at will but, once outside the allowed time (i.e. between 9:00pm and 3:00pm the next day or when the timer has timed out), the output and hence the TV can only be switched on by entering the code first. In this case, the TV must be switched on within five seconds of entering the code because otherwise the output will turn off again, as it will if the TV is subsequently switched off. Entering the code again when the output is on will also switch the output (and the TV) off whereas, during the allowed viewing time, the output will remain on and only the timer will be switched off, allowing the TV to be watched beyond the 9:00pm deadline or when the timer would normally have timed out.

The digits must be entered within five seconds of each other, otherwise they will be considered to be separate entries. Thus if the "code" is 1056, for example, and 105 is entered followed by a gap of more than five seconds, the unit will not switch on when the final "6" is keyed as it will regard the "6" as the first digit of a new attempt at entering the code. Any errors are ignored and there is no keyboard lockout, so any sequence of numbers which includes 1056 with no incorrect digits inbetween will switch the unit on.

At power up, the unit will start with the relay off, the time set to 21:00 (i.e. 9pm) and an initial code (1111) which must be entered to enable the output to be switched on and the unit programmed. (NOTE: The pre-programmed PIC for this project will normally be supplied with this default 4-digit code. If you require another code number, please specify at the time of ordering.) The CLOCK/TIMER RUNNING LED will be on continuously to indicate that the clock is running and the buzzer will emit ten beeps, followed by a continuous sound.

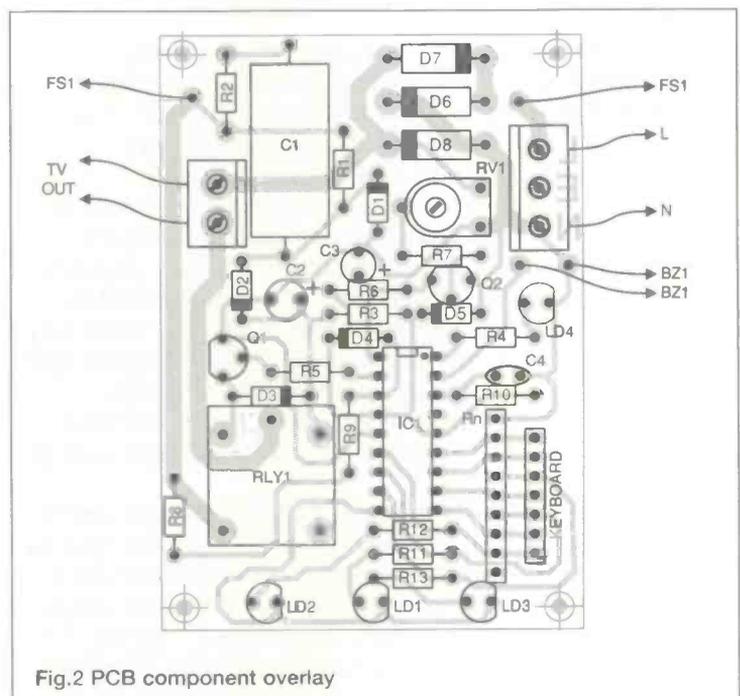
To enter the programme mode, the 4-digit code must be followed by the "\*" key (within five seconds) which will cause the PROGRAMME CODE LED indicator to light and the CLOCK/TIMER RUNNING LED to go out, signifying that the clock has been stopped. The new 4-digit code (or the old one

if no change to this is required) must now be entered followed by the "\*" key which will cause the indicator to go out returning the unit to the normal mode. Note that if more than four digits are entered, only the last four will form the new code. If fewer than four digits are entered before the \* key is pressed, the buzzer will sound an alarm and the unit will remain in the programme mode until the remaining digits have been entered and the "\*" key pressed. All keys are valid except \* and # and there is no time restriction on the entry of digits in the programming mode.

If the allowable viewing time is also to be entered/alterd, then instead of pressing the "\*" key, the "#" key should be pressed. This will store the code, switching off the PROGRAMME CODE indicator but, instead of returning the unit to the RUN mode, will light the PROGRAMME VIEWING TIME LED. Here a 3-digit number can be entered, representing the number of minutes for which viewing will be permitted, with the maximum time being 359. Again, only the last three digits are accepted and any attempt to enter a time greater than 359 minutes will cause an error consisting of three beeps, in which case another digit will have to be entered. Thus, if the first entry is 5, this will be ignored and an error signalled until a digit of 3 or less is keyed in. Any digit of 5 or less is acceptable for the second digit. If a time of less than 100 is to be entered, a zero should be keyed first (e.g. 058 or 005 if only five minutes are to be allowed, although, in this case, a better solution may be to sell the TV!).

Note that although the allowed time entered is stored as soon as the "#" key is pressed, it is only loaded into the timer counter when the clock reaches 15:00 or is set to a time between 15:00 and 21:00.

If the time of day is also to be altered, then again instead of entering "\*", the "#" key should be pressed. This will cause the PROGRAMME CLOCK LED to light. A 4-digit number representing the time of day in the 24 hour clock format (i.e. 0916 for 9:16 am or 1723 for 5:23pm) can then be entered and, assuming that a valid time has been entered, pressing the "\*" key will put the unit back to the running mode with the CLOCK/TIMER RUNNING LED on. If the # key is pressed, the PROGRAMME CODE LED will light again, allowing this to be



altered again if required.

If an allowed viewing time greater than zero (i.e. 000) has been entered and the time set is between 15:00 and 21:00 then the output relay will remain on when the "\*" key is pressed to enter the RUN or normal mode. In this case, assuming that the TV is on, the CLOCK/TIMER RUNNING LED will flash once per second to indicate that the timer is also counting. In other cases, the output will switch off and become active only when a time of 15:00 is reached.

Note that during the programme mode, the output is switched on and the CLOCK/TIMER RUNNING LED goes out to indicate that the unit is not counting. It switches on or resumes flashing only when the "\*" key is entered and the unit reverts to the RUN mode. This can be used to set the clock precisely by setting the time one minute ahead of the current time pressing the "\*" key when the time entered is reached.

## Construction

Although, at a pinch, the circuit could be built on stripboard, a printed circuit board will make construction quicker and much less error-prone which is very important, especially as there are mains voltages present on the board. A suitable printed circuit board layout is shown in Fig 2. Whatever method of construction is chosen, care should be taken to ensure that all diodes, transistors, electrolytic capacitors and the integrated circuit are fitted to the board the correct way around, otherwise component damage may occur. Note also that the resistor network Rn which consists of 7 resistors with a common connection must be fitted the correct way around, the common connection usually being indicated by a dot on the component. The board is laid out to accept a 7- or 8-way resistor network depending on what is available. The microprocessor is a CMOS type and although the input circuitry at the pins has been designed to protect the device from electrostatic damage it is best to fit a suitable ic. socket to the board and fit the chip to this when assembly is complete.

The order in which the circuit is assembled is, of course, unimportant but it is usually best to begin with the low profile components such as resistors and diodes and then progress to the taller ones (capacitors, transistors, LED and terminal blocks).

The circuit is designed to operate with virtually any keyboard as long as it has matrix connections (ie. Rows and Columns) and is not one with a common connection. The connections for the keyboard used are shown in Fig 3. However, if your keyboard does not have the same connections, this is not too important as long as the column connections of the keyboard are connected to the column connections on the printed circuit board. The same applies to the rows. The circuit will work although the numbers will be different and in particular the functions of the \* and # keys may be performed by two of the numbered keys. It is therefore best to adhere to the connections as shown in order to avoid confusion. The keyboard may be wired to the printed circuit board using a short piece of ribbon cable or individual wires as preferred.

Depending on the box chosen, the LEDs may also need to be mounted on the box and connected to the printed circuit by means of short pieces of wire. The fuse is best mounted in a panel-mounted fuse holder so that it may be changed, should the need arise, without having to open the box. This, too, should be connected to the appropriate points on the printed board with suitable wire. The circuit can then be built into the

box and, after testing, the lid glued permanently so that no attempt can be made by "budding engineers" to try to open the box in an effort to by-pass the internal relay. This would not only defeat all the clever electronics inside but could also be extremely dangerous.

## TESTING

REMEMBER THAT THIS CIRCUIT OPERATES AT MAINS POTENTIAL AND DANGEROUS VOLTAGES EXIST AT VARIOUS POINTS IN THE CIRCUIT. SWITCH OFF AND DISCONNECT THE CIRCUIT FROM THE MAINS BEFORE ATTEMPTING ANY MODIFICATIONS OR SOLDERING.

Since the circuit uses a microprocessor to define the logic, then assuming all the external connections to the chip are correct there is very little to go wrong and there is virtually no "setting up" other than to check that the circuit is working and familiarise yourself with its operation. The unit should be connected to the mains and the TV as shown in Fig 4. Before plugging in the chip, switch on and check that you have 5V between pins 5(-) and 14(+) of the i.c. socket with a voltmeter. If this is not the case, check the polarity of the Zener diodes D1 and D4 as well as diode D2 and capacitor C2. If all is well, switch off and insert the chip into its socket with the notch marking pins 1 and 18 nearest the mains input and output terminals and switch the power back on, ensuring that the TV is switched off.

The circuit should produce ten beeps followed by a continuous sound and the CLOCK/TIMER RUNNING LED (LED4) should be on with the relay remaining off. Enter the code 1111 and check that the relay is energised and switched off again after five seconds. Enter the code again but, this time, press the "\*" key before the relay switches off. LED2 should now light and the relay will remain energised with LED4 going out.

Connect a voltmeter set to measure 5 Volts across C3 and switch on your TV. The voltage should drop to zero or less than 1 Volt. If your TV has a standby mode, switch it to this and adjust VR1 for a reading of at least 2 Volts. Any setting of VR1 which gives a voltage of less than 1 volt when the TV is on and greater than 2 Volts when it is off or on standby is correct. Switch off the TV or set it to standby.

You may now enter a new code or the same one if you do not want to change it. Initially, key in only two numbers and then press "#" or "\*". The unit will respond with three beeps to indicate an error and LED2 will remain lit. Only after entering at least four numbers (a new valid code), will LED2 go out and LED1 light if "#" is pressed, or all the LEDs go out and LED4 switch on if "\*" is entered to return the unit to the RUN mode.

If LED1 is lit, you may enter a suitable "Viewing Time" up to a maximum of 359 minutes. Again, try making some "errors" like pressing 4 first and note the error warning which is given. Eventually, enter a "viewing time" of 1 minute (001) before pressing the "#" key to go into the SET TIME mode. If you make a mistake, continue entering (valid) numbers and press "#" each time until the entry is accepted - LED1 goes out and LED3 lights. Press the "#" key three times to return the unit to the "Programme Viewing Time" mode again with LED1 lit and enter the correct time. Note that invalid entries are ignored so that if you want to set a time of, say, 120 minutes but key in 4,1,2,0 then the 4 will not be stored. If you enter 1,4,2,0

however, this will be accepted as 0 (the 142 being discarded because a fourth digit had been entered which will be regarded as the first digit of a new number) and the unit will not allow you to exit from this mode until two more valid digits have been entered. The above procedure of entering numbers until accepted and then re-entering the required number should therefore be adopted if a mistake is made or you are unsure of which numbers you have entered.

In the SET TIME mode, with LED3 lit, again only valid entries will be accepted. These should be in the 24-hour format (e.g. 2358, 0936, 1343 etc) and each four digit group of valid numbers will be accepted when the "#" or "\*" key is pressed. If an invalid digit is entered, a warning will be generated and the entry ignored while if a fifth (valid) digit is entered, it will be regarded as the first digit of a new entry and in the case of confusion, the procedure described in setting the "Allowed Viewing Time" should be adopted. Initially, enter the time to 1459 and press the "\*" key.

The unit will resume counting, switching on LED4 to show that the clock is running and the relay will switch off. After one minute, the relay will switch on (i.e. when the time reaches 15:00). Leave the unit in this state for a few minutes with the TV off and check the the relay is still energised after this time by switching on the TV which should now remain on for the allowed one minute. Note that this time may be somewhat less than one minute, depending on the precise point in the clock minute cycle when the TV was switched on as the clock and timer are incremented at the same time. LED4 will now flash at a rate

of once per second to indicate that the timer is running. Switching off the TV or entering the code will disable the timer which will cause LED4 to stop flashing and light continuously.

The above procedure may be repeated but, this time, set the "Allowed Viewing Time" to 11 minutes (011) and the time to 15:00 or any other time between 15:00 and 21:00. This time when the "\*" key is pressed, the relay will remain energised and allow the TV to be left on for 11 minutes. Switch on the TV (LED4 flashing) and after the first minute, the unit will emit five beeps to signify that there are ten minutes of viewing left. After five minutes, another warning (five beeps) will be given and thereafter each minute will be marked by four, three or two beeps depending on the number of minutes left. When only one minute is left, ten beeps will be sounded to warn the viewer in no uncertain terms, that "Mario" is about to be zapped, no matter how expertly the joystick is manipulated or how great a score has been reached. Only if the code is entered (by a relenting parent) before the minute is up will play be allowed to continue.

Similar checks can be made to ensure that the relay will switch off at 21:00 even if the timer has not timed out, or that the unit can be switched on and off outside the allowed viewing time by entering the correct code.

Although the programming may appear complicated, it is quite logical and certainly more so than many video recorders on the market. If you still cannot figure it out, then, as with video recorders you can always get the children to do it, but make sure that you keep the initial code number a secret!

## PARTS LIST

<b>R1</b>	<b>1MOhm</b>	<b>C1</b>	<b>1uF/400V</b>
<b>R2</b>	<b>100 Ohms1W</b>	<b>C2</b>	<b>470uF/16V</b>
<b>R3</b>	<b>680 Ohms</b>	<b>C3</b>	<b>10uF/16V</b>
<b>R4</b>	<b>3.3kOhms</b>	<b>C4</b>	<b>22pF Ceramic</b>
<b>R5</b>	<b>4.7kOhms</b>	<b>D1</b>	<b>15V/400mW Zener</b>
<b>R6</b>	<b>220kOhms</b>	<b>D2, D3, D4</b>	<b>1N4148 Diode</b>
<b>R7</b>	<b>100 Ohms</b>	<b>D5</b>	<b>4V7/400mW Zener</b>
<b>R8, R9, 2M</b>	<b>Ohms</b>	<b>D6, D7, D8</b>	<b>1N5401 Diodes</b>
<b>R10</b>	<b>4.7kOhms</b>	<b>LD1</b>	<b>Yellow LED</b>
<b>R11, R12, R13</b>	<b>220Ohms</b>	<b>LD2, LD4</b>	<b>Red LED</b>
<b>Rn</b>	<b>7 or 8x 10kohm SIL Resistor network</b>	<b>LD3</b>	<b>Green LED</b>
<b>VR1</b>	<b>100 Ohm pre-set (horizontal)</b>	<b>TR1, TR2</b>	<b>2N3903 NPN Transistor</b>
<b>IC1</b>	<b>PIC16C54-4 Programmed*</b>		

**RLY1** 12V/400 Ohm coil 3A/240Vac contacts, 12-way (4x3) Matrix Keyboard, 2-Way and 3-Way pcb terminal blocks, 18 pin dil ic socket, 20mm Panel mounting Fuse holder, 20mm 3Amp Fuse, Miniature 6 Volt Piezo Buzzer, Printed circuit board, Box to suit.

\* A pre-programmed PIC16C54-4/F for this project is available from the author at £9.50 each. Customers outside UK please add £2.00 postage. Send orders to: B. Trepack, 20 The Avenue, London W13 8PH enclosing a cheque or Postal Order. Please state "VIDEOCHECK" on your order.

**Next month, the complete Videocheck Assembler Code**

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 - ALL EXPANDABLE - ALL PC COMPATIBLE

### SPECIAL BUY AT 286

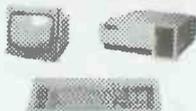
40Mb HD + 3Mb Ram



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 £149.00 (E)**  
CALL FOR QTY DISCOUNTS

Optional Fitted extras: VGA graphics card	£29.00
1.4Mb 3 1/2" floppy disk drive (instead of 1.2 Mb)	£24.95
NE2000 Ethernet (thick, thin or twisted) network card	£49.00

### PC SCOOP COMPLETE COLOUR SYSTEM ONLY £99.00



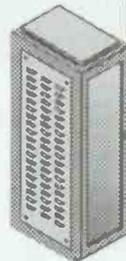
A massive bulk purchase enables us to bring you a COMPLETE ready to run colour PC system at an unheard of price! The Display Electronics PC99 system comprises of fully compatible and expandable XT PC with 256k of RAM, 5 1/4" 360k floppy disk drive, 12" CGA colour monitor, standard 84 key keyboard, MS DOS and all connecting cables - just plug in and go! Ideal students, schools or anybody wishing to learn the world of PC's on an ultra low budget. Don't miss this opportunity. Fully guaranteed for 90 Days.

Optional Fitted extras: 640k RAM	£29.00
2nd floppy drive, specify 5 1/4" 360k or 3 1/2" 720k	£29.95
Above prices for PC99 offer ONLY.	

Order as PC99COL **£99.00 (E)**

### 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 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 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)

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

5 1/4" from £22.95 - 3 1/2" from £24.95

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	£24.95 (B)
3 1/2" Mitsubishi MF355-C-L 1.4 Meg. Laptops only *	£36.95 (B)
3 1/2" Mitsubishi MF355-C-D 1.4 Meg. Non laptop	£29.95 (B)
5 1/4" Teac FD-55GFR 1.2 Meg	£29.95 (B)
5 1/4" BRAND NEW Mitsubishi MF501B 360K	£22.95 (B)
* Data cable included in price.	
Shugart 800/801 8" SS refurbished & tested	£195.00 (E)
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" drives with 2 mbyte capacity housed in a smart case with built in power supply. Ideal as exterior drive!	£499.00 (F)

### HARD DISK DRIVES

End of line purchase scoop! Brand new NEC D2246 8" 85 Mbyte of hard disk storage! Full Industry standard SMD Interface. Ultra hi speed data transfer and access time, replaces Fujitsu equivalent model. Complete with manual. Only **£299.00 (E)**

3 1/2" FUJII FK-309-26 20mb MFM I/F RFE	£59.95 (C)
3 1/2" CONNER CP3024 20 mb IDE I/F (or equiv) JRFE	£69.95 (C)
3 1/2" CONNER CP3044 40mb IDE I/F (or equiv) RFE	£89.00 (C)
3 1/2" RODIME R03057S 45mb SCSI I/F (Mac & Acorn)	£99.00 (C)
5 1/4" MINISCRIBE 3425 20mb MFM I/F (or equiv) RFE	£49.95 (C)
5 1/4" SEAGATE ST-238R 30 mb RLL I/F Refurb	£69.95 (C)
5 1/4" CDC 94205-51 40mb HH MFM I/F RFE tested	£69.95 (C)
8" FUJITSU M2322K 160Mb SMD I/F RFE tested	£195.00 (E)
Hard disk 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!

The TELEBOX consists of 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 tunable '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 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	£34.95
TELEBOX STL as ST but with integral speaker	£37.50
TELEBOX MB Multiband VHF-UHF-Cable-Hyperband tuner	£69.95
For overseas PAL versions state 5.5 or 6mhz sound specification.	
*For cable/hyperband reception Telebox MB should be connected to cable type service. Shipping code on all Teleboxes is (B)	

### FANS & BLOWERS

MITSUBISHI MMF-D6D12DL 60 x 25 mm 12v DC	£4.95 10 / £42
MITSUBISHI MMF-09B12DH 92 x 25 mm 12v DC	£5.95 10 / £53
PANCAKE 12-3.5 92 x 18 mm 12v DC	£7.95 10 / £69
EX-EQUIP 120 x 38mm AC fans - tested specifiy 110 or 240 v	£6.95
VERO rack mount 1U x 19" fan tray specifiy 110 or 240v	£45.95 (B)
IMHOF B26 1900 rack mnt 3U x 19" Blower 110/240v NEW	£79.95
Shipping on all fans (A). Blowers (B). 50,000 Fans Ex Stock CALL	

### IC's - TRANSISTORS - DIODES

OBSOLETE - SHORT SUPPLY - BULK

5,000,000 items EX STOCK

For MAJOR SAVINGS - SAE or CALL FOR LATEST LIST

### 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 monitor with fine 0.28 dot pitch tube and guaranteed resolution of 1024 x 768. A variety of inputs allows connection to a host of computers including IBM PC in CGA, EGA, VGA & SVGA modes, BBC, COMMODORE (including Amiga 1200), ARCHIMIDES and APPLE. Many features: Etched faceplate, text switching and LOW RADIATION MPR specification. Full 90 day warranty. Supplied in EXCELLENT little used condition.

Tilt & Swivel Base	£8.00
Leads for IBM PC	£8.95 (A)
External cables for other computers £ CALL	

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 monitoring / security applications with direct connection to most colour cameras. High quality with many features such as front concealed fan controls, VCR connection button etc. Good used condition - fully tested with a 90 day guarantee. Dimensions: W14" x H12 3/4" x 15 1/2" D. **Only £99 (E)**

Special Offer save £16.95 - Order TELEBOX ST & HCS35 together - giving you a quality colour TV & AV system for **Only £122.50 (E)**

KME 10" high definition colour monitors. Nice tight 0.28" dot pitch for 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". **Only £125 (E)**  
Good used condition. 90 day guarantee.

KME 10" as above for PC EGA standard **£145.00 (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 with a 90 day guarantee (possible minor screen bums). In attractive square black plastic case measuring W10" x H10" x 13 1/2" D. Mains powered. **Limited Quantity - Only £79.00 (D)**

### 20" 22" and 26" AV SPECIALS

Superbly made UK manufacture. PIL all solid state colour monitors, complete with composite video & optional sound inputs. 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)

### DC POWER SUPPLIES

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

### SPECIAL INTEREST

Zeta 3220-05 A0 4 pen HPGL RS232 fast drum plotter	£1950
3MD VDA - Video Distribution Amps. 1 In 32 out	£375
Trlo 0-18 vdc bench PSU. 30 amps. New	£470
Fujitsu M3041 600 LPM band printer	£1950
VG Electronics 1035 TELETEXT Decoding Receiver	£3750
Andrews LARGE 3.1 m Satellite Dish & mount (For Voyager)	£950
RED TOP IR Heat seeking missile (not armed)!	POA
KNS EMC / Line interference tester NEW	£1200
Thurby LA 160B logic analyser	£375
INTEL SBC 486/133SE Multibus 486 system. 8Mb Ram	£1200
GEC 1.5kw 115v 60hz power source	£950
Brush 2Kw 400 Hz 3 phase frequency converter	£850
Anton Pillar 75 kW 400 Hz 3 phase frequency converter	POA
Newton Derby 70 KW 400 Hz 3 phase frequency converter	POA
COMPONEDEX T1000 Portable TELEX tester NEW	£250
Sekonic SD 150H 18 channel digital Hybrid card recorder	£1995
HP 7580A A1 8 pen HPGL high speed drum plotter	£1850
Computer MCA1613APC 16mm auto iris lenses 'C' mount	£125
Seaward PAT 2000 dual voltage computerised PAT tester	£585
Densel MUD 0185AH 1kVa UPS system with battery NEW	£575

### 32U - High Quality - All steel cabinet

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 full 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 louvers. The top panel may be removed for fitting of Integral fans to the sub plate etc. Other features include: fitted castors and floor levelers, prepunched utility panel at lower rear for cable / connector access etc. Supplied in excellent, slightly used condition with keys. Colour Royal blue. External dimensions 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 in all sizes 19" 22" & 24" 3 to 44 U. 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 a PCB with on board sophisticated electronics. From the board comes a standard serial RS232 or TTL output. The output 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 screen size !! So, no position, however small fails detection. 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 etc Imagine using your finger in 'Windows' instead of a mouse !! (a driver is indeed available!) The applications for this amazing product are only limited by your imagination!! Supplied as a complete system including Controller, Power Supply and Data at an incredible price of only **£145.00 (E)**  
RFE Full Software Support Available - Fully Guaranteed

### 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 disk supplied. In good used condition fully tested and guaranteed.  
Windows compatible. Order as: ABOVE CARD **£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. **£32.95 or 512k £38.95 (A1)**

SIMM OFFERS			
1 MB x 9 SIMM 9 chip 120ns only		£19.50 (A1)	
1 MB x 9 SIMM 3 chip 80 ns	£23.50	70ns	£26.00 (A1)
1 MB x 9 SIMM 9 chip 80 ns	£22.50	70ns	£28.00 (A1)
4 MB 70ns 72 pin SIMM module only			£125.00 (A1)
SPECIAL INTEL 486-DX33 CPU			£79.99 (A1)

### NO BREAK UNINTERRUPTIBLE PSU'S

EMERSON ACCUCARD UPS, brand new 8 Bit half length PC compatible card for all IBM XT/AT compatibles. Card provides DC power to all internal system components in the event of power supply failure. The Accusaver software provided uses only 6k of base RAM and automatically copies all system, expanded and video memory to the hard disk in the event of loss of power. When power is returned the machine is returned to the exact status when the power failed !! The unit features full self diagnostics on boot and is supplied brand new, with full, easy fitting instructions and manual. Normally **£189.00 NOW! £69.00 or 2 for £120 (B)**

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

Display Electronics  
-ELECTRONICS-  
ESTABLISHED 25 YEARS

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

ALL MAIL & OFFICES  
Open Mon-Fri 9:00-5:30  
Dept ETI. 32 Biggin Way  
Upper Norwood  
LONDON SE19 3XF

DISTEL © The Original  
FREE On line Database  
Info on 1000's of Items  
V21, V22, V22 BIS  
0181 679 1888

ALL ENQUIRIES  
0181 679 4414  
FAX 0181 679 1927

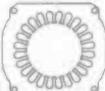
All prices for UK Mainland. UK customers add 17.5% VAT to TOTAL order amount. Minimum order £10. Bona Fide account orders accepted from Government, Schools, Universities and Local Authorities - minimum account order £50. Cheques over £100 are subject to 10 working days clearance. Carriage charges (A)=£3.00, (A1)=£4.00, (B)=£5.50, (C)=£8.50, (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 1995. E & O.E. 4/5

I Want...  
MAGNET WIRE,  
COIL BOBBINS,  
CLASS 'H'  
INSULATION  
TAPE, CORES,  
LAMINATIONS

I Want....  
Electric Motor  
Mfg Equipment,  
Commutators,  
Laminations,  
Burn-off  
Ovens

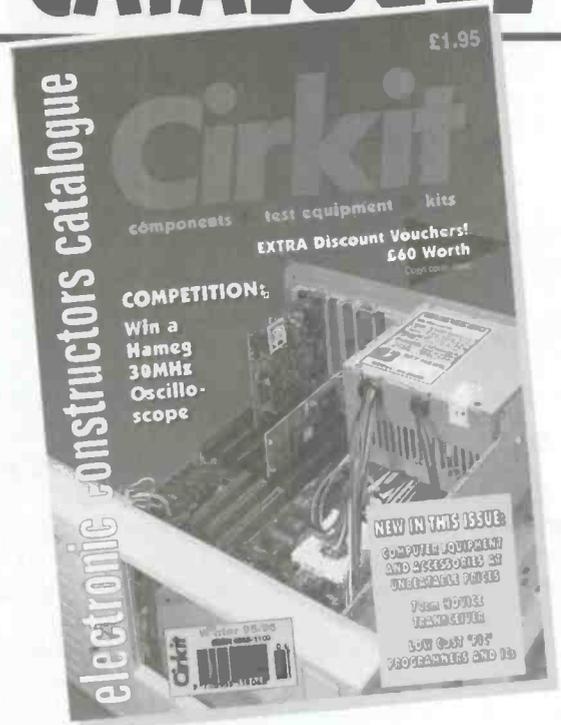
YOU WILL FIND  
IT ALL AT  
BERLIN CWIEME  
'96 EXHIBITION &  
CONFERENCE

**COIL WINDING / INSULATION  
ELECTRICAL MANUFACTURING  
EXHIBITION & CONFERENCE '96  
Berlin Messe, Berlin, Germany.  
4th to 6th June 1996**  
send for 'FREE' entry tickets and details to:

 CWIEME Inc - 2 Rosemary Road, Parkstone,  
Poole, Dorset BH12 3HB, England.  
Tel: +44 (0) 1202-380661 or 1202-743906  
Fax: +44 (0) 1202-380661 or 1202-736018

*All responses receive 'FREE' copy of 'Coil Winding/Insulation Buyer's Guide'*

# WINTER 1995/6 CATALOGUE



The new winter '95/96 edition has 280 pages packed with over 4000 products.

- ▶ New editions to our computer section further extending our range of PC components and accessories at unbeatable prices
- ▶ Free competition with a chance of winning a Hameg 30MHz oscilloscope
- ▶ 100's of new products including: Books, Component Packs, Connectors, Switches, Test Equipment and Tools.
- ▶ New range of oscilloscopes from Hameg and extended range of mobile phone batteries and accessories
- ▶ Latest PIC Microcontroller IC's and programmer
- ▶ New 70cms mobile transceiver for the novice radio amateur enthusiast
- ▶ 280 pages, 26 sections and over 4000 products from some of the worlds finest suppliers
- ▶ Available at most newsagents or direct from Cirkit
- ▶ Out 26th October 1995
- ▶ **Send for your copy today!**

**£1.95**  
+ 30p p&p

## When Performance is more important than size:-

two new re-programmable BASIC Stamp Computers.



### BS1-IC

8 I/O lines  
up to 100 program lines  
2,000 lines/sec  
Comms to 2400 baud

**£29** single price

### BS2-IC

16 I/O lines  
up to 600 program lines  
SPI, DTMF  
Comms to 19.2k baud

**£49** single price

Programming package £66

Milford Instruments Tel 01977 683665 Fax 01977 681465

# Cirkit



## Cirkit Distribution Ltd

Park Lane · Broxbourne · Hertfordshire · EN10 7NQ  
Telephone: 01992 448899 · Fax: 01992 471314

# Real Time 8 channel Logic Analyser

*A handy piece of test equipment for electronic engineers designed by Richard Grodzik*

**P**rototyping a microprocessor/microcontroller-based project is a precise science where luck does not get a look in. Unlike analogue electronics where component tolerance or even component failure could still produce a functioning circuit, no allowance for a single error is permitted in the art of microelectronics. A single corrupted bit in a Megabyte program will cause a software 'crash'. Similarly, one logic gate malfunction will render a computer kaput.

Once the hardware has been built and verified for connections, the next step is to write a small program to test the system. The prototype circuit may well mirror the hardware precisely, but what if data bus contention arises when two or more peripheral devices are being accessed at the same time?

This is a situation where the logic analyser is an invaluable piece of test equipment. Quite simply, it allows the capture of 3 bit wide data (data/address/control) bus at the system clock speed in real time, and then to be examined at leisure on the PC's screen.

Consider the following scenario which often happens when a newly constructed prototype board has been built. A small piece of software is written to, say, toggle a port pin. It doesn't work. Has the processor even got further than the reset stage when the first address is placed on the address bus to access the first operational code in ROM?

The solution is to attach the logic analyser probes, press the switch to arm the unit; 256 bytes will then be automatically captured. Press the switch again, and these bytes are then transferred via a standard RS232 serial data stream link to the PC's screen.

If the board being analysed uses a 8031 controller, then this has a reset address of 0000H and it is this address that first appears on the address bus. If we examine the captured data on the screen and find that the first address captured is 80H (10000000b) and succeeding bytes have the 8th bit held at logic 1, then there is obviously a fault with the A7 line. Close examination of the print on the PCB will probably reveal that address line A7 has a short to the 5 volt supply line.

So there we have it. A very effective way to locate a hardware fault.

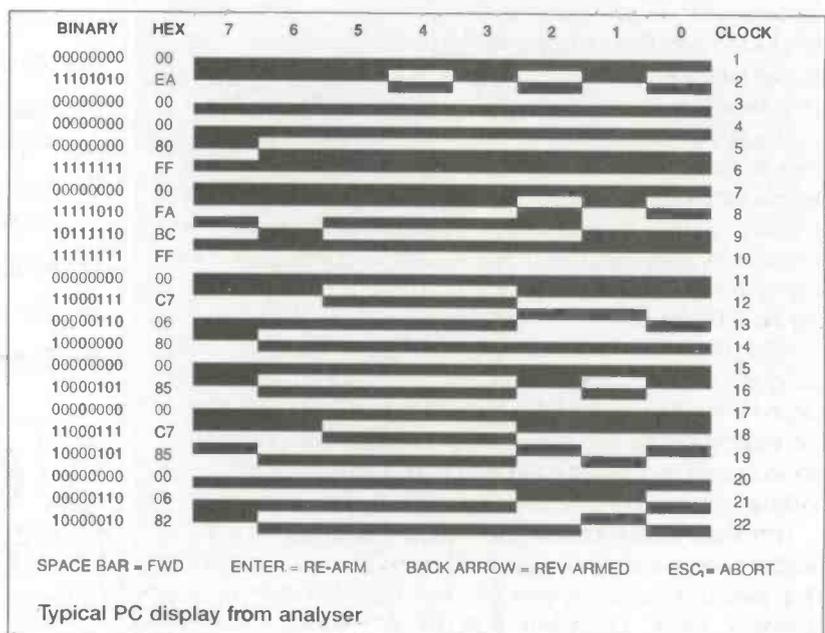
The logic analyser can also be used to determine the correct execution of software. Connect the analyser probes to the data bus, and press the reset switch on the target board. Arm the analyser and capture the data. Every single OPCODE/OPERAND on the data bus will then be captured as the program

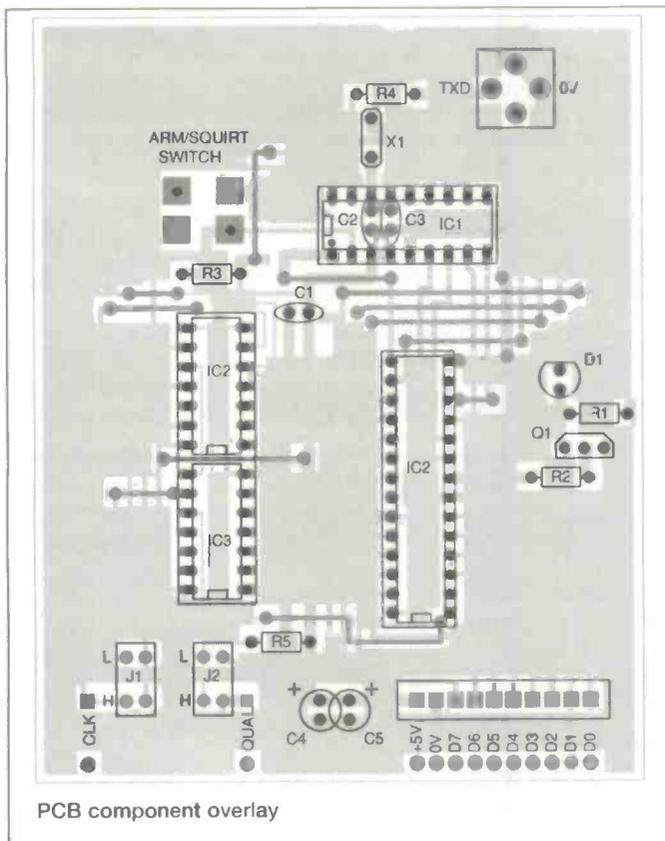
is being executed by the processor. Perhaps the operation of a conditional jump was misinterpreted when you wrote the software. A close examination of the captured data will verify if this is the case.

A typical microprocessor's instruction cycle will consist of a number of 'T' states or machine instruction cycles, which usually vary in number dependent on the type of instruction being executed. A multiplication instruction may take as many as five clock cycle/machine cycles. The clock cycle time is either a function of the crystal frequency or, more usually, an exact sub-multiple of the system clock.

The 'PIC' microchip is revolutionary compared to most other microcontrollers in that all instructions take one machine time cycle of 1/4 of the system clock. This means that if the xtal frequency is 4 MHz, a single instruction will be executed in 1 microsecond. In conventional microprocessor-based systems, the OPCODE may persist on the data bus for several clock cycles so that, when the logic analyser data is viewed, the same byte will have been captured several times. This is normal and doesn't mean that the processor is 'stuck'.

Many processors such as the 8088/8031 have a multiplexed low order address/data bus where the same 8 pins share data and address information; a latching D-type (74573) or (74373) is used to demultiplex data/address bytes. A control line (ALE in the case of the 8031) latches through the addresses on an active high pulse. When the pulse is at a logic low level, data is present on the input





pins of the D-type.

This is where the 'Qualifier' control probe from the logic analyser comes in. If we attach it to the ALE line of the processor and move jumper J2 to the H (active low) position, address information will be captured by the analyser. Conversely, moving the jumper to position 'L' will allow the capture of data information. Jumper J1 allows the analyser to capture the bytes on the leading (active high) or trailing edge (active low) of the clock pulse. The CLK (clock) probe lead is usually attached to one side of the crystal, or to any high frequency TTL source.

### How it works

The basis of the analyser's functionality is the Advanced Micro Devices AM7200 FIFO (First-In First-Out) 256 byte CMOS memory. As the name suggests, data that first enters the memory on a write cycle is the first data that comes out on the first read cycle; an exact opposite to the operation of a 'stack' in a processor system where the LIFO (Last-In, First-Out) operation pops off (reads) the last byte pushed (write) on the stack. Pressing the ARM/SQUIRT button arms the analyser.

The AM7200 has an access time of 50 nanoseconds which means that the analyser is capable of catching data on all but the very fastest processor systems. No firmware intervention (the PIC's software) occurs in the data capture process, since this would slow things down somewhat. Capture is completely hardware driven, the target processor providing the high speed clock to drive 256 bytes into the 7200's buffer.

When the RAM is full, further writes are inhibited and the FF (full) pin lights the LED. Pressing the analyser's ARM/SQUIRT button a second time will cause the PIC's firmware to read the RAM's data and transmit it to the PC via the serial port. Further 256 byte deep blocks of sample data can now be captured by re-arming the analyser i.e. pressing the switch button once.

Note that it is suggested to hold the target system in the reset position (keep the reset button pressed) when arming the analyser. Then release the target system's reset button i.e. data/address information will then be captured from processor reset (the start of

OPCODE execution).

The 7408 and 74132 consist of simple logic gates to multiplex clock and qualifier signals to the write pin of the 7200. When pin 9 of the 74132 Schmidt trigger NAND gate is low, the analyser is disabled and data will not be captured. When armed, this logic level changes to logic 1 permitting the target board's clock to write in successive bytes of data. If things appear to be happening rapidly, remember that with a clock of 1 MHz, it will take approximately 0.25 milliseconds to clock in 256 bytes of data!

### Construction

The unit is built on a double-sided PCB. This is not a formidable task as may at first appear. The following method has been used successfully by the author: make a 'sandwich' consisting of the double-sided photo resist board and the copper layer and component layer artwork, ensuring that the component layer is print side up.

The artwork dimensions must be exactly the same as that of the finished board, but at this stage cut the board with a 1 inch overlap at the sides to allow tape to keep the artwork in position. To ensure correct registration between both sides of the board, two 0.8 mm holes are drilled diagonally opposite at the edges through the board and the artwork. By holding the 'sandwich' up to a bright light source, a pinhole camera effect allows the artwork to be aligned.

With board and artwork aligned it is a simple matter of following the usual processing procedure i.e. exposure of both sides of the board to U.V. light and then developing and etching. Finally, the dried board is cut to final shape and the 'pin through' holes are made with short lengths of wire or by using special purpose PCB through connecting pins.

### System firmware

A PIC - 16C54 contains the logic analyser software for capturing the 256 bytes of data and transmitting them in binary form to the PC at 9600 baud 8 data bits 1 stop bit.

The source code listing is shown below:

MPASM 01.02.05 Intermediate LOGICBIN.ASM  
9-2-1995 15:6:0 PAGE 1

LOC	OBJECT CODE	LINE	SOURCE	TEXT
	0001			
	0002			; LOGIC ANALYSER
	0003			; 'LOGICBIN.ASM'
	0004			
	0005			LISTp=16C54
	0006			;
	0007			
0020	0008 BAUD_1	EQU	.32;9600	BAUD
	0009			
0000	0010 TXD	EQU	0	;RA0
0001	0011 RTCC	EQU	1	;RTCC
0002	0012 PC	EQU	2	
0003	0013 STATUS	EQU	3	; STATUS REGISTER
	0014 PORT_A	EQU	5	; PORT A
0005	0015 PORT_B	EQU	6	; PORT B
0006	0016 DLYCNT	EQU	8	
0008	0017 COUNT	EQU	9	
0009	0018 BUFFER	EQU	0AH	; TRANSMIT BUFFER
000A				
000B	0019 COUNTR	EQU	0BH	; TIMING COUNTER
	0020 INVERT	EQU	0DH	
0010	0021 BLOW	EQU	010H	
0011	0022 BHIGH	EQU	011H	
	0023			
	0024			
	; *****			
	*****			
	0025		ORG	0
0000	0026		start	
	0027			

```

0000      0028      NOP
0001 0000      0029      NOP
0002 0948      0030      CALL INIT
                                ;INITIALISE PORTS
                                0031
0003      0032      CYCLE
0003 0C40      0033      MOVLW 040H
0004 0030      0034      MOVWF BLOW
0005 0C04      0035      MOVLW .4
0006 0031      0036      MOVWF BHIGH
                                0037
0007      0038      POLL
0007 0004      0039      CLRWDT
0008 0665      0040      BTFSC PORT_A,3;GO SWITCH
                                LOW?
0009 0A07      0041      GOTO POLL
                                0042
000A 0C07      0043      MOVLW B'00000111'
                                ;DEBOUNCE
000B 0002      0044      OPTION
000C      0045      RELEASE
                                0046
000C 0061      0047      CLRF RTCC
000D 0004      0048      DEBOUNCE CLRWDT
000E 07E1      0049      BTFSS RTCC,7
000F 0A0D      0050      GOTO DEBOUNCE
                                0051
0010 0765      0052      BTFSS PORT_A,3
0011 0A0C      0053      GOTO RELEASE;STILL
                                LOW?THEN GOBACK

MPASM 01.02.05 Intermediate LOGICBIN.ASM
9-2-1995 15:6:0 PAGE 2
LOC OBJECT CODE LINE SOURCE TEXTVALUE
0012 0525      0054
                                0055      BSF PORT_A,1 ;ARM ON
                                0056
0013      0057      FLUSH
0013 0665      0058      BTFSC PORT_A,3 ;PRESS 2ND TIME
                                TO;READ
                                0059
0014 0A13      0059      GOTO FLUSH
                                0060
0015 0425      0061      BCF PORT_A,1 ;ARM OFF
                                062
0016 0C07      0063      MOVLW B'00000111'
                                ;DEBOUNCE
0017 0002      0064      OPTION
0018      0065      RE_LEASE
                                0066
0018 0061      0067      CLRF RTCC
0019 0004      0068      DE_BOUNCE CLRWDT
001A 07E1      0069      BTFSS RTCC,7
001B 0A19      0070      GOTO DE_BOUNCE
                                0071
001C 0765      0072      BTFSS PORT_A,3 ;STILL LOW?
                                THEN;GOBACK
001D 0A18      0073      GOTO RE_LEASE
                                0074
001E      0075      EMPTY
001E 0445      0076      BCF PORT_A,2;READ LINE LOW
001F 0206      0077      MOVF PORT_B,0;READ DATA INTO W
                                ;DATA IN W
                                0078
0020 092C      0080      CALL CONVERT;INVERT ALL BITS
0021 0931      0081      CALL TRANSMIT ;AND TRANSMIT
                                AT 9600
0022 0004      0082      CLRWDT
                                0083
0023 0545      0084      BSF PORT_A,2;READ LINE HIGH
                                0085
0024 02F0      0086      DECFSZ BLOW,1
0025 0A1E      0087      GOTO EMPTY
0026 0C40      0088      MOVLW 040H
0027 0030      0089      MOVWF BLOW
0028 02F1      0090      DECFSZ BHIGH,1
0029 0A1E      0091      GOTO EMPTY
                                0092
002A 0004      0093      CLRWDT
002B 0A03      0094      GOTO CYCLE
                                0095

002C      0096
002C 00FF      0097      CONVERT
002C 00FF      0098      XORLW 0FFH
002D 002A      0099      MOVWF BUFFER;IN FILE REGISTER A
002E 0C08      0100      MOVLW 8;8 DATA BITS
002F 002B      0101      MOVWF COUNTR
0030 0800      0102      RETLW 0
                                0103
0031      0104      TRANSMIT
0031 0505      0105      BSF PORT_A,TXD
0032 0942      0106      NEXT CALL DELAY ;104 uS DELAY

MPASM 01.02.05 Intermediate LOGICBIN.ASM
9-2-1995 15:6:0 PAGE 3
LOC OBJECT CODE LINE SOURCE TEXT VALUE
0033 032A      0107      RRF BUFFER ;ROTATE BUFFER
0034 0603      0108      BTFSC STATUS,0 ;TEST CARRY
                                FLAG
0035 0505      0109      BSF PORT_A,TXD
0036 0703      0110      BTFSS STATUS,0 ;TEST AND
                                TRANSMIT BIT
0037 0405      0111      BCF PORT_A,TXD
0038 02EB      0112      DECFSZ COUNTR
                                ;UNTIL ALL 8 BITS
                                ;TRANSMITTED
0039 0A32      0113      GOTO NEXT
                                0114
003A 0942      0115      CALL DELAY
003B 0405      0116      BCF PORT_A,TXD ;STOP BIT
                                0117
003C 0942      0118      CALL DELAY
003D 0942      0119      CALL DELAY
003E 0942      0120      CALL DELAY
003F 0942      0121      CALL DELAY
0040 0942      0122      CALL DELAY
                                0123
0041 0800      0124      RETLW 0
                                0125
0042      0126      DELAY;104 uS DELAY
0042 0C20      0127      MOVLW BAUD_1
0043 0028      0128      MOVWF DLYCNT
0044 02E8      0129      REDO DECFSZ DLYCNT,1
0045 0A44      0130      goto REDO
0046 0004      0131      CLRWDT
0047 0800      0132      retlw 0
                                0133
0048      0134      INIT
0048 0004      0135      CLRWDT
0049 0CFF      0136      MOVLW 0FFH
004A 0006      0137      TRIS PORT_B;PB0 - PB7 INPUTS
004B 0C08      0138      MOVLW 8;
004C 0005      0139      TRIS PORT_A;RA0 SERIAL OUTPUT
                                0140
004D 0405      0141      ;RA1 OUTPUT ARM
                                0142      ;RA2 OUTPUT READ
                                0143      ;RA3 INPUT GO
                                0144
004E 0425      0145      BCF PORT_A,TXD ;START WITH
                                STOP BIT;LOW
004F 0545      0146      BCF PORT_A,1 ;ARM OFF
                                0147      BSF PORT_A,2 ;READ LINE HIGH
                                0148
0050 0800      0150      RETLW 0
                                0151
                                0152      org 01FFh
0050 0800      0153      goto start
                                0154      END

MPASM 01.02.05 Intermediate LOGICBIN.ASM
9-2-1995 15:6:0 PAGE 4
SYMBOL TABLE
LABEL VALUE
BAUD_1 0020
BHIGH 0011

```

```

BLOW      0010
BUFFER    000A
CONVERT   002C
COUNT    0009
COUNTR    000B
CYCLE     0003
DEBOUNCE  000D
DELAY     0042
DE_BOUNCE 0019
DLYCNT    0008
EMPTY     001E
FLUSH     0013
INIT      0048
INVERT    000D
NEXT      0032
PC        0002
POLL      0007
PORT_A    0005
PORT_B    0006
REDO      0044
RELEASE   000C
RE_LEASE  0018
RTCC      0001
STATUS    0003
TRANSMIT  0031
TXD       0000
__16C54   0001
start     0000

```

```

Errors   : 0
Warnings : 0
Messages : 0

```

## Operating

The power for the analyser is taken from the target board and must be +5 volts (+/- 0.25 volts). Connect the eight data leads to the target's address or data bus via a chip glomper. If no qualifying signal is required, remove jumper J2. Jumper J1 selects between an active low or active high signal and can be selected by experiment according to the processor type.

Connect the serial link (i.e. the PC's serial port - either COM1 or COM2). The receive data pin of the serial port is pin 2 (pin 5 0v). Strap together pins 4, 6, 7, 8 together. Press the analyser switch once. The system is now armed. When 256 bytes have been captured, press the same switch again. The data will then be presented on the PC's screen for inspection and analysis.

The DOS software driver was written by the author to be used with the Logic Analyser. The software gives the user a better representation of the captured data than does a Terminal Emulator. An example of the driver graphics is shown below:

The data is shown in pure binary format, it's hexadecimal equivalent, a 'bar-chart' representation of logic levels and the clock cycle associated with each captured byte. In addition, the ASCII printable character is displayed alongside each byte.

## Operating the software driver

One can quite easily write a simple software driver and data display programme for the analyser using in any computer language, even Basic. However, if you don't want to do this, a programme is available free from the author with the purchase of a programmed PIC chip; see below for details.

Install either 'LOGCOM1.EXE' or 'LOGCOM2.EXE' file onto the hard disk and connect in the Logic Analyser to the COM1/COM2 serial port of the PC. Arm the logic analyser board by pressing the ARM switch once. A flashing 'ARMED' message on the PC screen display will show that the system is operational. The Full buffer LED will light showing that the FIFO buffer is full.

Pressing the switch a second time will stream the captured data to the PC. 256 bytes will be saved in a buffer and written to disk in file 'Logic\_a'. To view the data, press the space bar to increment the

BINARY	HEX	7	6	5	4	3	2	1	0	CLOCK
11101110	EE	█	█	█	█	█	█	█	█	2
11101111	EF	█	█	█	█	█	█	█	█	3
11110000	F0	█	█	█	█	█	█	█	█	4
11110001	F1	█	█	█	█	█	█	█	█	5
11110010	F2	█	█	█	█	█	█	█	█	6
11110011	F3	█	█	█	█	█	█	█	█	7
11110100	F4	█	█	█	█	█	█	█	█	8
11110101	F5	█	█	█	█	█	█	█	█	9
11110110	F6	█	█	█	█	█	█	█	█	10
11110111	F7	█	█	█	█	█	█	█	█	11
11111000	F8	█	█	█	█	█	█	█	█	12
11111001	F9	█	█	█	█	█	█	█	█	13
11111010	FA	█	█	█	█	█	█	█	█	14
11111011	FB	█	█	█	█	█	█	█	█	15
11111100	FC	█	█	█	█	█	█	█	█	16
11111101	FD	█	█	█	█	█	█	█	█	17
11111110	FE	█	█	█	█	█	█	█	█	18
11111111	FF	█	█	█	█	█	█	█	█	19
00000000	00	█	█	█	█	█	█	█	█	20
00000001	01	█	█	█	█	█	█	█	█	21
00000010	02	█	█	█	█	█	█	█	█	22

viewing window and, similarly, the back-arrow key will decrement the clock cycle number. The driver may be re-armed at any time by pressing the ENTER key. To abort, simply hit the ESCAPE key. Screen contents can be printed by using the PrtSc button on the keyboard.

A pre-programmed PIC is available from the author:

Mr.R.Grodzik (MICROS)  
53 Chelmsford Road,  
Bradford BD3 8QN  
West Yorkshire  
United Kingdom

Price £29 (p&p inc). Includes free PC logic analyser software driver on disk.

Tel.01274 662085 for further details.

Also available: AM7200-50RC FIFO £10 (p&p inc).

## PARTS LIST

### Capacitors

C1 100n  
C2 33p  
C3 33p  
C4 100u  
C5 10u

### Resistors

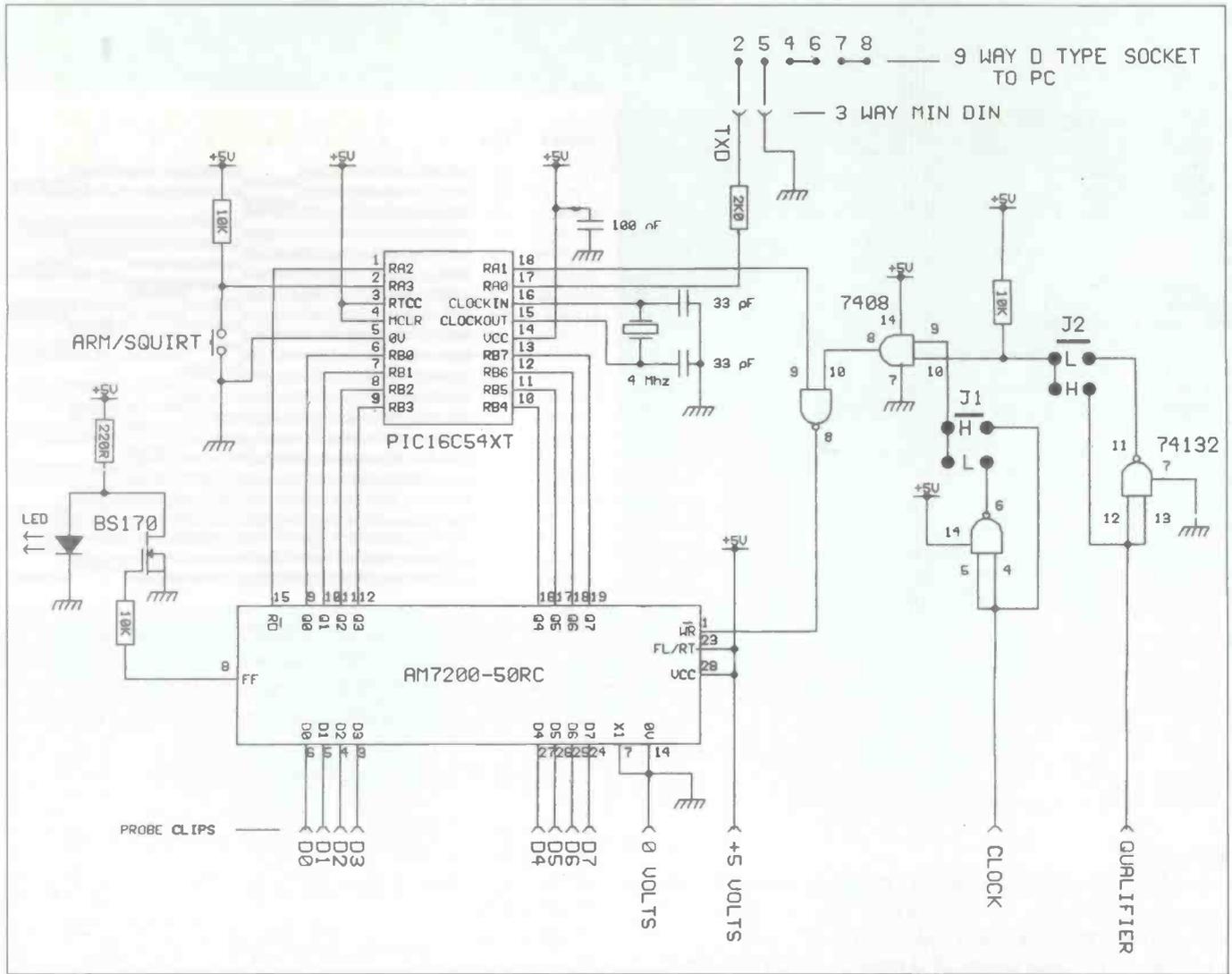
R1 220R  
R2 10k  
R3 10k  
R4 2k  
R5 10k

### Semiconductors

IC1 PIC16C54XT  
IC2 AM7200-50RC  
IC3 7408  
IC4 74132  
Q1 BS170  
D1 LED

### Miscellaneous

X1 4MHz crystal  
9-way D-type socket  
3-way miniature DIN  
Pushbutton switch  
0.1in connector pins



# SEETRAX CAE RANGER PCB DESIGN

WITH COOPER & CHYAN AUTOROUTER

RANGER3 - DOS	£2500
- Windows\NT	£2900

Hierarchical or flat schematic linked to artwork.  
 Unlimited design size, 1 micron resolution  
 Any shaped pad, definable outline library  
 Pin, gate & outline swapping - auto back annotation  
 Split power planes, switchable on - line DRC

**COOPER & CHYAN SPECCTRA**  
 autorouter (SP2)

Inputs: OrCAD, Cadstar,  
 PCAD, AutoCAD DXF

Outputs: Postscript, Windows bit map

R2 & R3 Outputs: 8/9 & 24 pin printers, HP  
 Desk & Laser Jet, Cannon Bubble Jet,  
 HP-GL, Gerber,  
 NC Drill, AutoCAD DXF

RANGER2	£150
---------	------

Upto 8 pages of schematic linked to artwork  
 Gate & pin swapping - automatic back annotation  
 Copper flood fill, Power planes, Track necking,  
 Curved tracks, Clearance checking,  
 Simultaneous multi-layer auto-router

RANGER2 UTILITIES	£250
-------------------	------

COOPER & CHYAN SPECCTRA auto-router (SP1)  
 Gerber-in viewer, AutoCAD DXF in & out

UPGRADE YOUR PCB PACKAGE TO RANGER2	£60
--	-----

**TRADE IN YOUR EXISTING PACKAGE TODAY**

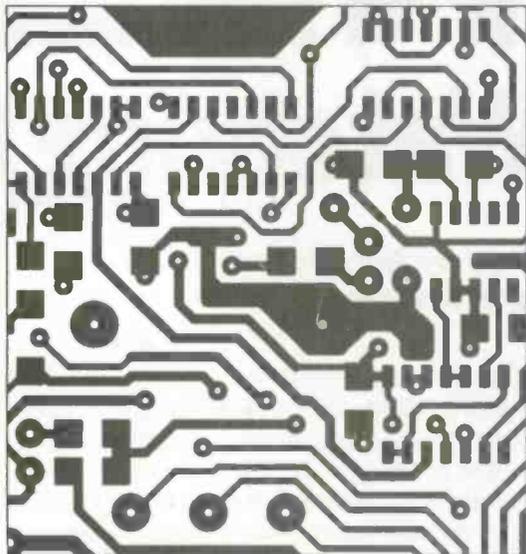
Seetrax CAE, Hinton Daubnay House, Broadway Lane, Lovedean, Hants, PO8 0SG  
 Call 01705 591037 or Fax 01705 599036 + VAT & P.P

ELECTRONICS TODAY INTERNATIONAL

All Trademarks Acknowledged

# EASY-PC, Schematic and PCB CAD

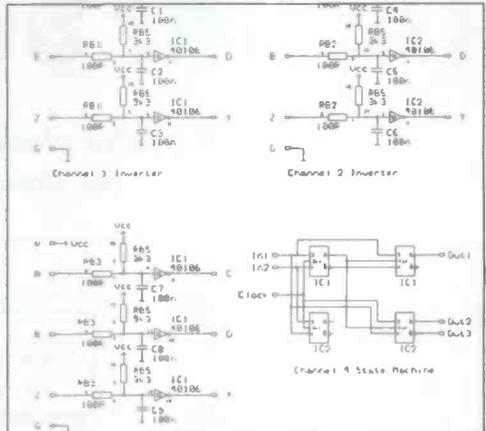
Over 19,000 Installations  
in 80 Countries World-wide!



- Runs on:- PC/XT/AT/286/386/486 with Hercules, CGA, EGA or VGA display and many DOS emulations.
- Design:- Single sided, Double sided and Multi-layer (8) boards.
- Provides full Surface Mount support.
- Standard output includes Dot Matrix / Laser / Ink-jet Printer, Pen Plotter, Photo-plotter and N.C. Drill.
- Tech Support - free.
- Superbly easy to use.

**Still Only £98.00!**  
Plus P&P+VAT

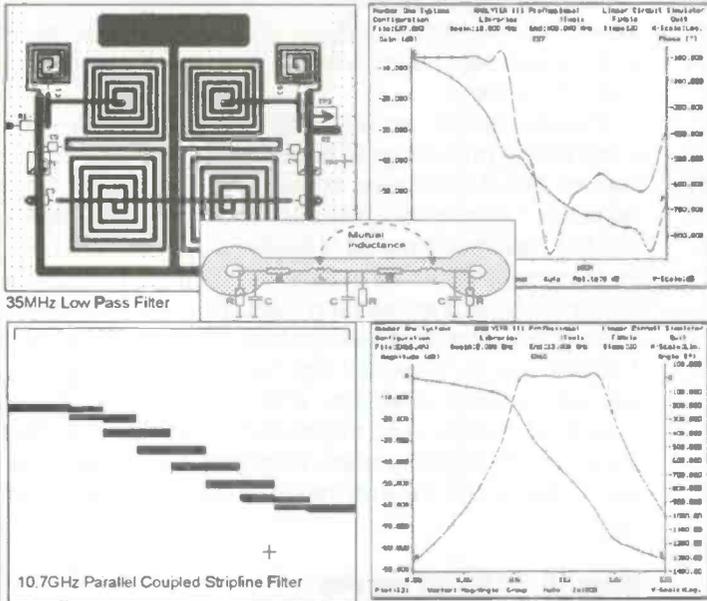
BRITISH  
**DESIGN**  
AWARD  
1989



Options:-500 piece Surface Mount Symbol Library £48,  
1000 piece Symbol Library £38, Gerber Import facility £98.

## Electronic Designs Right First Time?

### LAYAN - Electro-magnetic Simulation ONLY £495



### Affordable Electronics CAD

LAYAN: New Electro-magnetic layout Simulator. Include board parasitics in your Analogue simulations. Links with and requires EASY-PC Professional XM and ANALYSER III Professional	\$950	£495
EASY-PC Professional: Schematic Capture and PCB CAD. Links directly to ANALYSER III, LAYAN and PULSAR.	From \$375	£195
PULSAR: Digital Circuit Simulator	From \$195	£98
ANALYSER III: Analogue Linear Circuit Simulator	From \$195	£98
FILTECH: Active and Passive Filter Design program	From \$275	£145
STOCKIT: New comprehensive Stock control program for the small or medium sized business	\$275	£145
EASY-PC: Entry level PCB and Schematic CAD.	\$195	£98
Z-MATCH for Windows: Windows based Smith-Chart program for RF Engineers.	\$475	£245

*We operate a no penalty upgrade policy. US\$ prices include Post and Packing Sterling Prices exclude P&P and VAT.*

For full information, please write, phone or fax:-

## Number One Systems

UK/EEC: Ref. ETI, HARDING WAY, ST.IVES, CAMBS., 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: (415) 968-9306

- TECHNICAL SUPPORT FREE FOR LIFE
- PROGRAMS NOT COPY PROTECTED.
- SPECIAL PRICES FOR EDUCATION.

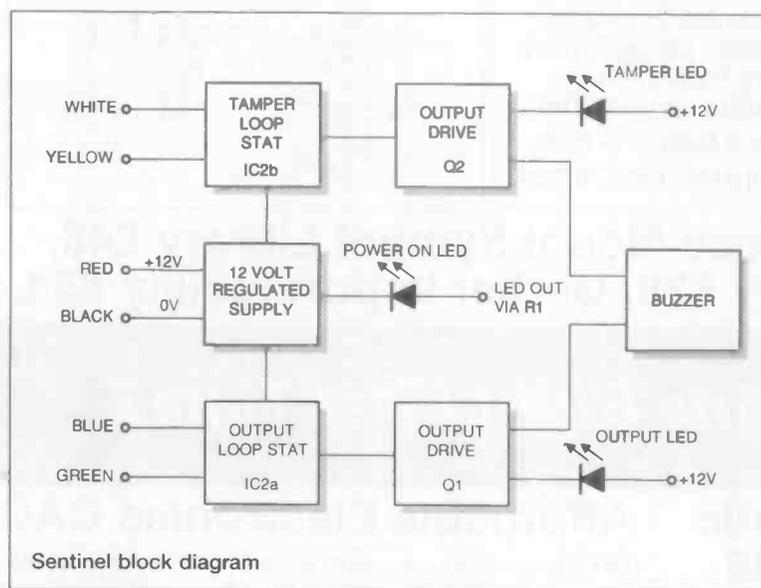
e-mail: sales@numberone.com  
International +44 1480 461778



# SENTINEL

## (Alarm Sensor Watchdog)

*A useful piece of equipment designed by Bob Noyes  
for testing and setting up alarm systems*



Sentinel block diagram

**T**he DIY home security systems market is booming, alarm systems are forever coming down in price as a result of keen competition between manufacturers and, as a result, both quality and reliability are suffering.

A typical example of this is the tamper loop provision on PIR (passive infra red) sensors; in the past this has consisted of a microswitch mounted in such a position that if the alarm cover is removed, the tamper trip is activated and the alarm sounds. This has worked extremely well for many years, but now, with all the cost-cutting, the microswitch in several systems has been replaced by a bent piece of metal that touches a contact when the lid is in place but springs up when the alarm cover is removed, thereby breaking the circuit. This seems OK but, when subjected to vibration, smoke or condensation, it fails after only a few months, setting the alarm off when no actual intrusion has taken place. The two different metals become tarnished or, in some extreme cases, corroded, causing a bad connection.

Another shortcoming in certain cheaper PIR detectors is that the PCB is no longer screwed to the case but held in place by a plastic clip or clips made from the moulding of the case. These clips either bend out of place or, in some extreme cases, snap off altogether when the PCB is connected to the wires and pressed back into position; because it is not being held firm, it is free to move about, albeit slightly. Vibration from heavy

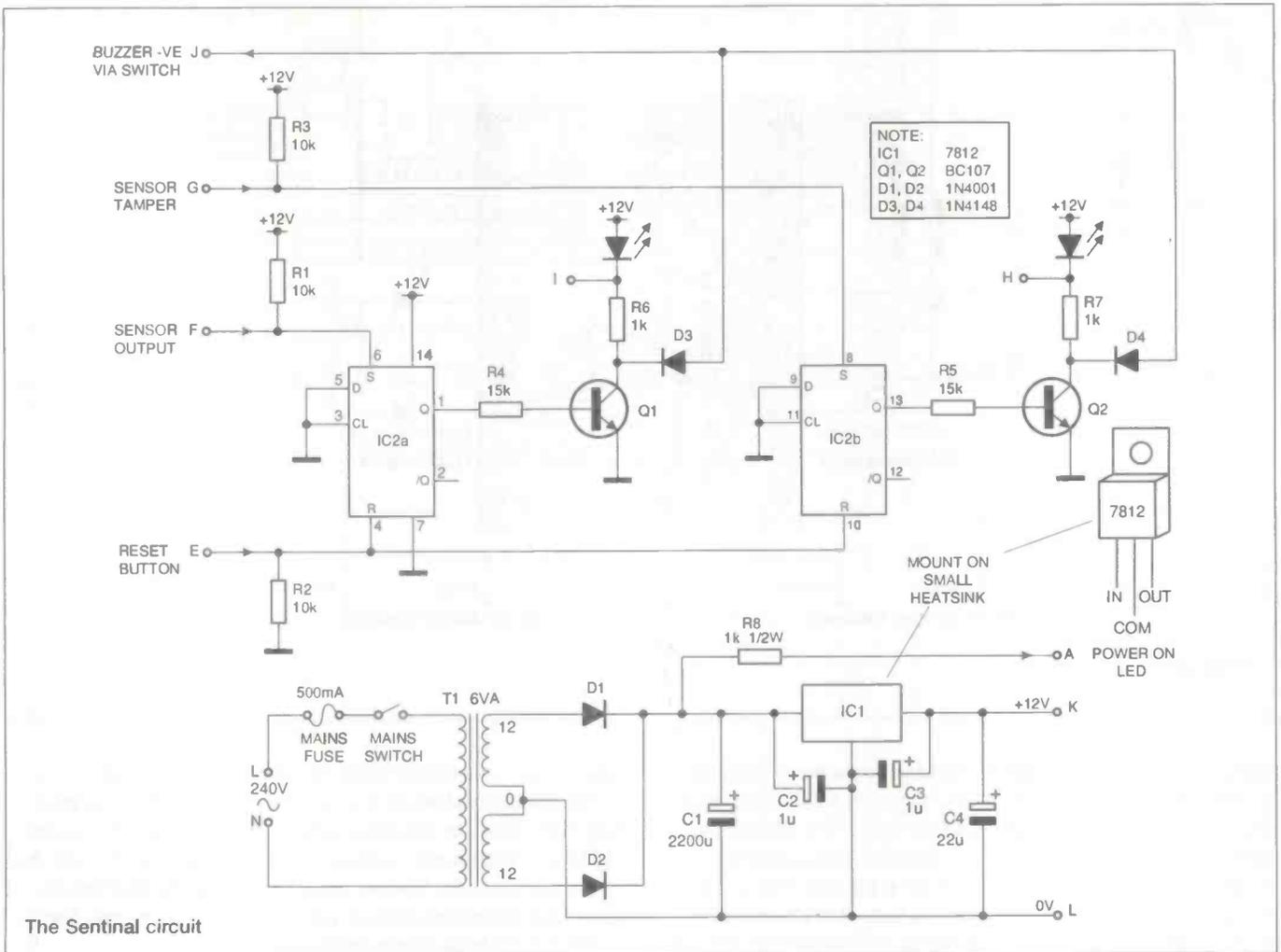
traffic or even a slamming door can cause a false alarm because the PCB containing the PIR sensor moves rather than a heat source moving, and so the alarm 'sees' it as an intrusion and sets off the alarm. In most alarms it is possible to see which zone loop has activated the alarm but if several PIR detectors are connected to this zone it is impossible to say which one is giving the false signal. This problem is more prevalent in certain alarm systems' tamper loops where all sensor switches and detectors share one common loop and any break anywhere only shows on the alarm panel's LEDs as a tamper problem - one LED for maybe six or seven detectors. Although a break, i.e. a permanent open circuit, is easy enough to find with a meter, an intermittent break is far harder to find as it may only happen under certain conditions such as a cold night or when subjected to vibration. This is where Sentinel comes into its own; if any break occurs, the corresponding LED will come on and stay on even if the loop breaks and connects itself again -

the most common type of problem. Sentinel doesn't need feeding so it is always vigilant and any failure will activate the LED or sound the buzzer.

If several detectors are to be tested they must be done one at a time and for long enough so that any possible fault can show. If only one area of fault is being looked at, the other one can be looped out. For instance, if the tamper loop is the area of fault in a unit, the output loop terminals of Sentinel can be shorted out; in the prototype these are the blue and green. This means the PIR unit can be handled and although it would trip due to handling, it does not cause Sentinel to activate because of the added loop. The other loop, i.e. the tamper, can then be tested fully by exposing the PIR to vibration etc. If this fails to show the problem, it can be left and the sound switched on. As soon as it fails, the buzzer sounds, indicating exactly when the failure occurs. If you are out of earshot at the time, the LED and buzzer remain on until reset.

### How the circuit works

Sentinel must be able to power the sensor under test so, to accommodate this, a regulated 12 volt supply is provided. This is a standard supply consisting of two diodes (D1, D2) producing DC from a 12-0-12 volt tap on the transformer; this is smoothed by a reservoir capacitor C1. The voltage across C1 is around 17 volts off load which is the feed to IC1 a 7812 the standard +12 volt 1 amp regulator. In order to suppress any high frequency present,



The Sentinel circuit

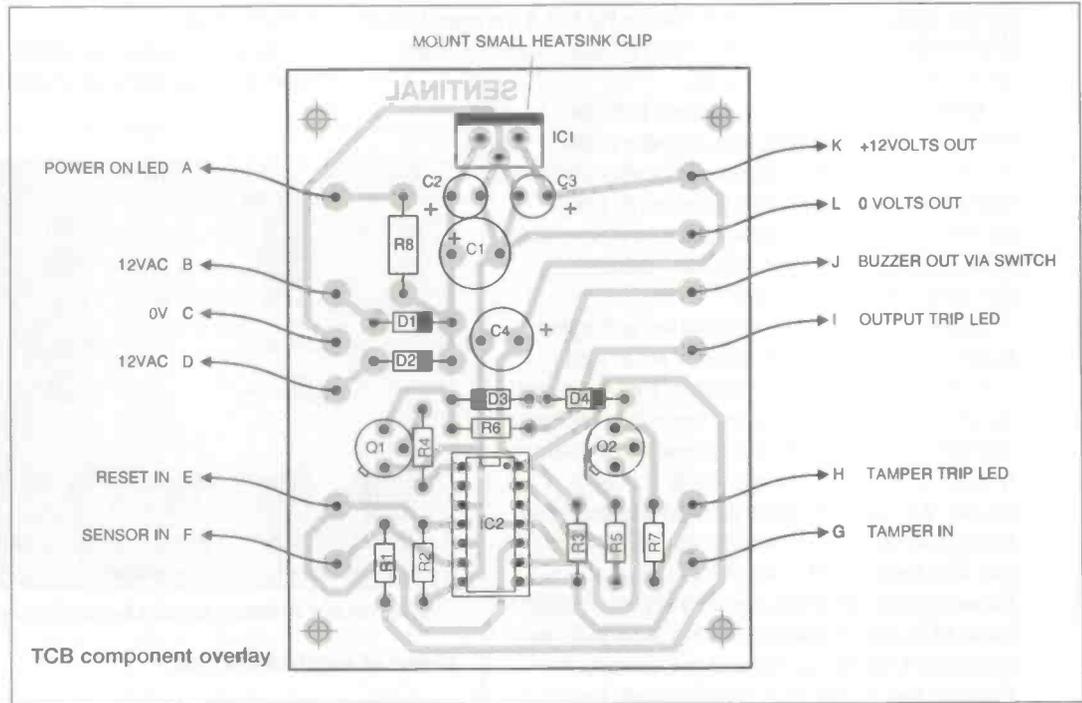
C2 and C3 are mounted as close to IC1 as practicably possible. This +12 volt supply is used to power Sentinel's electronics as well as provide the +12 volts for the sensor under test, +12 volts to the red terminal, 0V to the black terminal.

The principle of the tamper loop test circuit is identical to that of the output alarm circuit except it uses the other half of IC2.

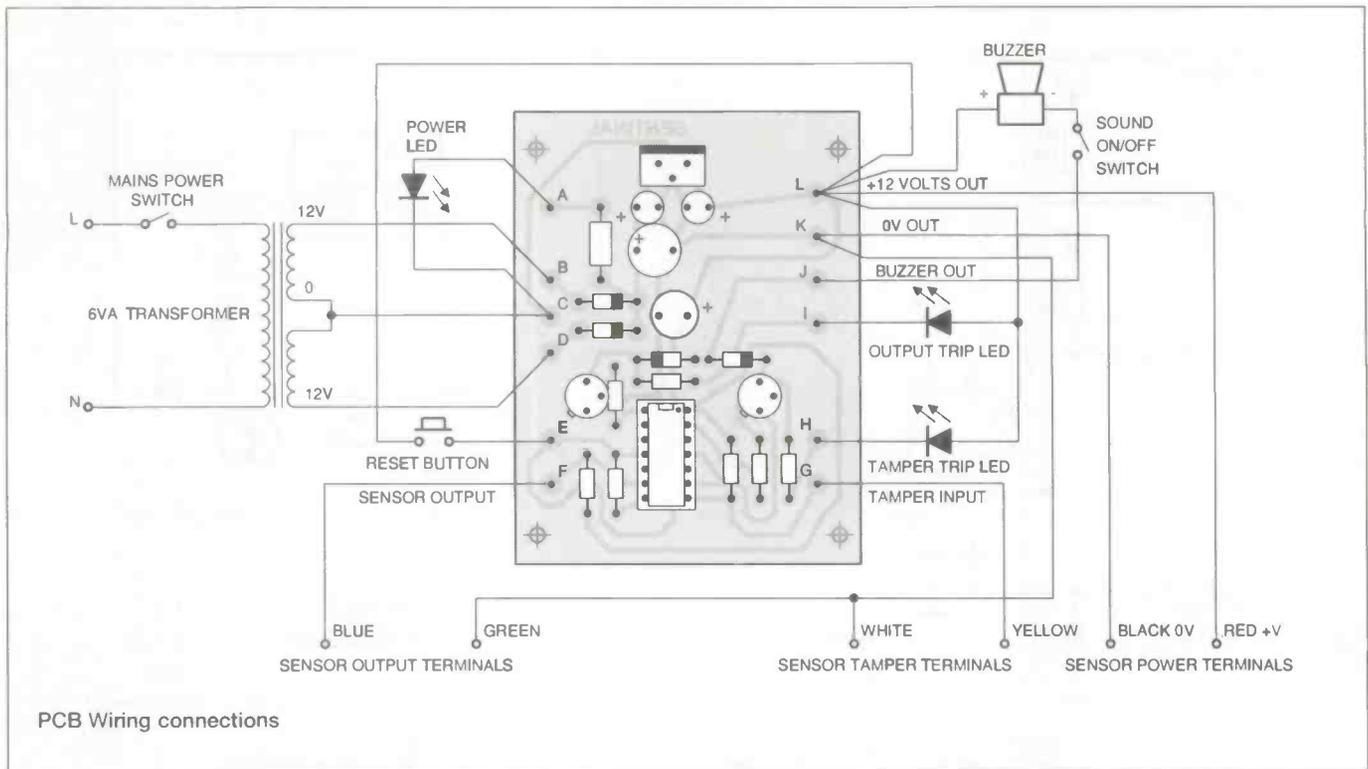
The white and yellow terminal are used on the front panel to bring the two tamper wires from the PIR sensor under test to Sentinel. The tamper wires may be connected either way round as this is an isolated loop, as per diagram. The white terminal goes to 0 volts while the yellow goes to pin G on the PCB. From here, it goes to the set (pin 8) of a D type stat IC2 as well as a pull up resistor.

The D type is at the heart of the memory circuit; when a fault - in our case, a break in the loop - occurs, it is remembered, even if the break connects again - an intermittent fault. The clock and "D" inputs are grounded in IC2 leaving only the set and reset input pins in use. In such a circuit when a positive or 12 volts is detected on the set, pin

8, the "Q" pin 13, goes high and stays high until reset by a high or 12 volts on the reset, assuming the set is not still high. Although this sounds a bit of a mouthful it all fits in rather well because if there is a "high" on the set the PIR's fault is showing itself i.e. the loop is broken - a permanent fault. These types of fault are easy to detect and can be confirmed on a meter. However, the type of



TCB component overlay



fault Sentinel has been designed to detect is the intermittent one.

Normally, the tamper loop on the alarm is a short circuit i.e. a loop in through a closed switch and out again. This means that, when working, the white and yellow terminals are connected together on Sentinel via the tamper loop in the PIR. This means that pin G on Sentinel is at 0V which, in turn, puts 0V on the set input of IC2. If, however, this loop fails i.e. a break occurs, the set input of IC2 is pulled high via R3. This high, no matter how fast, turns the "Q" pin high; this via R5 turns on TR2. The collector of TR2 goes low and in turn illuminates the monitor LED on the front panel. D4 now becomes forward biased and, if the sound switch is on, will sound the buzzer - very handy when Sentinel is used on test for a long time as you can be getting on with something else. D4 and D3 are required to prevent the tamper loop interfering with the output loop LEDs and vice versa.

The rest pin 10 of IC2 is held low via R2 but, if the reset button is pressed, pin 10 becomes high as the other side of the reset switch is connected to +12 volts.

Under normal working conditions both the tamper connectors (white and yellow) and the output loop connectors (green and blue) are two separate closed loops (not connected to one another). So all the unit does is constantly monitor both loops and indicate if a break is detected by illuminating the relevant LED.

A little more care is required when testing the output loop of, say, a PIR detector as, to start with, they normally take a couple of minutes to get settled down. During this time, the output LED will illuminate so it's a good idea to have the sound turned off as it can get a little irritating. After a couple of minutes, it will be working and the reset button can be pressed; the monitor LED will go out. But, being a PIR, it will detect body movement so it must be placed firmly so it cannot move of its own accord and facing away from you, otherwise it will detect you and give an output. While on test it must face away from any heat

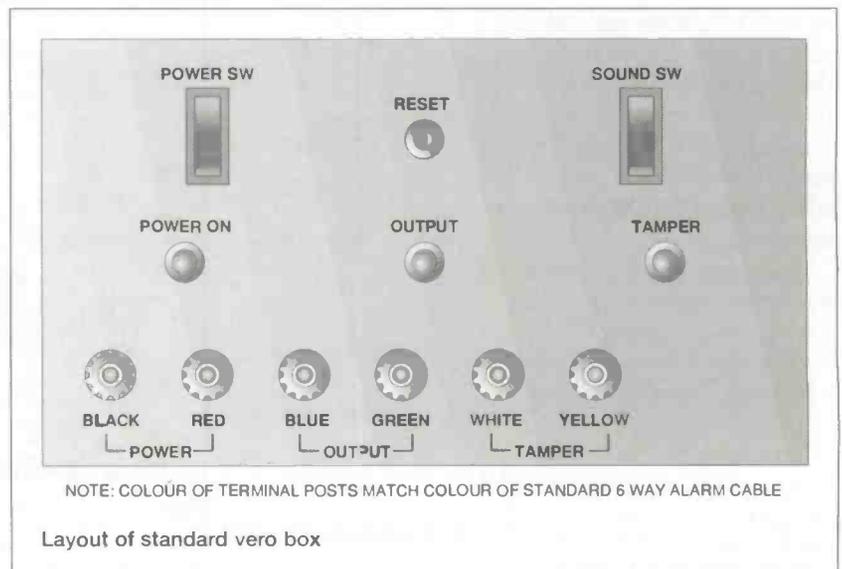
source such as a human body, radiator, powerful light etc.

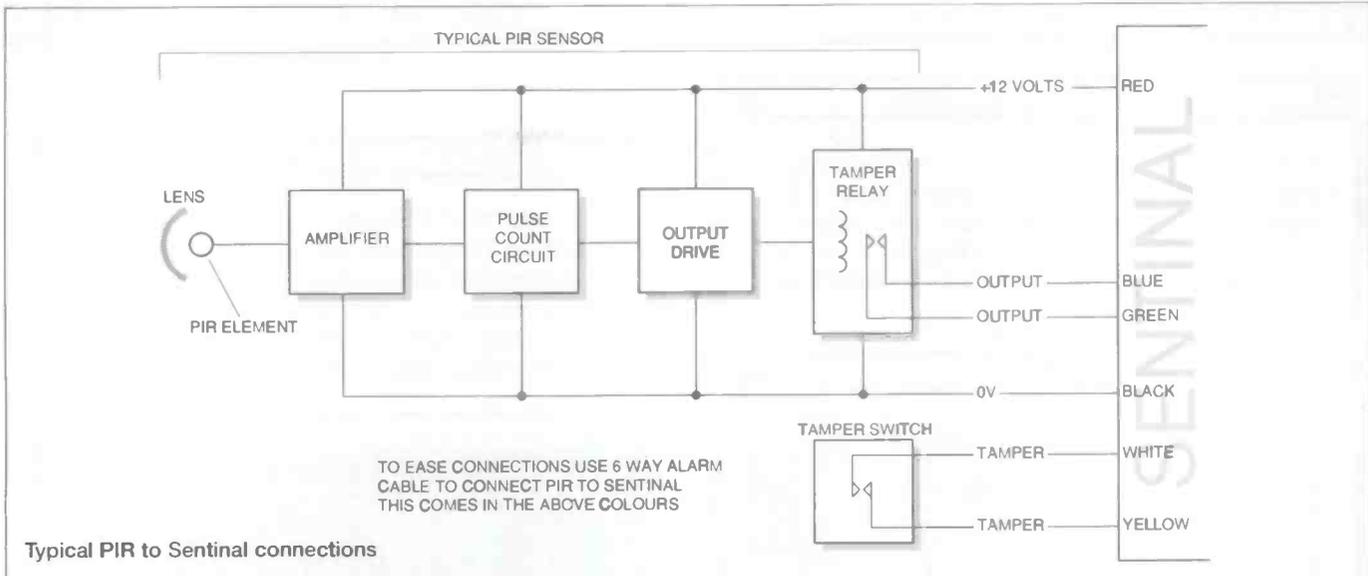
Ideally, it should be left in an unattended room. If the room is fairly dark, it can be left some distance from an open door as the LEDs can be seen from outside. If this is not convenient, then the sound can be used. This will indicate when the PIR has tripped, as a result of the slamming of a door, heavy traffic, a plane flying overhead, the fridge motor starting up, etc.

As well as Sentinel being an extremely useful fault finding aid, it is also of benefit for setting up the PIR in its actual position. It may not be practicable to energise the whole alarm system to power up the PIR but, by using Sentinel, the PIR can be tested and positioned during installation.

Although PIRs are by far the most common type of sensor, other types can be tested such as Doppler, ultrasonic, radar etc. They must be 12 volt devices and have closed loop outputs when not activated.

As well as electronic detectors, even simple switches such as reed switches, commonly used on doors etc, can be monitored





Typical PIR to Sentinel connections

**PARTS LIST**

**Resistors**

R1	10K
R2	10K
R3	10K
R4	15K
R5	15K
R6	1K
R7	1K
R8	1K 1/2W

**Capacitors**

C1	2.200nF 25V Rad
C2	1nF 25V Rad
C3	1nF 25V Rad
C4	22n F 25V Rad
IC1	7812 +12 V Reg
IC2	4013 CMOS "D" type stat
D1, D2	1N4001

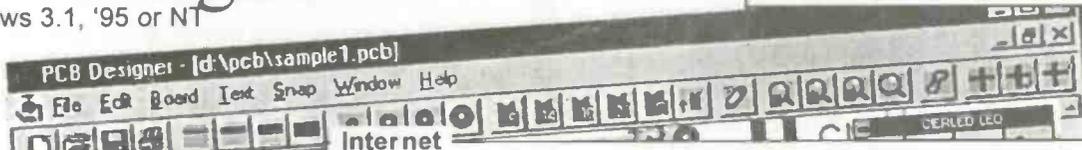
**Miscellaneous**

- 1 x 2-0-12V 6VA transformer
- Red LEDs 0.2" (2 off), Green LED 0.2"
- 12V buzzer
- Switches single pole on-off (2 off)
- Coloured terminal posts (red, black, green, blue, white, yellow) (2 off)
- Box to suit (Vero type used)
- Press to make switch
- 14-pin IC holder
- TO220 Heat sink clip
- Fuse (max 1 Amp)

**PCB Designer**

For Windows 3.1, '95 or NT

Runs on any PC running Windows 3.1, Windows 95 or Windows NT with a minimum 2MB RAM  
Will work with any Windows supported printer and monitor



Looking for the price?  
It's just £49.00 all inclusive!  
...no VAT...no postage...  
...no additional charges for overseas orders.  
Dealers and distributors wanted.

Visit our WWW site at [www.niche.co.uk](http://www.niche.co.uk) for more information and a working demo. The demo is also available via anonymous FTP from [ftp.demon.co.uk](ftp://ftp.demon.co.uk/pub/ibmpc/windows/pcbdemo/) in the dir /pub/ibmpc/windows/pcbdemo/ as pcbdemo.zip. Internet e-mail [orders@niche.demon.co.uk](mailto:orders@niche.demon.co.uk).

- ✓ Produce Single or Double sided PCBs.
- ✓ Print out to *any* Windows supported printer.
- ✓ Toolbar for rapid access to commonly used components.
- ✓ Helpful prompts on screen as you work.
- ✓ Pad, track & IC sizes fully customisable.
- ✓ No charges for technical support.
- ✓ Snap-to grid sizes 0.1", 0.05" 0.025" and unrestricted.
- ✓ SMT pads and other pad shapes.
- ✓ Prints at the resolution of your printer - much higher than the screen shot shown here.

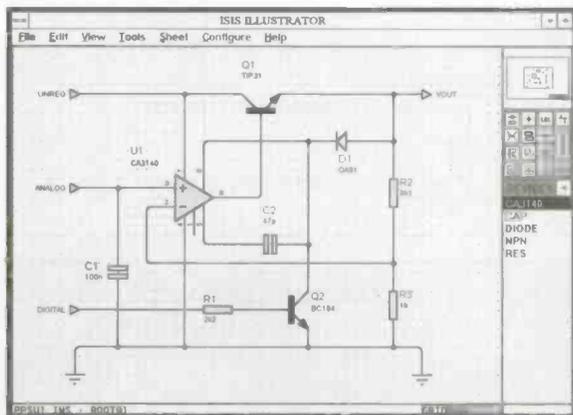
**Niche Software (UK)**  
22 Tavistock Drive, Belmont, Hereford, HR2 7XN. Phone (01432) 355 414



# PROFESSIONAL CIRCUIT AND PCB DESIGN AIDS FOR WINDOWS

## CADPAK for Windows

CADPAK is especially suited to educational, hobby and small scale schematic and PCB design. CADPAK includes both schematic drawing and 32-bit PCB drafting tools but as an entry level product, there is no netlist link between them.



The schematic drawing module of CADPAK, ISIS ILLUSTRATOR, enables you to create circuit diagrams like the ones in the magazines.

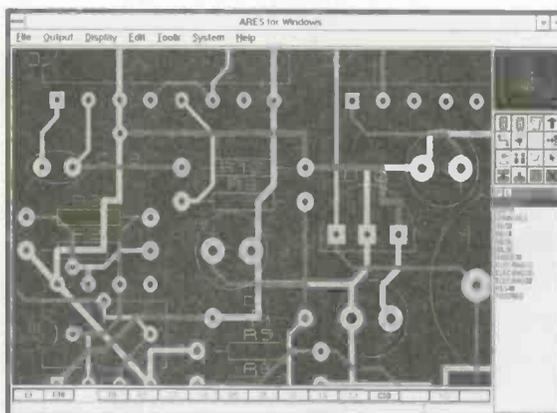
- Runs under Windows 3.1 making full use of Windows features such as on-line help.
- Full control of appearance including line widths, fill styles, fonts, colours.
- Automatic wire routing & dot placement.
- Fully automatic annotator.
- Complete with device and comprehensive package libraries for both through hole and SMT parts.
- Advanced route editing allows deletion or modification of any section of track.
- Gerber, Excellon and DXF outputs as well as output via Windows drivers. Also includes Gerber viewer.
- Exports diagrams to other applications via the clipboard.
- CADPAK is also available for DOS.

**CADPAK FOR WINDOWS ..... £ 149**

**CADPAK FOR DOS ..... £ 79**

## PROPAK for Windows

PROPAK has all of the features in CADPAK plus netlist based integration, automatic power plane generation and a powerful auto-router. PROPAK includes enough schematic capture and PCB design functionality for all but the most demanding applications.



PROPAK's schematic drawing editor ISIS ILLUSTRATOR+ includes even more features than ISIS ILLUSTRATOR. PROPAK's 32-bit PCB design tool, ARES for Windows, is our most powerful and easy to use yet.

- Multi-sheet and hierarchical designs.
- Netlist link between modules guarantees consistency between schematic and PCB.
- Netlists are also compatible with SPICE-AGE and most other electronics CAD packages.
- Generates a full bill of materials.
- ASCII data import facility.
- Electrical rules and connectivity checkers.
- Ratsnest display with automatic update during placement and routing.
- Multi-strategy autorouter gives high completion rates.
- Power plane generator creates ground planes with ease.
- PROPAK is also available for DOS.

**PROPAK FOR WINDOWS ..... £ 495**

**PROPAK FOR DOS ..... £ 395**

**Call or fax us today for a demo pack. Please state whether you would like a DOS or Windows pack.**

Prices exclude postage (£5 for UK) and VAT. ISIS ILLUSTRATOR and ARES for Windows are also available separately. All manufacturers trademarks acknowledged.

# abcenter

**E l e c t r o n i c s**

53-55 Main St. Grassington, N. Yorks. BD23 5AA

Tel: 01756 753440 Fax: 01756 752857



# Software. review

*Continuing our look at software for the engineer's PC, Frank Guaschi delves into the intricacies of Mathplus*

**C**omputers and mathematicians have always gone together. Indeed, if we go back to the last century, the original derivation of the word computer was none other than a mathematician whose job it was to 'compute' some complex and usually repetitious formulae. So it seems only right that the mathematician of today should enjoy the assistance of an electronic 'computer' to perform, amongst other things, those same complex and repetitious formulae.

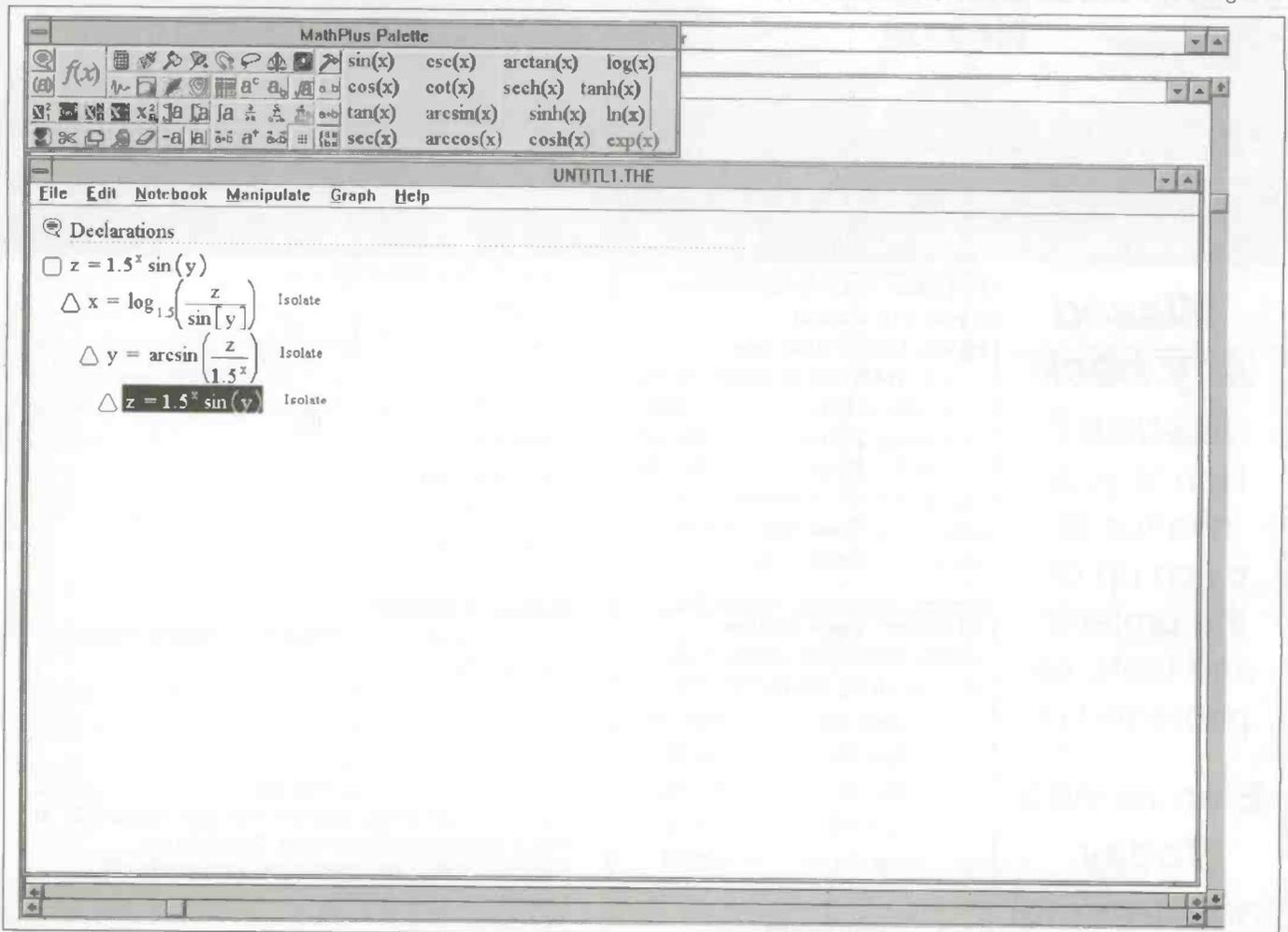
Of course mathematicians have been using computers since the very first system was constructed. But it is only in the last few years that very powerful personal computers have

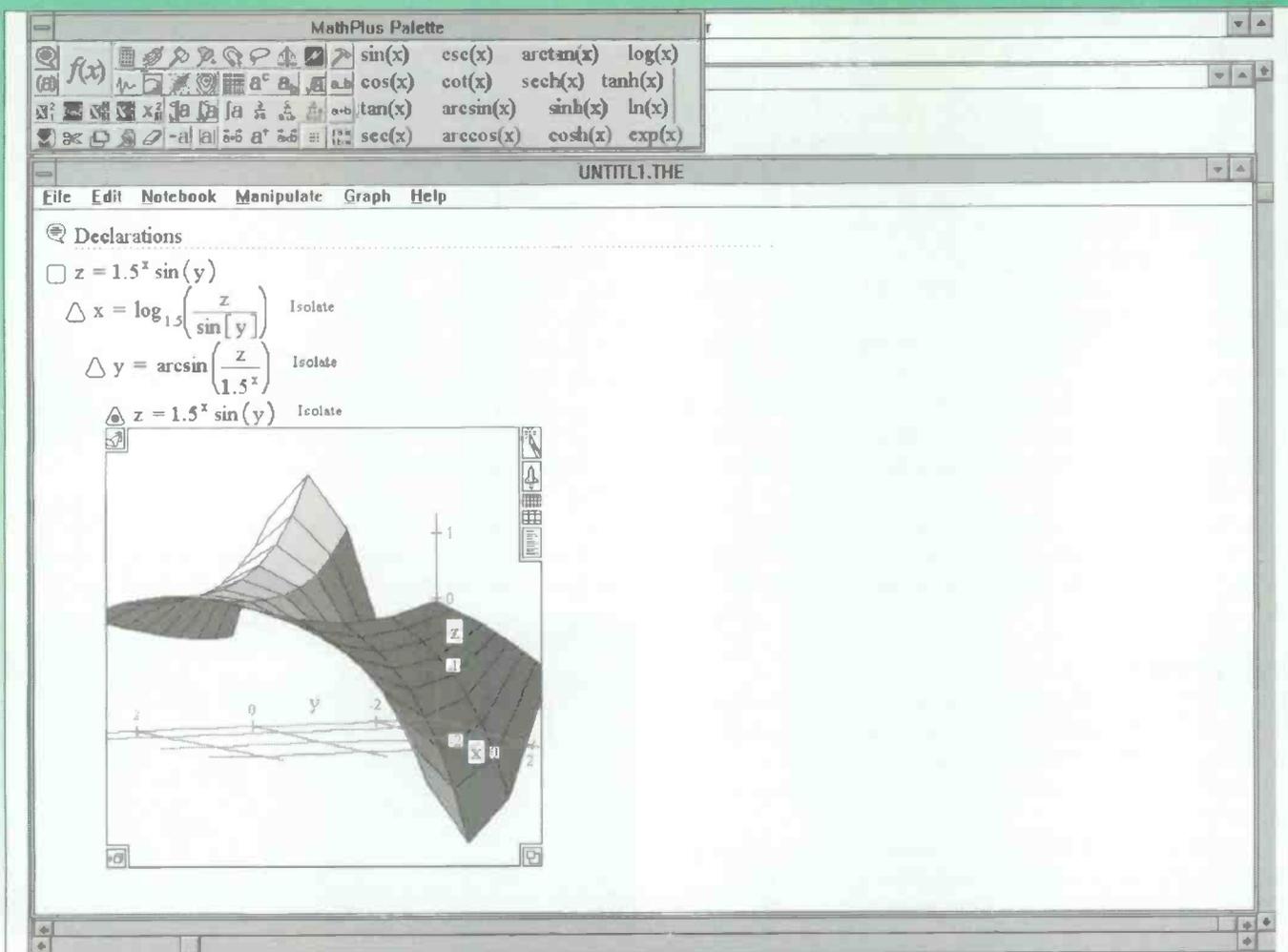
made it possible to write software that can form the basis of a practical real time tool to aid mathematicians in a wide range of different procedures. Procedures ranging from multi-dimensional graph plotting of a complex polynomial to solving problems with differential calculus.

There are several such programmes available commercially today, and the one we are going to look at in this article is Mathplus from the Canadian software house Waterloo Maple.

## Mathplus

Mathplus has been produced for mathematicians and scientists with particular emphasis on its use as a teaching and





learning tool in secondary schools, colleges and universities. It has been designed to run on a standard personal computer and sports a graphical user interface that makes it very easy to use. This is in contrast to some of the other packages on the market, such as Maple V, which require the user to learn a programming language before being able to use it.

Mathplus is, in fact, an improved Windows version of a programme called Theorist. This has been a very popular computer algebra package which has been available for the Apple Macintosh for several years.

The review version which I looked at ran under Windows. Installation was a matter of just a few minutes thanks to the install routine initiated through Window's Programme Manager. The installation copy was on two 3.5inch disks that came with two thick and very comprehensive manuals. (It should be noted that Maple publish a whole range of books on using this programme that form an invaluable library of associated information; a list of these books was provided in the box.)

### Using the programme.

Mathplus comes with a fully illustrated 320-page learning guide that is quite easy to follow with plenty of examples to help the user to get familiar with the different procedures. This is supplemented by a handy and extensive 350-page reference manual that expands on many of the things in the learning guide. These were both essential given the enormous range of features and functions supported by this package.

With Mathplus, one simply creates a mathematical equation by entering symbols and figures using the keyboard, or selecting from a palette using the mouse. Solving such equations is made very easy thanks to the use of 'click and solve' techniques,

highlighting the expression with the mouse, and choosing a host of manipulative icons from the palette.

Built into the Mathplus software are over 250 maths functions with instructive live notebooks illustrating finite and infinite series, Laplace transforms, 2-D and 3-D graphics, 15-digit arithmetic precision, remanipulation, vectors, matrices, trigonometry, polynomials, etc.

The Graph feature is particularly good and, indeed, one can very easily get quite carried away with entering a wide range of polynomial and trigonometric functions and experimenting with the differently shaped curves produced by modifying the parameters. It is also possible to extract tables from the graphs so that values of  $y$  can be tabulated for a range of values of  $x$  in the function  $y=f(x)$ . Three-dimensional representations of graphs can be shown for bi-variate functions.

The program makes it possible to do very simple mathematics like basic addition and subtraction etc, although most users will probably find it easier to get out their hand calculators. However, when it comes to Algebra, the program is much more useful. The program readily deals with the manipulation of quite complicated expressions. It can cope with the solution of quadratic equations, and of polynomial equations of higher degree using graphical methods. There are also neat methods of handling Non-linear equations.

The program's ability to handle the Calculus is an attractive feature. The program takes in its stride the straightforward problems in differential calculus such as differentiation of algebraic and trigonometric functions, slopes and tangents, and maxima and minima. Similarly, it is equally impressive in handling the integral calculus. Simple definite and indefinite integrals, integration by parts, or by substitution, can be done although,

with some of the difficult problems, care has to be taken to follow through the steps. This is especially true of Multiple or other complicated integrals that require intelligent intervention by the operator. In other words, the program is no mere robot.

The rest of the program's abilities in the Calculus is taken up with the solution of differential calculus. Because this is a vast and complicated field requiring great ingenuity in the solution of many equations, the program could not be expected to cope with other than the more simple ones. Even so, its use of graphs to solve numerical equations of first, second, and higher degrees makes a very useful contribution.

The program's capability in dealing with Matrices is a definite advantage. The basic matrix operations of multiplication and inversion that are often a bit of a chore are carried out with great speed. The program's ability to handle General linear systems, determinants and the solution of simultaneous equations is similarly impressive.

Finally, the Mathplus program gives the mathematician a demonstration of the way in which it can be at home with more advanced techniques like Fourier transforms, Bessel, and the Gamma functions.

### In Conclusion

I found the Mathplus program very attractive and well laid out. The palette of icons makes it easy to become familiar with the various facilities. Many mathematicians, and especially mathematical students, will find this a very useful package to have on their PCs.

The package is well suited to the needs of students studying maths, the sciences and information technology within the National Curriculum, as well as higher level students and

professionals, particularly those in the sciences and technology who are not specialist mathematicians.

### Supplier Details

Product: (MATH)plus version 2

Publisher: Waterloo Maple, 450 Phillip Street, Waterloo, Ontario, Canada, N2L5J2. Tel (from UK) 001 519 747 2373. Fax 001 519 747 5284 or electronically on:

info@maplesoft.on.ca

and World Wide Web:

http://www.maplesoft.on.ca.

UK Distributor - Robinson Marshall (Europe) plc, Nadella Building, Progress Close, Leofric Business Park, Coventry, Warwickshire, CV3 2TF. Tel 01203 233216. Fax 01203 233210.

email: RME@cityscape.co.uk

Price: £199 per single user, network licences begin at £1000.00 for 10 users (there is a special schools version with an unlimited user site licence fee of £995.00)

### System Requirements

PC version: 386 or higher processor, 4MB+ of RAM, 3MB+ hard disk space, VGA display, and Windows 3.1 or NT

Macintosh version: Apple Mac Plus and above including Quadras, 2MB+ RAM, 2MB+ hard disk space, System 6, 7 and A/UX compatible. Math co-processor support version included.

# ELECTRONIC SURVEILLANCE KITS

Micro are experts in the field of Surveillance, Counter-Surveillance, Transmitting & Receiving equipment. We stock the largest range of top quality kits and built units at unbeatable prices. Not to mention our efficient mail order service. All our products are tried and tested and come with an unconditional guarantee that includes that ALL our products are on sale throughout Londons West End shops and around Europe sold as professional equipment at many times the cost. We accept all major credit cards, P.O. and cheques.

- \* MICRO ROOM TRANSMITTER £15.00
- \* 5 MILE BROADCASTING TRANSMITTER £29.00
- \* MAINS POWERED TRANSMITTER £17.00
- \* SIGNAL STRENGTH METER £19.00
- \* REMOTE CONTROL SYSTEM £45.00
- \* REMOTE CONTROL ROOM TRANSMITTER £33.00
- \* MINIATURE HIGH GAIN AMPLIFIER £12.00
- \* CRYSTAL CONTROLLED ROOM TRANSMITTER £35
- \* CRYSTAL TELEPHONE TRANSMITTER £29.00

- \* CRYSTAL CONTROLLED RECEIVER £60.00
- \* SCRAMBLED ROOM/TELEPHONE SYSTEM
- \* MINIATURE TELEPHONE TRANSMITTER £12.00
- \* ROOM & TELEPHONE TRANSMITTER £18.00
- \* TELEPHONE RECORDING SWITCH £13.00
- \* VOICE ACTIVATED ROOM TRANSMITTER £17.00
- \* TRACKING TRANSMITTER £18.00
- \* TELEPHONE TAP DEFEAT SYSTEM £13.00
- \* ROOM/TELEPHONE BUG LOCATOR £45.00

**\* JUST TELEPHONE OR WRITE FOR A FREE COPY OF YOUR CATALOGUE \***

MICRO 9 THE GREENWAY WEALDSTONE HARROW MIDDLESEX HA3 7EW  
TEL: 0181-424-2408 FAX: 0181-863-0222

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

**TEKTRONIX 7000 SERIES OSCILLOSCOPES**  
Available from £200 - **PLUG-INS SOLD SEPARATELY**

TEKTRONIX TA5275 40 Channel 100MHz Cursors	£1300
TEKTRONIX TA5455 Dual Trace 60MHz Delay Cursors	£800
TEKTRONIX 2335 Dual Trace 100MHz Delay	£750
TEKTRONIX 485 Dual Trace 350MHz Delay Sweep	£750
TEKTRONIX 475 Dual Trace 200MHz Delay Sweep	£500
TEKTRONIX 485 Dual Trace 100MHz Delay Sweep	£400
TEKTRONIX SC504 Dual Trace 80MHz in TM503	£400
H.P. 1740A Dual Trace 50MHz Delay Sweep	£350
TEKTRONIX 2225 Dual Trace 200MHz An TB Magnification	£350
TEKTRONIX 2215 Dual Trace 60MHz Delay Sweep	£300
TEKTRONIX 2213 Dual Trace 60MHz	£300
PHILIPS PM3217 Dual Trace 50MHz Delay Sweep	£240
HITACHI V423 Dual Trace 40MHz Delay Sweep	£350
GOULD OS1100 Dual Trace 30MHz Delay Sweep	£300
HAMEG HM204 Dual Trace 20MHz Delay Sweep Component Tester	£300
HITACHI V223 Dual Trace 20MHz Delay Sweep	£250
BECKMAN 9020 Dual Trace 20MHz Delay Sweep	£240
HAMEG 412 Dual Trace 20MHz Delay Sweep	£220
KIKUSUI 5530A Dual Trace 35MHz	£220
GOULD OS300 Dual Trace 20MHz (No Handle)	£180
BECKMAN 2230 Dual Trace 100MHz Digital Storage Cursors	£90A
TEKTRONIX 468 Dual Trace 100MHz Delay Sweep Dig Storage	£750
PHILIPS PM3305 4 Channel 35MHz Digital Storage	£650
GOULD OS0400 Dual Trace 10MHz Digital Storage	£300
H.P. 1741A Dual Trace 100MHz Analogue Storage	£400

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

EATONALTECH 380K11 Syn Sig Gen 1-2000MHz with PM3602 AM/FM Phase Mod.	£200A
MARCONI 2019 Synthesised AM/FM Sig Gen 80KHz-1040MHz	£1750
H.P. 8620C Sweep Oscillator Main Frame only	£200
RACAL 9081 Syn AM/FM Sig Gen 5 - 520MHz	£450
MARCONI TF2237 Automatic Meter	£200
MARCONI TF2231A Distortion Factor Meter 20Hz-20KHz 0.05% unavsd	£225
MARCONI TF2238 Audio Power Meter Snd.	£250
MARCONI TF2163 Attenuator DC-1GHz	£100
RIS Video Noise Meter LPSP22 10MHz-40MHz	£1500
RIS Video Analyser Type LVF	£200A
H.P. 8160A Programmable Prec Pulse Gen 50MHz	£300A
PHILIPS PM5134 Sweep Func Gen 0.001Hz-20MHz Sine/Sq/Tri etc	£350
PHILIPS PM5190 Syn Func Gen 0.001Hz-2MHz Sine/Sq/Tri	£750
H.P. 5006 Signature Analyser	£100
H.P. 500AA Signature Analyser	£100
H.P. 9495B Attenuator DC-10GHz 0-70dB in 10dB Steps	£350
HATFIELD 2105 Attenuator 50ohm	£75

**BRUEL & KJOER EQUIPMENT AVAILABLE PLEASE ENQUIRE**

**SPECTRUM ANALYSERS**

HFR A7550 Synthesised 1 GHz	£4000
H.P. 8565A 0.01-20GHz	£4000
POLARAD 641-1 10MHz-18GHz	£1000
H.P. 182 with 8558B 100MHz-1500MHz	from £1500
H.P. 141T with 8554A & 8552B 10MHz - 18GHz	£1700
H.P. 141T with 8554B & 8552B 500KHz - 1250MHz	£1200
H.P. 141T with 8553B & 8552A 1KHz - 110MHz	£800
H.P. 141T with 8553L & 8552A 1KHz - 110MHz	£700
H.P. 141T MAIN FRAMES ONLY, GOOD TUBES	£225
MARCONI TF2370 30Hz - 110MHz	£1000
H.P. 3555A 20Hz - 40MHz	£10A
H.P. 3560A 5Hz-50KHz	£1000

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

**STEWART OF READING**  
110 WYKEHAM ROAD, READING, BERKS RG6 1PL  
Tel: 01734 268041 Fax: 01734 351696  
Callers welcome 9am to 5.30pm MON-FRI (UNTIL 8pm THURS)

H.P. 5341A Frequency Counter 50MHz - 1.5GHz LEC	£300
RACAL 1988 Frequency Counter 1.3GHz (Options GPIB & High Slew)	£900
RACAL/DANA 1991 Universal Counter/Timer 160MHz 9 digit	£800
MARCONI 2437 Universal Counter/Timer DC - 100MHz 8 digit	£175
RACAL 9918 Frequency Counter 10Hz - 800MHz	£175
RACAL 9959A Frequency Counter 10Hz - 200MHz	£250
SOLARTRON 7065 6 1/2 digit Microprocessor Voltmeter AC/DC Ohms/Ah/Hz	£400
SOLARTRON 7150 6 1/2 - 3 1/2 digit DMM with IEEE	£800
SOLARTRON 7045 4 1/2 digit Multi-meter Volt/Amps/Ohms	£300
THAXTER 1503 4 1/2 digit Multi-meter with Adapter	£250
PHILIPS PM5134 Sweep Func Gen 0.001Hz-20MHz Sine/Sq/Tri etc	£350
PHILIPS PM5190 Syn Func Gen 0.001Hz-2MHz Sine/Sq/Tri etc	£750
H.P. 3310A Func Gen 0.0005Hz-5MHz Sine/Sq/Tri etc	£200
WAVETEK 182A Func Gen 0.004-4MHz Sine/Sq/Tri etc	£225
GOULD JSB Sine/Square Oscillator 10Hz - 100MHz	£150
FEEDBACK FG600 Sine/Sq/Tri 0.1Hz - 100KHz	£160
THANDAR T5051 Func Gen 0.0005Hz - 5MHz Sine/Sq/Tri/Ramp/Pulse etc	£175
THAXTER EP501 Audio Analyser	£350
AWA DISTORTION & NOISE METER F242A	£400
PHILIPS PM565 Waveform Monitor	£300
PHILIPS PM817 Video Limb Selector	£250
FERRISGRABH R152 Recorder Test Set	£200
NAGRA IV S3 Tape Recorder	£350
KEMO Dual Variable Filter VBF/3 @ 1Hz - 100Hz	£200
RACAL Instrumentation Recorder type Store 40N	£300
RACAL Instrumentation Recorder type Store 7DS	£500
MARCONI TF2700 Universal Bridge Battery Operated	from £150
WAVETEK KE818 Digital Counter Component Meter LCT	£200
H.P. 16300 43 Channels	£750
SORENSEN DCR600-4 5B 0 - 500 Volts 0 - 4.5Amps	£200
H.P. 6268 0 - 40 Volts 0 - 30Amps	£500
FARNELL HD0100 0 - 30Volts 0 - 100Amps Milliammeter	£300
FARNELL THANDAR 15P2222 Programmable PSU32V 2A Twice	£500
GPIB Digital	£200
THURBY PL300MD 0 - 30Volts 0 - 2Amps Twice Digital	£225
THURBY PL320 0 - 30Volts 0 - 2Amps Digital	£100
FARNELL TSV70 70Volts 5Amps/35Volts 10Amps	£200
FARNELL L302 0 - 30Volts 0 - 5Amps Metered	£200
FARNELL LT30-2 0 - 30Volts 0 - 2Amps	£160
FARNELL L30-2 9 - 30Volts 0 - 2Amps Metered	£80
BRANDENBURG Model 472R w- 3KV Metered	£300

**MANY OTHER POWER SUPPLIES AVAILABLE**

**NEW EQUIPMENT**

HAMEG OSCILLOSCOPE HM1005 Triple Trace 100MHz Delay Timebase	£647
HAMEG OSCILLOSCOPE HM504 Dual Trace 60MHz Delay Sweep	£553
HAMEG OSCILLOSCOPE HM303 Dual Trace 30MHz Comp. Tester	£422
HAMEG OSCILLOSCOPE HM205 3 Dual Trace 20MHz Digital Storage	£553
All other models available - all oscilloscopes supplied with 2 probes	
<b>BLACK STAR EQUIPMENT (P&amp;P all units £5)</b>	
APOLLO 10 100MHz Counter Timer Ratio/Period/Time etc etc	£202
APOLLO 100 100MHz (as above with more functions)	£322
METRO 100 FREQUENCY COUNTER 100kHz	£119
METRO 100 FREQUENCY COUNTER 600kHz	£149
METRO 1000 FREQUENCY COUNTER 1GHz	£185
JUPITER 500 FUNCTION GEN. 0.1Hz-500kHz Sine/Sq/Tri	£145
ORION COLOUR BAR GENERATOR Pal/TV/Video	£243
All other Black Star equipment available	
OSCILLOSCOPE PROBES Switched X1 X10 (P&P C3)	£13

AN5521	1.35	STK73410/2	5.95	TDA5660P	2.50
AN5732	1.40	STK73605	4.50	TDA7072	3.99
AN6327	9.85	STR441	14.75	TDA8370	14.00
AN6677	8.50	STR451	25.00	TDA8405	8.00
BA5114	1.55	STR3125	5.50	TDA8732	5.95
BA6218	1.85	STR4211	5.50	TEA2018A	1.50
BA6219	1.20	STR4090	11.15	TEA2026C	4.50
HA11423	1.65	STR20005	5.00	TEA5170	1.40
HA13119	2.50	STR40090	4.00	TUA2000-4	4.25
KA6210	4.99	STR50103A	3.85	UH84B	2.35
LA3220	0.60	STR54041	3.75	U4606B	5.50
LA4183	1.35	STR58041	3.75	UAA1008	3.00
LA4445	1.90	STR80001	6.00	UPC1178	1.05
LA4495	1.40	STR1706	4.75	UPC1182H	5.15
LA4588	2.55	STRD1806	4.50	UPC1278H	2.20
LA7835	2.35	STRD5008	10.00	UPC1420	4.50
LB1415	2.25	TA227	1.85	UPD1937	3.00
LM301	0.25	TA2721	2.50	25A814	0.71
LM317	1.50	TA7280	2.25	25A839	1.40
M4918BI	4.75	TA7281	2.20	25A1062	1.00
M498BI	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	6.00	TA75339	**		
STK2250	7.45	TDA1908A	2.00		
STK4121/2	7.00	TDA2170	3.00		
STK4141/2	5.50	TDA2270	2.50		
STK4142/2	6.50	TDA3500	4.99		
STK4162/2	6.25	TDA3562A-TFK	3.25		
STK4171/2	8.10	TDA3562A-PAILL	3.25		
STK4191/2	8.50	TDA3562A-SSSG	3.00		
STK4352	6.20	TDA3545	8.00		
STK4372	5.65	TDA3550	8.99		
STK4803	7.05	TDA3850	18.99		
STK4843	7.05	TDA4400	1.75		
STK5315	5.85	TDA4500	3.50		
STK5332	1.80	TDA4505A	4.10		
STK5338	3.25	TDA4505B	4.10		
STK5361	4.15	TDA4505M	5.25		
STK5372	2.85	TDA4505K	6.15		
STK5372H	4.15	TDA4560	4.50		
STK5412	3.75	TDA4950	1.40		
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**

**250V Working**

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
47UF (each)	1.40

**CERAMIC FILTERS**

5.5MHz SFE (5/pack)	2.40
6.0MHz SFE (5/pack)	2.40
6.5MHz SFE (5/pack)	2.40
10.7MHz SFE (5/pack)	2.40
5.5MHz CDA (5/pack)	2.40
6.0MHz CDA (5/pack)	2.40
6.5MHz CDA (5/pack)	2.40
10MHz CDA (5/pack)	2.40

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**  
63 THE CHASE, EDGEWARE, MIDDX. HA8 5DN, ENGLAND  
Hotlines No 081 381 1700/081 952 4641  
Free Fax order Line only : 0800 318498  
General Fax 081 381 1700

**COMPUTER KNOWLEDGE CALL NOW ON: 0891 515 066**  
MODEM DOWNLOAD SERVICE V21 UP TO V42bis & V.F.C.  
\* Over 330 file areas to download from \*

The latest Shareware, updates & Additions via daily file links to Europe & USA for the PC, Amiga & Atari

Areas of specialisation include DOS, OS/2, Windows/Windows NT, DESQview, Novel, Virus Protection, Dbase/Clipper, Engineering/Electronics & recently DOOM + Much More.

Recreational \* Multi User Games Available \*  
Calls cost 39p per minute cheap rate & 49p per minute at all other times.  
MODEM PARAM's: -8 Data Bits, No Parity, 1 Stop Bit.

**Computer Knowledge, 3 Station Cottages, Cheddington, LU7 OSQ**

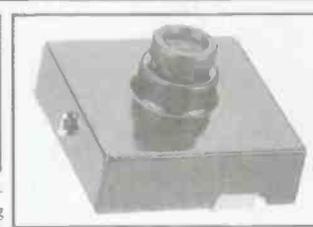
**EQT LTD STEVENAGE**  
Professional Sub-Contract Manufacturing & Suppliers to the Electronics Industry

Do you have a requirement for any of the following services:

PCB Assembly (Conventional and Surface Mount)	Product Design/Consultation
Wave & Hand Soldering	Full Procurement Service
Complete Equipment Manufacture	PCB Test & "Burn in" Facilities
Device Programming from hand written sheets or PC 3 1/2" disc	Enclosure Design & Manufacture
Cable Harness Assembly/loom Manufacture	PCB Artwork Manufacture
Card Cage and Module Wiring	Circuits Drawn Professionally
Full Inspection	Kit Procurement & Supply
	Component Sales
	Refurbishment a speciality
	Top Quality Work at Reasonable Rates

Phone Angela on (01438) 360406 or fax details of your requirements to us on (01438) 352742  
EQT LTD, Cromer House, Caxton way, STEVENAGE, HERTS, SG1 2DF

**HIGH QUALITY LOW COST C.C.T.V. CAMERA**  
EXTREMELY LOW LIGHT LEVEL  
AUTO ELECTRONIC SHUTTER  
COMPOSITE VIDEO OUT VIA BNC PLUG.  
SMALL DISCRETE SIZE.  
CAN BE USED WITH PC DIGITISER.



This super quality CCD camera can be connected to your existing TV or video using the AV channel and can be used for discrete surveillance or observing your property externally using a suitable weatherproof housing. Can accommodate lighting levels ranging from daylight to street lighting using its built-in electronic shutter. Excellent when using with an infra red source. Built-in wide angle fixed focus lens, the camera has a resolution of 380 TVL. Can be housed inside an empty floodlight case, (extra). Camera size only 45mm x 45mm.

Special offer price of only: **£79.95 plus VAT (P&P £3.00)**  
For full range of CCTV products send SAE to:  
**DIRECT CCTV LTD., DEPT ETI, UNIT 6, CARRICK COURT, FORREST GROVE BUSINESS PARK, MIDDLESBROUGH TS2 1QE**

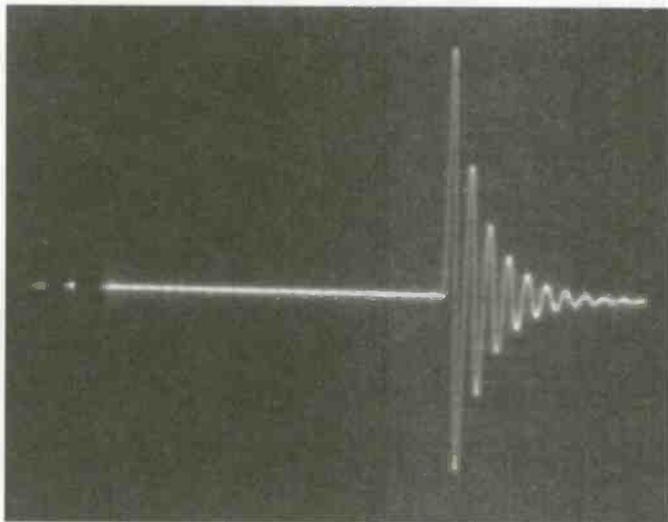
**OMNI ELECTRONICS**  
174 Dalkeith Road, Edinburgh EH16 5DX • 0131 667 2611

The supplier to use if you're looking for -  
★ A WIDE RANGE OF COMPONENTS AIMED AT THE HOBBYIST ★  
★ COMPETITIVE VAT INCLUSIVE PRICES ★  
★ MAIL ORDER - generally by RETURN OF POST ★  
★ FRIENDLY SERVICE ★  
★ 1995/96 CATALOGUE NOW AVAILABLE Price £2.00 ★

Open: Monday-Thursday 9.15-6.00  
Friday 9.15-5.00 Saturday 9.30-5.00

# HUGHES MICROPHONES

*George Pickworth delves into some very early electronic devices  
- how and why did they work?*



**T**he Hughes microphone or loose-joint was the first device able to detect electrical pulses that were too feeble or of too short duration to be detected directly by a galvanometer or a telephone earpiece. Until then these were the most sensitive device available to experimenters; the Hughes Microphone was infinitely more sensitive than the minute spark gap detector later employed by Hertz.

Its great sensitivity made it possible for the first time to detect minute pulses induced in an antenna by early spark transmitters and this played a leading role in the evolution of a practical "wireless" system.

The loose-joint type detector was the simplest device imaginable; it was essentially a pair of minute metal/metal or metal/carbon electrodes just making physical contact with each other. See Figure 1.

## Microphones

Hughes' used the term "microphones" for his loose-joints presumably because its peculiar characteristics were first noticed with early telephone microphones; indeed, the loose-joint was basically the same as an early telephone microphone.

So in respect to Hughes, the term

"microphones" is used in this study; moreover, the term is easy to use and differentiates the detector as a whole from its component electrodes.

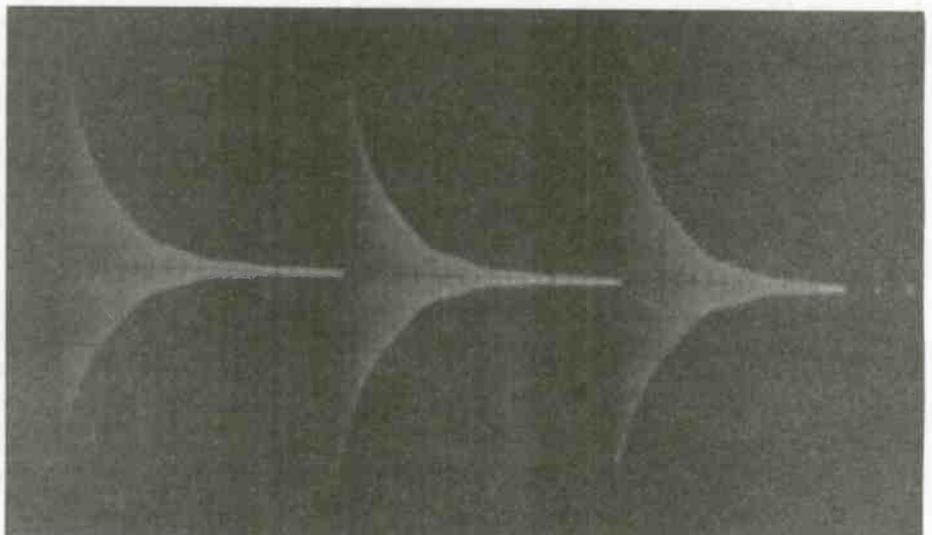
## Relay

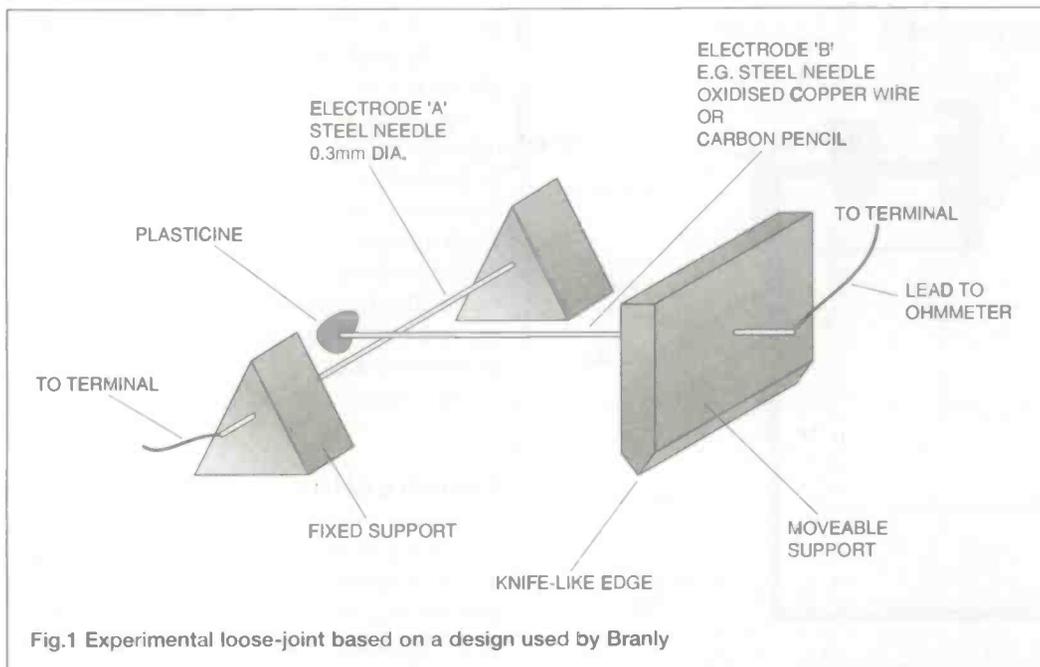
Ordinarily, the joint presents almost infinite resistance, but when subjected to a voltage pulse with a very fast rise-time, referred to as a trigger pulse, its resistance instantly drops to a low level, generally less than  $10\Omega$ .

Current from a local DC source can then flow across the joint to deflect the needle of a galvanometer or cause a "click" to be heard in a telephone earpiece. However, I used an Ohmmeter for most of my experiments and to avoid damaging the joint's electrodes and of course the meter, the local DC was limited by a resistor to about  $500\mu\text{A}$ .

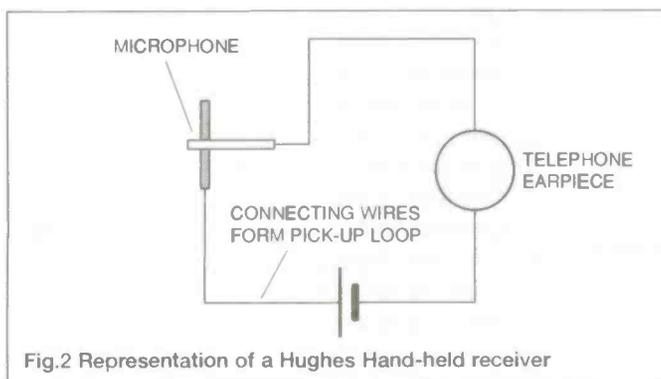
In effect, the microphone behaves as an extremely sensitive, high-speed, latching-relay and, when used as a detector with early radio systems, the trigger pulse was the first half-wave of an exponentially-declining wave-train induced in the receiver antenna by a spark transmitter (see Photo A).

Paradoxically, the trigger pulse needs to have a peak potential in the order of 20V compared with about 0.5V for the local DC and at first sight this would indicate very poor sensitivity. However, sensitivity is not simply related to voltage but to the amount of energy required to trigger a microphone and this was exceedingly small; indeed, the static charge on a small screwdriver driver was more than





developed loose-joint as a detector for his "aerial-wave" wireless telegraph system, which according to some authorities was an Hertzian wave system before Hertz. However, I am rather sceptical if it was an Hertzian wave system but this in no way detracts from Hughes' pioneering work with detectors. Indeed, as far as the microphone was concerned, it was immaterial whether energy was induced in the receiver circuitry by Hertzian waves or by em induction. Hughes was a Professor of Music and not a member of the scientific



fraternity, so he was probably unaware of Schuster's work. The professor's perception was that the loose-joint responded directly to aerial waves radiated by his transmitter.

However, the scientific establishment led by Professor Stokes rejected the concept of "aerial" waves and dismissed Hughes' system as being based on the "well know principles of induction". Disenchanted, Hughes abandoned his research.

### Sir William Crookes

Sir William Crookes had observed Hughes' demonstration when his hand-held receiver responded to pulses emitted by his transmitter over a distance of several hundred metres along Great Portland Street, London, where he conducted the "long range" experiments. Hughes' receiver was simply a microphone, a small cell and a telephone earpiece connected in series (incidentally, this seems to be the first record of a hand-held radio receiver). See Figure 2.

After Hertz had actually demonstrated the existence of em waves, Crookes reviewed Hughes' aerial-wave system, which he then believed to have been an Hertzian-wave system before Hertz, but as I have said, I remain sceptical.

Crookes wrote to technical writer J J Fahie to ask if he could persuade Hughes to publish his research. Hughes responded with a series of letters to Fahie and these provide the background material for this study. Indeed, had it not been for Crookes, the pioneering work of Hughes

adequate. Moreover, its almost infinitely high resistance allows high potentials to develop across the electrodes.

The microphones also respond to pulses induced by natural phenomena. Indeed, I have employed my replicas to detect mysterious earth currents and distant lightning strikes.

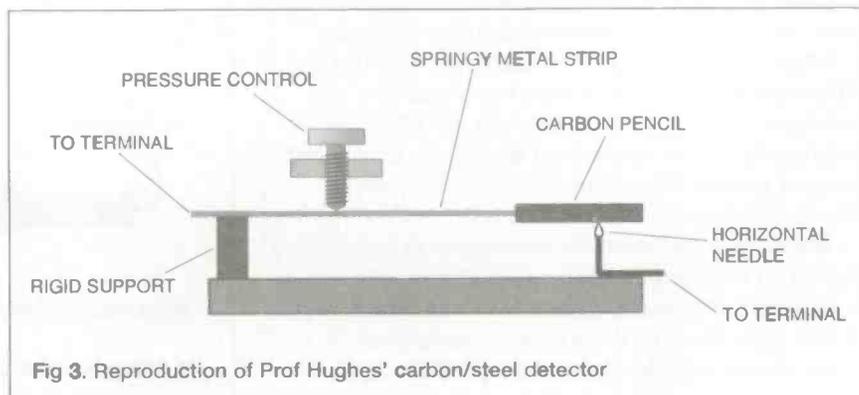
### Restoring

As the microphone behaves like a latching relay, it needs to be restored to its high resistance state after each operation; this simply requires slight vibration. Some types of microphones were restored by ambient vibration and were known as self-restoring detectors. Other types were restored by mechanical arrangements (more about that later). However, fairly fast restoration was, of course, vital when the device was used in a signalling system.

### Evolution

The earliest reference I have found to the peculiar characteristics of a loose-joint is in a paper entitled "On Unilateral Conductivity" read by Arthur Schuster before the British Association in 1874. The effects were described by Schuster as a new discovery in electricity but he did not continue his research.

In 1878, Prof. D E Hughes successfully



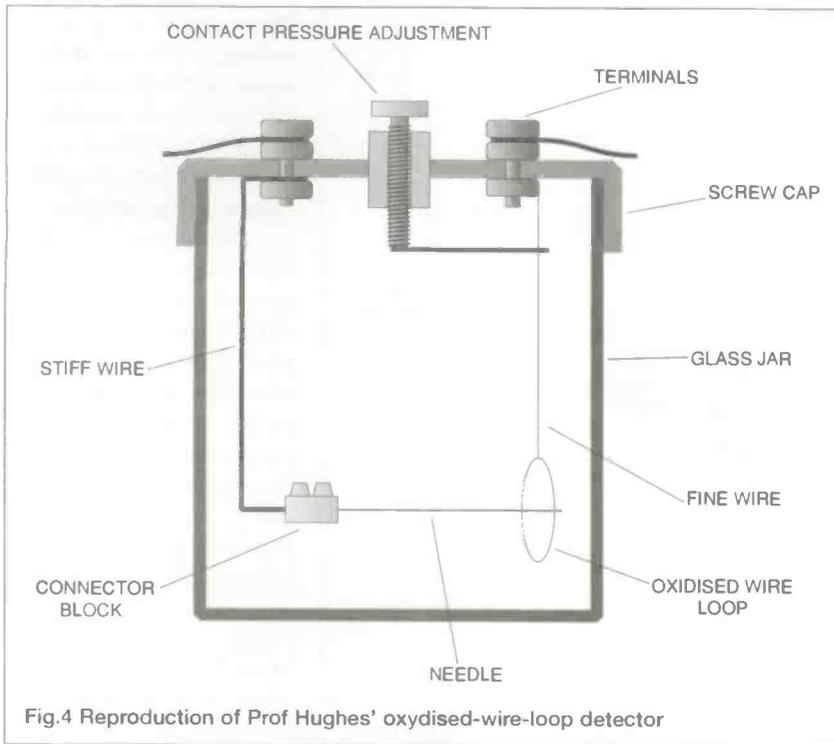


Fig.4 Reproduction of Prof Hughes' oxydised-wire-loop detector

experiments demonstrated that microphones were triggered by current induced in the circuitry.

Radiation of em waves by my reproduction of Hughes' sender was found to be minimal and, for this reason, I am not convinced that his system was a true em wave system though obviously some em waves were radiated. Hughes connected his transmitter to gas and water mains and I am inclined to believe that energy was propagated along metal pipes buried under Great Portland Street.

### Construction

As already mentioned, the microphone's electrodes were arranged so as to be in actual physical contact, but for now let us assume that contact pressure was so low that the oxide film present on the metal electrodes, which can be considered as a dielectric, was not ruptured. As there was no actual metallic contact, the joint presented almost infinite resistance.

Nonetheless, my experiments showed contact pressure to be critical and that contact area must be almost microscopic. Optimum contact pressure was experimentally found to be between 0.3 and 0.5g with the device shown in Figure 1.

My experiments also showed the oxide film to have a dielectric strength of about 10V. So, when a pulse with a peak potential greater than 10V was applied across the electrodes, the dielectric was presumably punctured and metal/metal or metal/carbon contact occurred.

### Vibration

With my replicas, vibration caused by walking across my study caused immediate restoration of the replica microphone; indeed, this extreme sensitivity to vibration made the experiments difficult.

Hughes claimed that his microphones were instantly restored by ambient vibration but I found ambient restoration too unpredictable for my experiments so I

isolated the microphone on rubber sponge and adopted manual-restoration by gently tapping the case with a pencil.

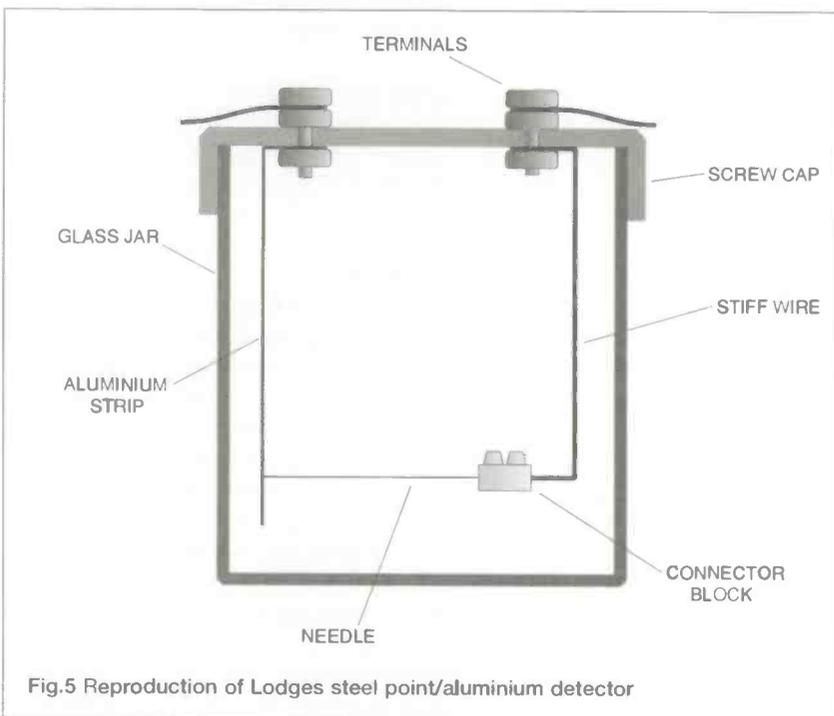


Fig.5 Reproduction of Lodges steel point/aluminium detector

would almost certainly have been consigned to oblivion.

Unfortunately, space only allows a brief mention of Hughes' senders; indeed little seem to be known about them, so this study concentrates on his detectors.

Hughes' primary objective seems to have been to detect aerial-waves rather than investigate the behaviour of his detectors; this was left to Prof. E Branly, who in 1891 published the results of his study in a paper entitled "Variations of Conductivity under Electrical Influence".

Branly too, perceived the loose-joint as responding directly to electrical influence. (See Part 2) Indeed, during my reproduction of Branly's experiments, it did at first sight seem as if my replica microphone responded directly to em waves. However, my



Fig.6 Reproduction of Italian Navy detector

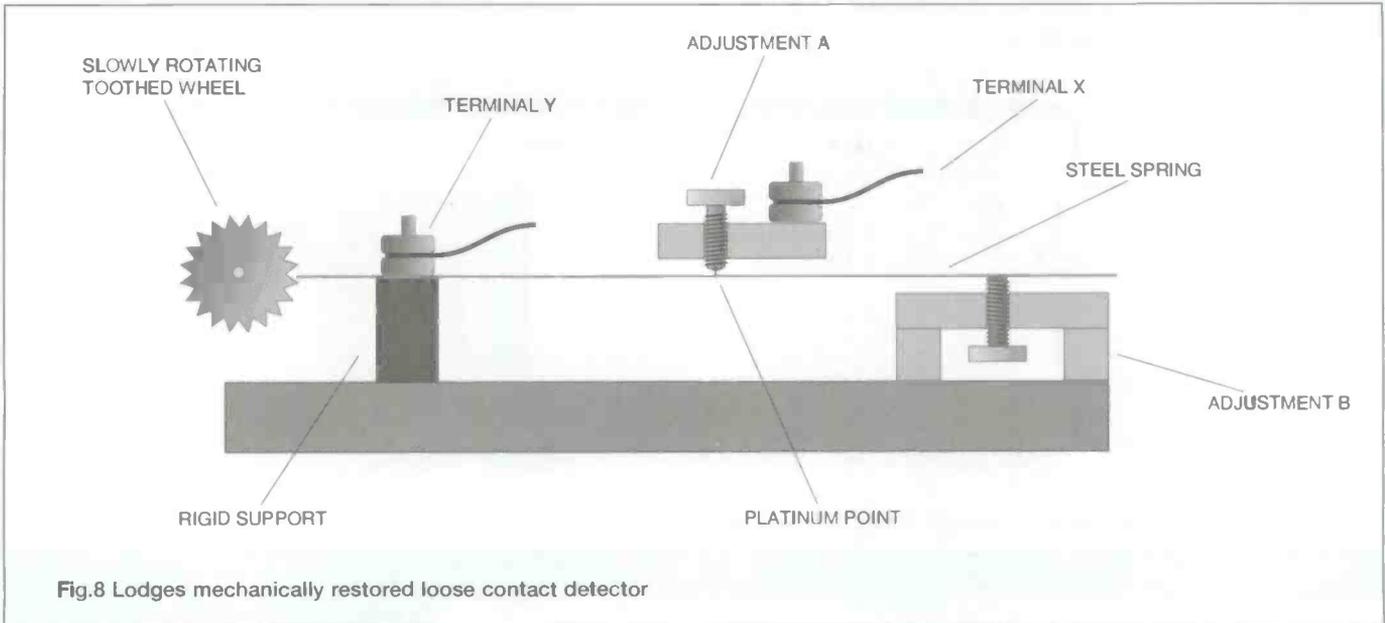


Fig.8 Lodge mechanically restored loose contact detector

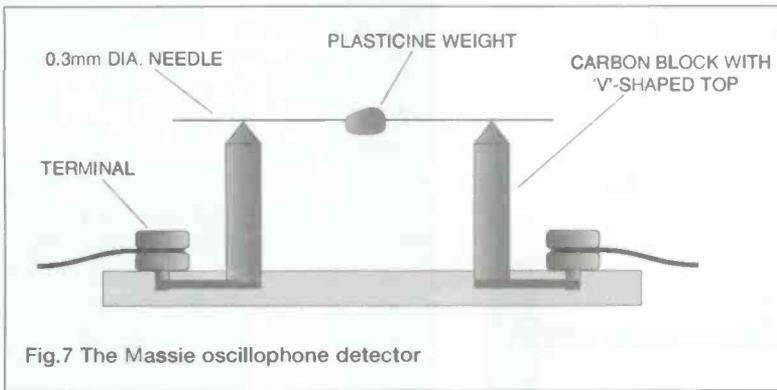


Fig.7 The Massie oscillophone detector

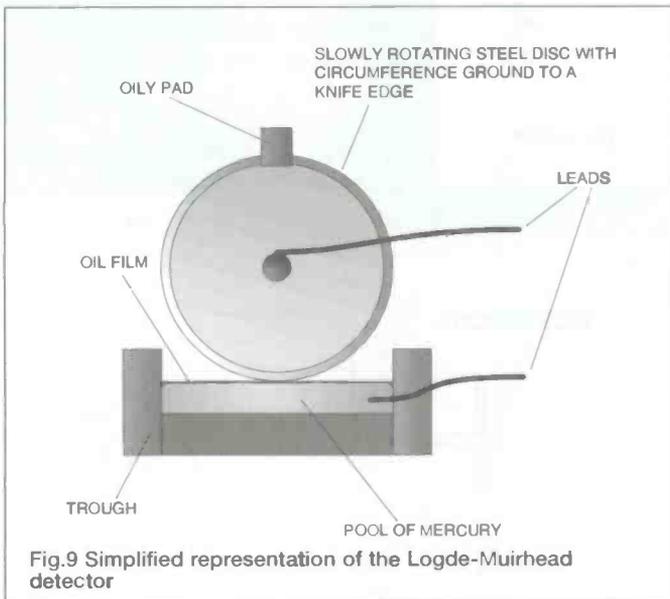


Fig.9 Simplified representation of the Lodge-Muirhead detector

### Sensitivity

As already mentioned, my experiments showed that pulses with a peak potential of more than 20V were necessary for reliable triggering. Nonetheless, my very low power Hertz-type transmitter (Figure 11) was able to trigger my replica of Hughes' hand-held receiver at a distance of 25m. See Graph A.

All the replicas were readily triggered by lightning

discharges up to 10km away but range was dramatically increased by increasing the length of connecting wires to form a large loop-type antenna.

Like Branly, I also found that sensitivity of a new microphone increased to a maximum after being subjected to a number of trigger pulses and, thereafter, sensitivity remained at maximum level. Presumably, some reaction occurred on the surface of the electrodes during the first few operations.

Remarkably, sensitivity was significantly increased by triggering the microphones with a strong, locally generated pulse and restoring immediately before the distant transmitter radiated a wave-train.

### Signalling

At the time of Hughes' research, much land-line telegraphy was still by observing the deflection of a galvanometer needle, or by listening to "clicks" produced by a sounding board; the microphone detector was therefore well adapted to a "wireless" system using this form of signalling. (See Photo B)

Notwithstanding claims made by users of self-restoring microphones, the pioneers found that for signalling, some form of automatic restoration was highly desirable. One of the first mechanically restored microphones was made by Lodge but this was a failure. (See Figure 8)

However, the Lodge-Muirhead detector (Figure 9) was the most successful of all relay type detectors and was reported to respond to individual trigger pulses with a repetition rate greater than 50kHz per second (Photo B) but, being a relay device, it could not produce a musical note. It was more generally used with a paper-tape type Morse-register.

### Behaving as a rectifier

It was, however, claimed that some later self-restoring microphones, particularly the Massie oscillophone (Figure 7) and the Italian Navy Detector (Figure 6) restored themselves so quickly that they responded to individual trigger pulses with a repetition rate in the order of several hundred kHz and were therefore used as a detector in

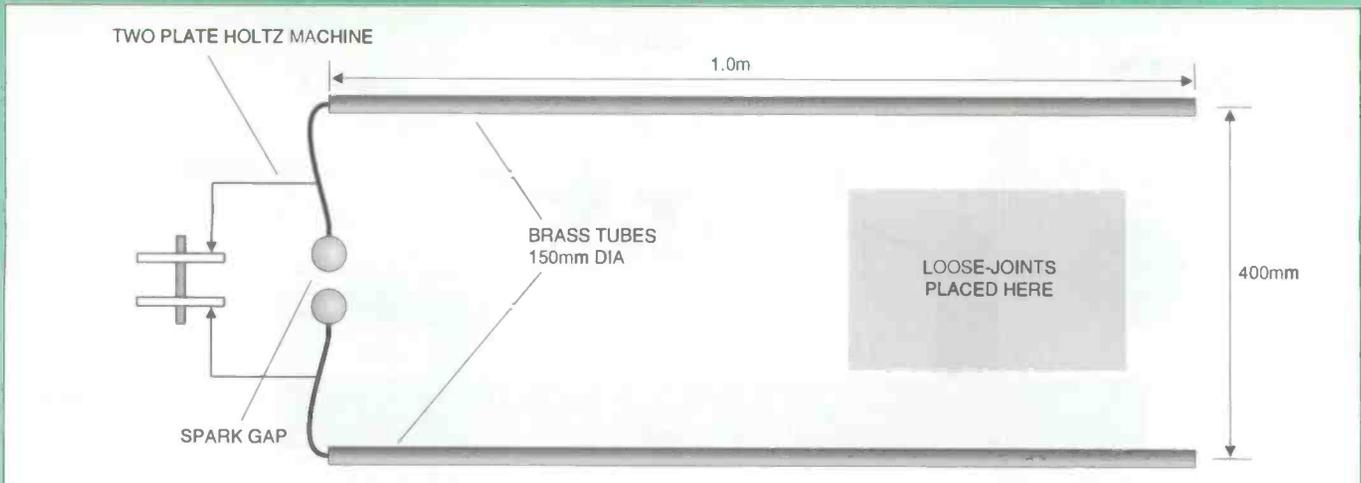


Fig.10 Simplified representation of Branly's "Influence Generator"

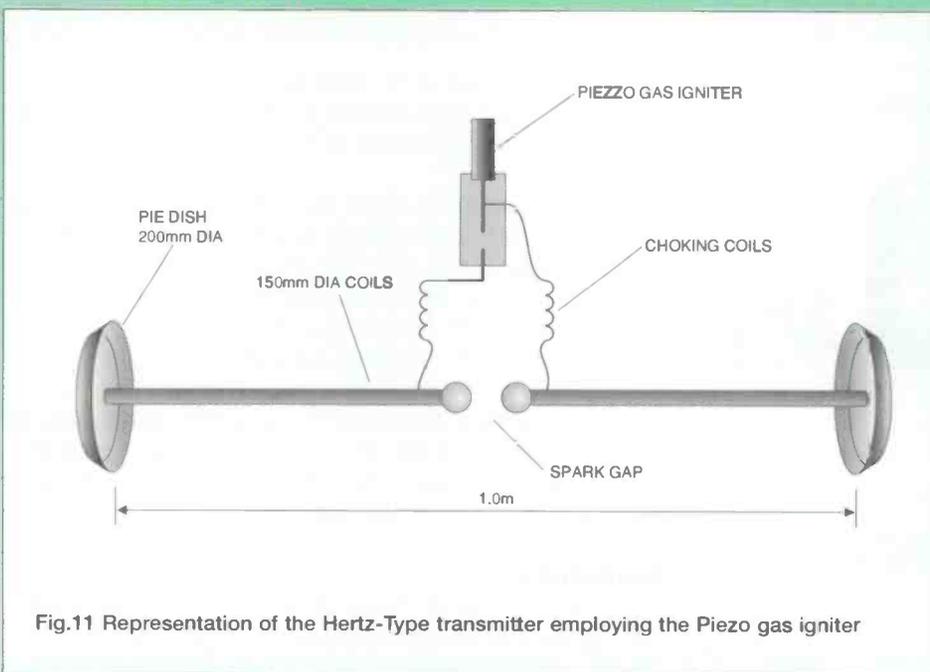


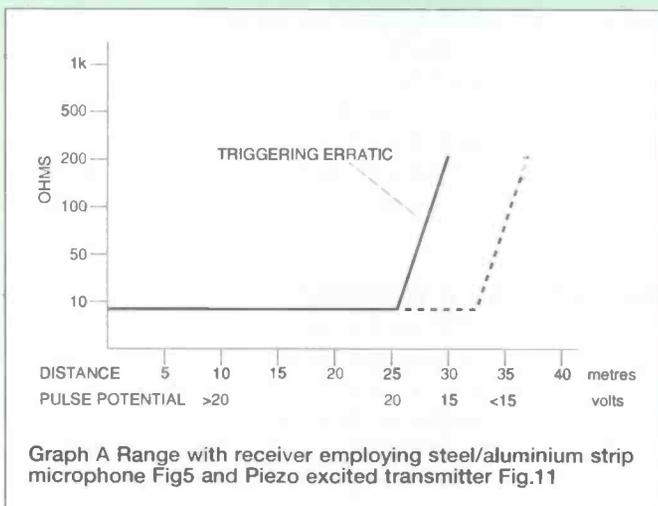
Fig.11 Representation of the Hertz-Type transmitter employing the Piezo gas igniter

presumably, the devices must also have been capable of operating as rectifier type detectors. Indeed, my research showed that under certain conditions the Italian Navy Detector could be made to behave as a rectifier similarly to Fessenden's Liquid Detector; this dissipated positive-going half cycles but blocked negative-going half cycles which were then diverted through the telephone earpiece. My experiments seem to be the first to actually demonstrate this rectifier effect. Unfortunately, so far I have been unable to make the Massie Oscillophone respond to radio frequencies. Obviously I am missing something here!

**In part 2 we look at microphone type detectors in more detail.**

practical wireless systems.

Indeed, both the Massie Oscillophone and the Italian Navy Detector were used in practical "wireless" systems shortly after the turn of the century, but mechanical restoration would have been impossible at radio frequencies. So,



Graph A Range with receiver employing steel/aluminium strip microphone Fig5 and Piezo excited transmitter Fig.11

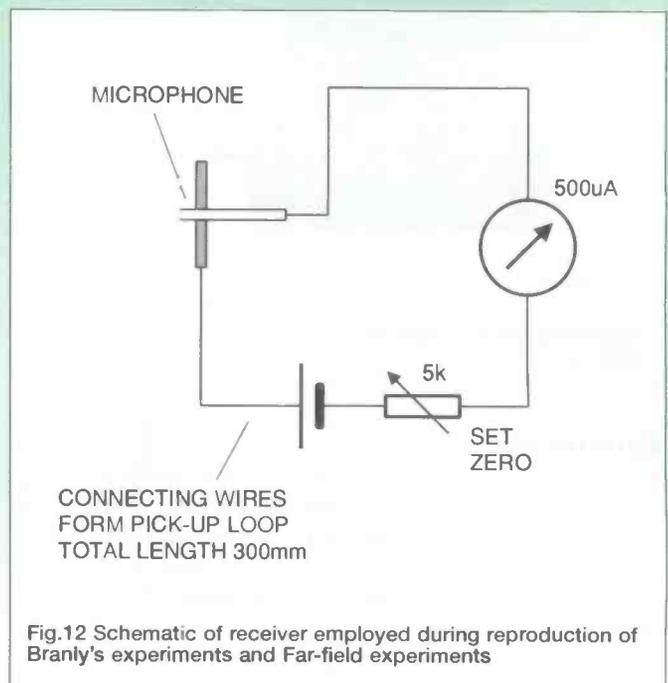


Fig.12 Schematic of receiver employed during reproduction of Branly's experiments and Far-field experiments

DRIVE THE FLYING SCOTSMAN,  
 SAIL THE CUTTY SARK,  
 RACE A WILLIAMS RENAULT  
 FLY A SOPWITH CAMEL,  
 AND FIGHT IN THE BATTLE  
 OF WATERLOO.

ALL FOR JUST £7.



Enter the amazing miniature world of models and modelling.

(Forget the real thing. This is a hundred times more exciting.)

Under the three roofs of Olympia's Grand, National and West Halls, you'll find over a thousand impeccable models in the UK's largest competitive display.

Throughout the eight days there's a programme of non-stop action to suit the whole family.

Experience the excitement of indoor model flying and watch radio controlled racing cars zoom round a specially constructed race circuit. Then try your

hands at the skills of racing cars and sailing boats on a massive boat pool,

before jumping aboard the largest indoor railway.

Besides the vintage aircraft and cars, the battle scenes, steam locomotives and a World Record attempt to create the biggest ever Scalextric track, there will be endless displays by specialist clubs and societies showing every conceivable type of model.

So if you're looking for some big thrills over the holidays come down to The International Model Show at Olympia between

December 30th and January 6th. Or phone 01442 66551 for further information and to book tickets in advance.

THE INTERNATIONAL SHOW  
**model**

*and The Model Engineer Exhibition*  
 OLYMPIA 30 DECEMBER - 6 JANUARY 1996

The Grand, National and West Halls, Olympia, Kensington, London W14.

Opening Times: 10am to 6pm daily.\* Prices (on the door): Adults £7, OAPs £5, Children £3.50, Family Ticket £16.

**INFORMATION & ADVANCE TICKET HOTLINE 01442 66551**

\* Except Thursday 4th January 1996 late night until 8pm, and closes at 5pm on Saturday 6th.



# Practically SPEAKING

## CASSETTE RECORDERS

BY TERRY BALBIRNIE

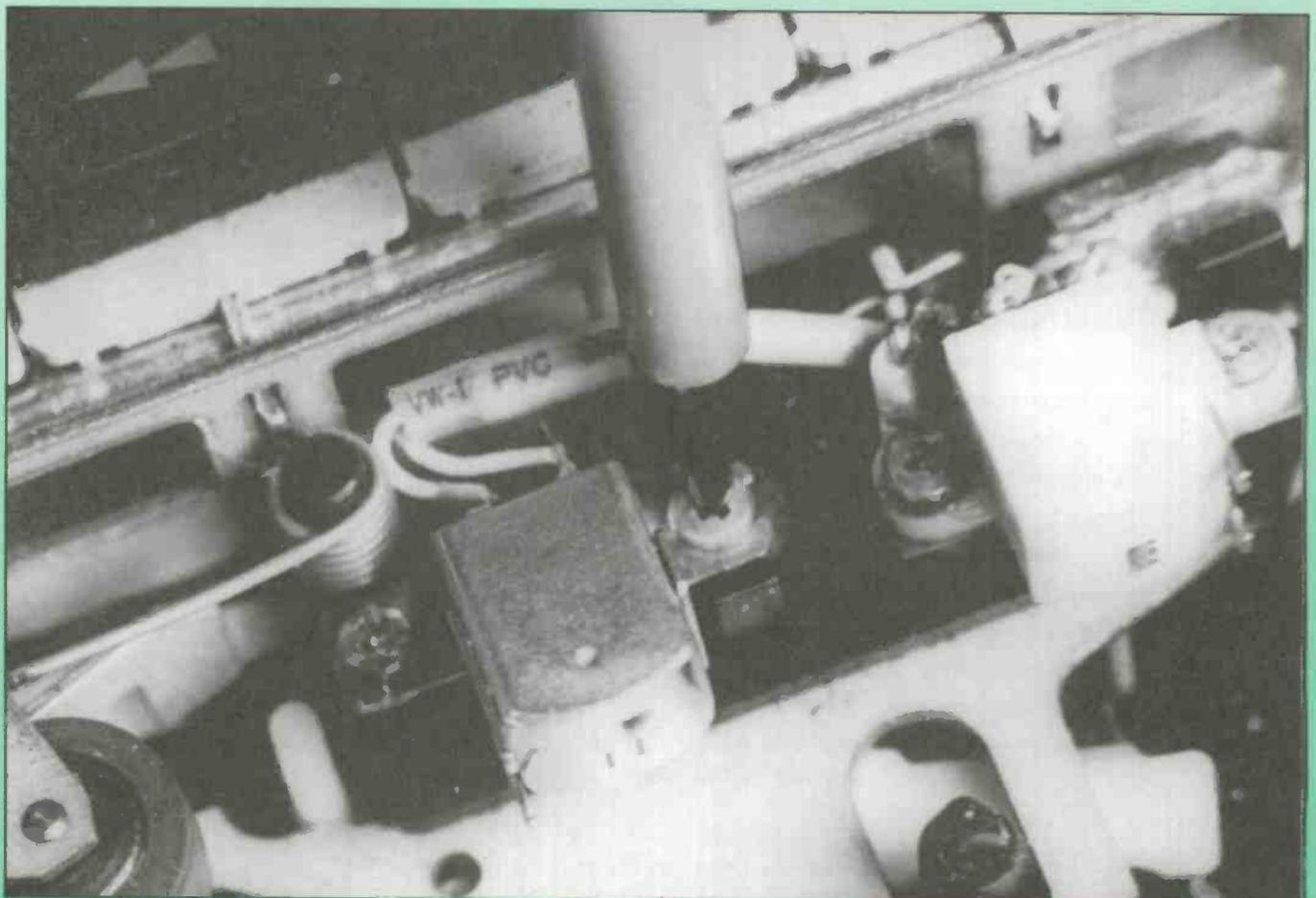
PART 2

**L**ast month we discussed methods of cleaning a cassette player's tape transport mechanism. If this does not cure problems of poor high-frequency response (often described as "muffled" sound) it may be that the record/playback head is misaligned. There may be further problems of permanent head magnetisation or possibly the head itself could be worn out. Fortunately, all these problems may be corrected cheaply and easily. If the head is worn, you will need to work very

carefully and, depending on the size of the machine, in a confined space. Head replacement will be described next month.

### Special cassette

Record/playback head demagnetisation should be carried out regularly as a matter of routine. Over a period of time, the material it is made of tends to become permanently magnetised. This, again, will result in poor-quality sound.



Demagnetisation is easily carried out using a special cassette which is inserted in the machine like an ordinary one. The machine is then operated according to the manufacturer's instructions. There are two types of demagnetising cassette - one contains a rotating magnet, the other is more sophisticated and houses an electronic oscillator circuit. However, both types do the same job. Do not confuse a demagnetising cassette with a cleaning cassette. However, combination cassettes can be bought which perform both functions (Maplin catalogue P88).

### Adjusting the azimuth

If these measures do not improve the sound quality, suspect misalignment of the record/playback head. This is referred to as incorrect "azimuth". The magnetic information on the tape is "read" as it passes a very narrow gap in the head. This gap must always be maintained at right angles to the direction of movement of the tape. Over a period of time, the setting tends to fall out of adjustment. A maintenance engineer will tell you that special equipment is needed to re-set the azimuth exactly and this is probably true. However, the initial setting is often so bad that even a reasonable re-adjustment will give a dramatic improvement in sound quality. If you are lucky, there will be a small hole drilled in the case at the position of the head. Through this hole, a small screwdriver (such as a watchmakers' screwdriver) may be used to adjust the azimuth. Often, the cassette door has to be removed or moved out of the way to expose this hole. If you are unlucky, some dismantling will be needed to expose the head.

The head is usually held in position with two screws. One bears down on a small fork on the body and there will be a

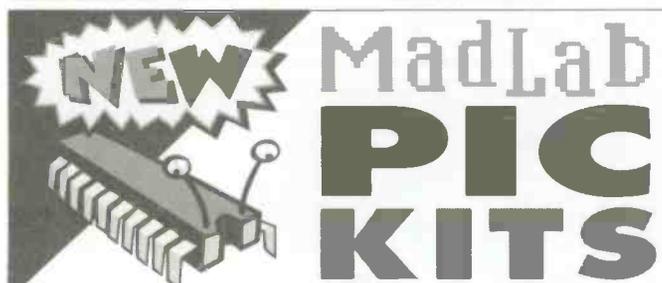
small spring beneath this to hold it in position. It is this latter screw which adjusts the alignment. It is very important to understand that only minute adjustments to the screw are required. You may find that the position of the screw is sealed against movement using a little coloured varnish. This will not interfere with the adjustment process. It could be re-sealed using a little nail varnish if this is thought necessary.

### Best sound

Adjustment may be made while playing a commercially-recorded tape with plenty of high frequency sounds (very high-pitched notes) in it. Listen carefully and very slowly adjust the screw one way and then the other. You will hear the sound improve and then deteriorate again. Do this a few times so that you know what you are listening for and to get a feel for the process. Make small adjustments until the best sound is obtained.

Setting may be carried out more quickly by using a cassette specially made for the purpose. These tapes are often made with a variety of diagnostic sounds but the most important one here is a steady tone of a very high pitch (about 8kHz). It is played and the azimuth adjusted for optimum sound quality. These tapes are available from Hart Electronic Kits Ltd, at £9.99. Tel: 01691 652894

If problems persist, it could be that the record/playback head is worn out. Worn out heads sometimes show themselves by periods of good and bad sound at unpredictable intervals. Sometimes the sound on one channel sounds good while that on the other is poor. Fortunately, replacement heads are easily obtained and this will be discussed further next month.



Everybody's talking about the PIC these days - the hottest microcontroller on the hobbyist market. It's cheap, robust, easy to interface to the outside world, and a breeze to program. Now's your chance to build a kit featuring one of these chips. MadLab® at the Edinburgh International Science Festival has developed an exciting range of PIC kits which allow you to explore the capabilities of this powerful device.

All MadLab kits include a professional pcb and full instructions.

**MAD MUSIC MACHINE** £12.00 - our simplest kit and an excellent introduction to the PIC. Pre-programmed with 4 tunes (state Scottish, Soaps or Kids mixes). You can also play your own tunes over 4 octaves.

**LOTTOMANIA** £13.00 - could win you a fortune in the National Lottery. And much more. Also simulates the rolling of dice, a 1 or 2-player reaction game, and a tracker game which tests how quick thinking you are.

**RAZZLE DAZZLER** £13.50 - a stylish piece of electronic jewellery. A ring of superbright LEDs around a circular pcb displays an ever-changing pattern of light. Wear it as a badge or pendant and get noticed.

**SPYCATCHER** £14.00 - a sophisticated security alarm with multiple sensors, silent mode and security code. The infra-red sensor triggers the piezo alarm when a light beam is interrupted. Also includes a magnetic switch which can be attached to a door or window. In fact most of the features of a professional burglar alarm for a fraction of the cost!

**SPACEFLAG** £15.00 - our most advanced kit. When the SpaceFlag is waved in front of your eyes a scrolling message magically appears in space. Any message (up to 24 characters) can easily be programmed using the on-board pushbuttons. As featured in *New Scientist*.

All kits require a PP3 battery (£1) except the Razzle Dazzler which needs a miniature 12V battery (75p). All prices are inclusive. P&P is £1.50 (UK). Please make cheques and PO's payable to MadLab Ltd. Send your order to: MadLab (Dept. ET1), 149 Rose Street, Edinburgh EH2 4LS. No callers please. Allow 28 days for delivery. Please send a SAE for further details on MadLab kits, including our range of educational electronic kits.

E&OE

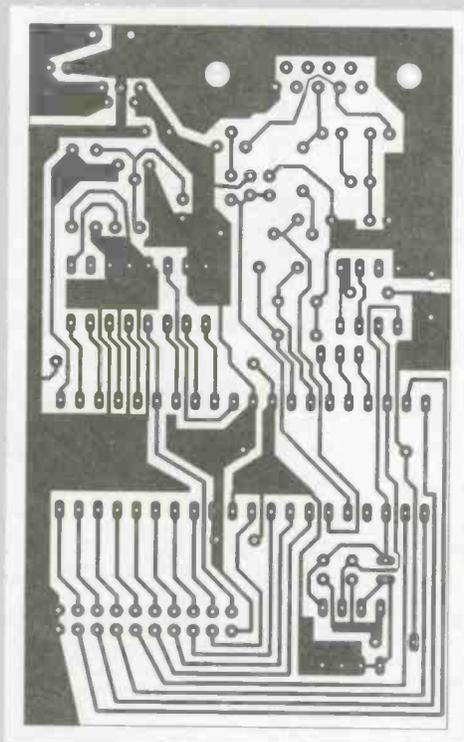
### NEW MINI CAMERA AND SPECIAL OFFERS

New mini waterproof TV camera 40x40x15mm requires 10 to 16 volts at 120mA with composite video output (to feed into a video or a TV with a SCART plug) 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) £33.57 + VAT = £39.95 or 10x £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. £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 of faulty £33.45  
 spare 6v battery £1.20  
 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) £0.99  
 AA 700mAh £1.75  
 C 2AH with solder tags £3.60  
 D 4AH with solder tags £4.95  
 1/2AA with solder tags £1.55  
 AAA (HP16) 180mAh £1.75  
 AA 500mAh with solder tags £1.55  
 C (HP11) 1.8AH £2.20  
 D (HP2) 1.2AH £2.60  
 PP3 8.4V 1100mAh £4.95  
 Sub C with solder tags £2.50  
 1/2 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 nead batteries 171mmx16mm dia with red & black leads 4.8v £8.95  
 5 button cell 6V 280mAh battery with wires (Varta 5x250DK) £2.45  
 Shaded pole motor 240VAC 5mm x 20mm shaft 30 x 30 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  
 £1.44 100+  
 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  
 BC547A transistor £0.20 for £1.00  
 74LS05 hex inverter £10.00 per 100, used 8748  
 Microcontroller £3.50

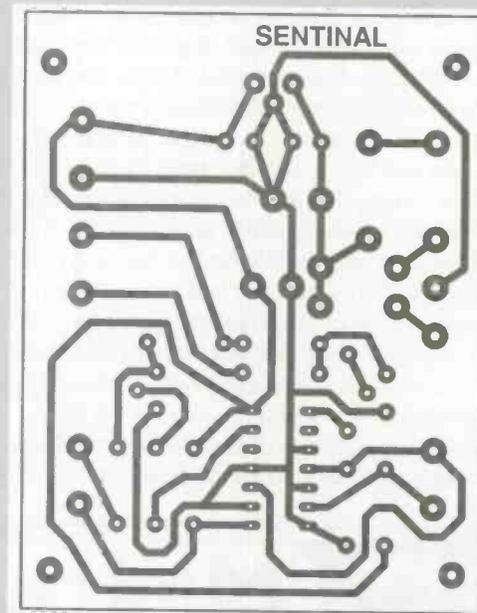
SL952 UHF Limiting amplifier LC 16 surface mounting package with data sheet £1.95  
 AM27502 £1.25 each 90p 100+, CD4007UB 10p 100+, 6p 1000+ £3.95  
 Sinclair light gun terminated with a jack plug and PP3 clip gives a signal when pointed at 50Hz flickering light with output wave form chart £3.95  
 DC-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  
 Alpkax AB2903C large stepping motor 14v 7.5' step 270rhm 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+ 1uf 50v bipolar electrolytic axial leads 15p each, 7.5p 100+ 0.22uf 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 10B series long life 22uf 63v axial 30p each 15p 1000+ Multilayer AVX ceramic capacitors all 5mm pitch 100v 100p, 150pf, 220pf, 10,000pf (10n) 10p each, 5p 100+, 3.5p 1000+ 500pf compression trimmer £.60  
 40 uf 370vac motor start capacitor (dielectric type containing no PCBs) £5.95 or £49.50 for 10  
 Solid carbon resistors very low inductance ideal for RF circuits 270rhm 2W, 680rhm 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) dms 212x49x148mm excluding switch £26.50 each £138.00 for 6  
 MX180 Digital multimeter 17 ranges 1000vdc 750vac 2Mohm 200mA transistor Hfe 5v and 1/5v battery test £9.95  
 AMD 27256-3 Eproms £2.00 each, £1.25 100+ Imcax delux anti-glare static control panel window size 228x161mm overall size 264x200mm held to the monitor with hook & loop tape pads £7.95 each 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  
 All products advertised as new and unused unless otherwise stated. Price 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

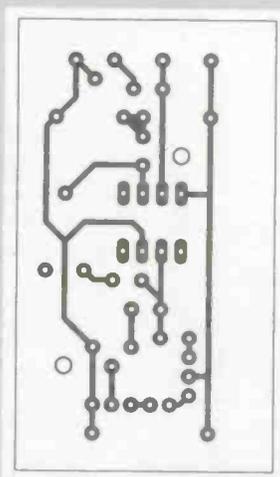
ETI 276-278 Chatsworth Road, Chesterfield S40 2BH  
 Access Visa Orders (01246) 211202  
 Callers Welcome



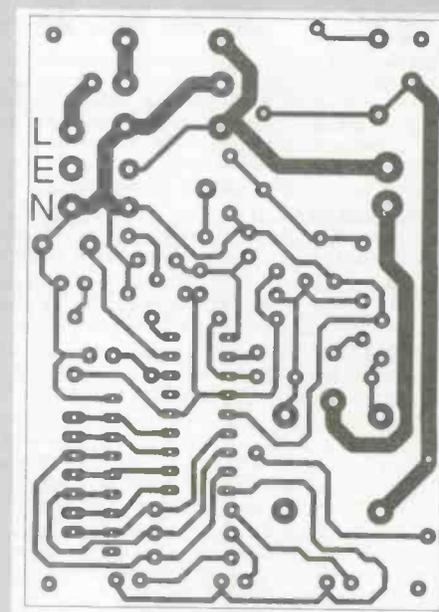
PIC BASIC CONTROLLER



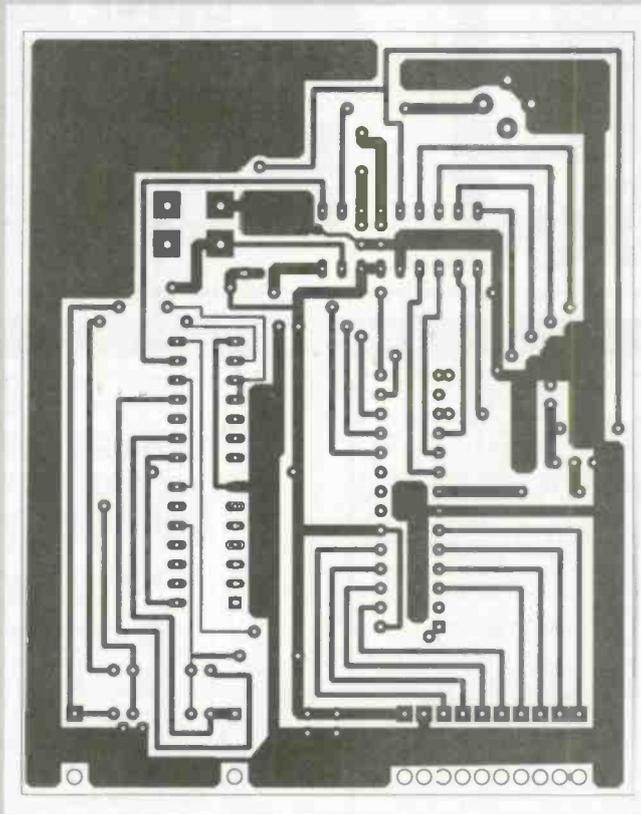
SENTINAL ALARM TESTER



LOVE FINDER

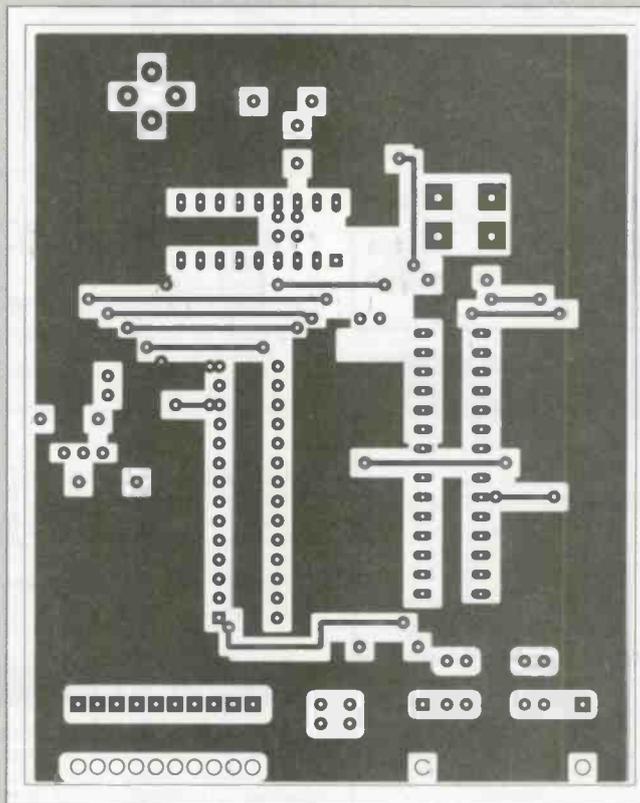


VIDEOCHECK



LOGIC ANALYSER (FOIL SIDE)

LOGIC ANALYSER (COMPONENT SIDE)



# ETI Classified



**James Gale**  
**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

### VARIABLE VOLTAGE TRANSFORMERS

INPUT 220/240V AC 50/60  
OUTPUT 0-260V

	Price	P&P
0.5KVA 2.5 amp max	£31.90	£6.00
	(£14.53 inc VAT)	
1KVA 5 amp max	£41.15	£7.00
	(£56.58 inc VAT)	
2KVA 10 amp max	£59.40	£8.50
	(£79.78 inc VAT)	
3KVA 15 amp max	£78.65	£8.50
	(£102.40 inc VAT)	
5KVA 25 amp max	£139.15	

(Plus Carriage)  
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 enquires

#### ULTRA VIOLET BLACK LIGHT FLUORESCENT TUBES

4ft 40 watt £14.00 (callers only)	(£10.45 inc VAT)
2ft 20 watt £9.00 (callers only)	(£6.58 inc VAT)
12in 8 watt £4.80 + 75p p&p	(£6.52 inc VAT)
9in 8 watt £3.95 + 50p p&p	(£5.24 inc VAT)
6in 4 watt £3.95 + 50p p&p	(£5.24 inc VAT)

#### 230V AC BALLAST KIT

For either 6in, 9in or 12in tubes £8.05 + £1.40 p&p (£9.75 inc VAT)

The above Tubes are suitable for Forged Bank Note detection, security marking etc.

Other Wave Lengths of U.V. TUBE available please telephone your enquires.

#### 400 WATT UV LAMP

Only £38.00 + £4.00 p&p (£49.35 inc VAT)

#### 160 WATT SELF BALLASTED BLACK LIGHT MERCURY BUB

Available with BC or ES fitting. Price inc VAT & p&p and VAT £25.55



#### 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 joules. Adjustable speed £50.00 + £3.00 p&p (£52.28 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.



### SERVICE TRADING CO

57 BRIDGMAN ROAD, CHISWICK, LONDON W4 5BB  
FAX 0181-995 0549 0181-995 1560  
ACCOUNT CUSTOMERS MIN, ORDER £10



Ample Parking Space

### LIVERPOOL

#### PROGRESSIVE RADIO

87/93 Dale Street  
Tel: 0151 236 0982 0151 236 0154

47 Whitechapel  
Tel: 0151 236 5489  
Liverpool 2

'THE ELECTRONICS SPECIALISTS'  
Open: Tues-Sat 9.30-5.30

#### 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

ELECTRONICS TODAY INTERNATIONAL

### COOKE INTERNATIONAL

#### SUPPLIER OF QUALITY USED TEST INSTRUMENTS.

ANALYSERS, BRIDGES, CALIBRATORS, VOLTMETERS, GENERATORS, OSCILLOSCOPES, POWER METERS, ETC  
ALWAYS AVAILABLE

ORIGINAL SERVICE MANUALS FOR SALE  
COPY SERVICE ALSO AVAILABLE

EXPORT, TRADE AND U.K. ENQUIRIES WELCOME  
SEND FOR LIST OF EQUIPMENT AND MANUALS  
ALL PRICES EXCLUDE VAT AND CARRIAGE

DISCOUNT FOR BULK ORDERS SHIPPING ARRANGED

OPEN MONDAY TO FRIDAY 9AM - 5PM

#### COOKE INTERNATIONAL

#### ELECTRONIC TEST & MEASURING INSTRUMENTS

Unit Four, Fordingbridge Site, Main Road, Barnham, Bognor Regis, West Sussex, PO22 0EB Tel (+44) 01243 545111/2 Fax (+44) 01243 542457

WANTED TEST EQUIPMENT & MANUALS TO PURCHASE

### 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 TEUFEL WIRE NICKEL  
SAE BRINGS LIST 18 RAVEN  
RD LONDON E18 1HW  
FAX 0181 559 1114

### LEN COOKE ENTERPRISES

For the best value in Used  
Electronic Test Instruments

We buy, sell and service oscilloscopes, signal generators, frequency counters, spectrum Analysers, Power meters, logic testers, etc.  
Spare parts available for most Testronic scopes.

Tel: 0181-813-9946  
Fax: 0181-574-2339  
Mobile: 0802 177752

Mail order address: Unit 5, Southall Enterprise Centre, Bridge Road, Southall, Middx. UB2 4AJ

We engineer what we buy, we support what we sell.

### FIELD ELECTRIC LTD

Unit 2, Willows Link,  
Stenevage, SG2 8AB  
Tel: 01438 353781 Fax: 01438 359397

Test equipment, computer hardware, audio video communications  
mechanical bought & sold stock list available. Please ring

THE PARALLEL INTERFACE POWER CARD by HANDDI Ltd for complete COMPUTER CONTROL.

This could be your most useful and cheapest computer/PC "add on" at only £19.95...Post FREE!  
Drives robotics, motor speeds, stepper motors lamps, relays etc. using its 8x20v/2A outputs. Many sold already for successful Model Railway Layout control...FULL INSTRUCTIONS supplied!

Send cheque for £19.95 OR S.A.E. for details to: HANDDI Ltd. (Dept. D), P.O. Box 583, Milton Keynes, MK5 4JD.

### COMPONENTS

EPROMs, PLDs, + microcontrollers copied or programmed. We supply devices/convert discrete logic to PLDs. P.O. Box ETI 1561, Bath 01225 400966.

### ELECTRONIC VALVES

#### CHELMER VALVE COMPANY

130 NEW LONDON ROAD,  
CHELMSFORD  
ESSEX CM2 0RG  
Tel: 01245 355296  
Fax: 01245 490064  
For high quality audio valves

### SMART CARD PRODUCTS

Smartcards, Readers/Writers, OEM couplers, Evaluation kits and more.

**EPSILON ELECTRONICS**  
Brynsengvn. 1A, 0667 Oslo,  
Norway TEL/FAX  
+4722640810

### L.F. HANNEY

Your Electronic  
Component Specialist for  
Avon, Wilts & Somerset..  
77 Lower Bristol  
Road, Bath, Avon.  
Tel: 01225 424811

### 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.



# Around the Corner

*Nick Hampshire takes a look at the technology of tomorrow*

**C**omputer networks are very much the technology of today. Indeed, if we are to go by the number of times they are mentioned in the newspapers and on TV, it seems as if everyone is talking about the Internet and the World Wide Web. These systems are revolutionary and are already starting to have a major impact on the way we work, on business, and in our leisure hours.

Companies worth billions have sprung up overnight and, in a recent poll, nearly half the population of the UK wanted a multimedia, Internet-compatible PC as their number one choice of Christmas present.

But for one American company, network pioneers Novell, this is not enough. They have already developed a technology which will not only allow users to send e-mail and access the Net but will also allow them to control household devices, all without the need for a conventional PC.

The technology unveiled by Novell is a tiny software 'agent', known as Novell Embedded Systems Technology, or NEST. It can be installed in any processor, whether it is in a conventional computer, the controller in your central heating system, a burglar alarm, even your washing machine, or your car.

This tiny piece of software can be incorporated by the manufacturers into the processor chip of any product that employs an embedded microcontroller. It will then allow that product to be connected to the Internet via a phone line or even the power cable. With NEST, it would be feasible to phone your home, turn on the washing machine, or even phone up your car and check whether it has enough petrol for the journey you intend taking.

In some ways, this may all sound rather far-fetched, but a lot of companies are taking it very seriously. In fact, over 300 different electronic devices from some of the biggest US, European and Japanese companies will incorporate NEST and be commercially available by the end of the year.

However, the odds are that one of the first

implementations of this technology will be in the UK. It is understood that at least one of the electricity companies is working with Novell to develop a system for broadcasting commands over the power cables.

The power company's primary interest in NEST is that it will allow them to encourage users to use electricity at times when the demand is lowest, and it will also enable them to develop remotely readable electricity meters, thus eliminating the quarterly call of the meter man.

Novell are not the only company to be looking at ways of expanding the market for networks without having to have lots of PCs with their very expensive Intel processors and Microsoft software. The British computer company Acorn and its subsidiaries, chip maker ARM and interactive TV company Online Media, are understood to be working with the database software giant Oracle to develop a very low-cost Internet box.

According to reports, this box will cost just a couple of hundred pounds and come with a full keyboard and modem. It will use a standard domestic TV as the monitor and be connected directly to any standard domestic phone line. The user will be able to send and receive e-mail, download software for applications such as wordprocessing, access the Internet and World Wide Web, play interactive games and, in the near future, download video and music.

This is an interesting concept that should expand the potential market for access to the Internet by encouraging people to become involved who would not have otherwise bought a full featured PC. It will also be of interest to the cable and telephone companies since it offers yet another way of selling telecommunications services.

No one can really know how successful any of these products will be, particularly in the face of very rapid technology development. But, one thing is certain - the future will be filled with increasingly complex and ever larger networks of processors.

Networks are here to stay!

## Next Month...

In the March 1996 issue of Electronics Today International, Robin Abbott takes a close look at using the PC bus and, from Terry Balbimie, there is a miniature sound recorder which can store and replay ten seconds of speech, which could form an interesting addition to many projects.

Digital thermometers are the subject of a piece by Graham Reith, Bart Trepak examines ways of controlling power devices with the PIC microcontroller, and Tony Sercombe introduces a project to build a portable audio mixer.

The feature articles will include a look at advances in solar energy power systems by Dave Clarkson and George Pickworth will conclude his delving into the technology behind early electronics.



### EDITORIAL

Editor **Nick Hampshire**

Sub Editor **Eamonn Percival**

Editorial Assistant **Lynn Bugden**

### CREATIVE

Designer **Wayne Griffin**

Technical Illustration **John Puczynski**

Photography **Manny Cefai**

### ADVERTISEMENT SALES

Display Sales

**Alison Wetherill**

Advertisement Copy Control

**Marie Quilter**

Classified Sales

**Jim Gale**

Group Advertising Manager

**Diane Farnham**

### MANAGEMENT

Divisional Director

**Terry Pattison**

Production Administrator

**Theresa Davis**

Business Manager

**Claire Jenkinson**

Marketing Manager

**Jason Doran**

Copy Sales Manager

**David Pagendam**



ETI is normally published on the first Friday in the month preceding the cover date. The contents of this publication including all articles, plans, drawings and programs and all copyright and all other intellectual property rights therein belong to Nexus Special Interests. All rights conferred by the Law of Copyright and other intellectual property rights and by virtue of international copyright conventions are specifically reserved to Nexus Special Interests and reproduction requires the prior written consent of the company c1990 Nexus Special Interests. All reasonable care is taken in the preparation of the magazine contents, but the publishers cannot be held legally responsible for errors. Where mistakes do occur, a correction will normally be published as soon as possible afterwards. All prices and data contained in advertisements are accepted by us in good faith as correct at the time of going to press. Neither the advertisers nor the publishers can be held responsible, however, for any variations affecting price or availability which may occur after the publication has closed for press.

Subscription rates-UK £25.80 Europe £34.70 Sterling Overseas £36.20 US Dollars Overseas \$54.00

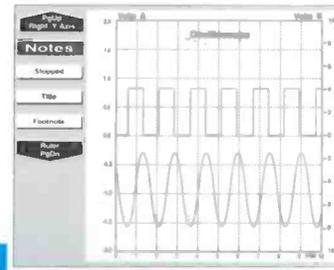
Published by Nexus Special Interests, Nexus House, Boundary Way, Hemel Hempstead HP2 7ST. Telephone (01442) 66551. UK newstrade distribution by SM Distribution Ltd, 6 Leigham Court Road, London SW16 2PG. Telephone 0181-667 8111. Overseas and non-newstrade sales by Magazine Sales Department, Argus House, Boundary Way, Hemel Hempstead, HP2 7ST. Telephone (01442) 66551. Subscriptions by Nexus Subscription Dept. Tower House, Sovereign Park, Lathkill Street, Market Harborough, Leicestershire, LE16 9EF. US subscriptions by Wise Owl Worldwide Publications, 4314 West 238th Street, Torrance, CA90505 USA. For Visa/Mastercard orders in USA - Telephone (310) 375 6258 Fax (310) 375 0548. Pacific Time: 9am-9pm Weekdays. 10am-6pm Weekends. Typesetting and origination by Ebony, Liskeard, Cornwall. Printed by Wiltshire Ltd, Bristol.



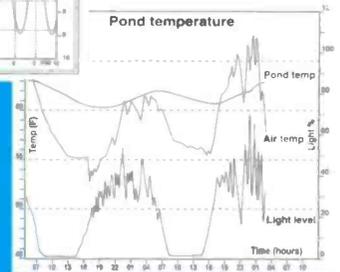
Nexus House, Boundary Way,  
Hemel Hempstead HP2 7ST  
Telephone (01442) 66551  
Fax (01442) 66998

# Pico Releases PC Potential

Pico's Virtual Instrumentation enable you to use your computer as a variety of useful test and measurement instruments or as an advanced data logger.



**PicoScope**  
'Virtual instrument' software.



**PicoLog**  
Advanced data logging software.

Hardware and software are supplied together as a package - no more worries about incompatibility or complex set-up procedures. Unlike traditional 'plug in' data acquisition cards, they simply plug into the PC's parallel or serial port, making them ideal for use with portable PC's.

**Call for your Guide on 'Virtual Instrumentation'.**

## **NEW from Pico TC-08 Thermocouple to PC Converter** **8 channel Thermocouple Interface**

- Connects to your serial port - no power supply required.
- Supplied with PicoLog datalogging software for advanced temperature processing, min/max detection and alarm.
- 8 Thermocouple inputs (B,E,J,K,N,R,S and T types)
- Resolution and accuracy dependant on thermocouple type. For type K the resolution is better than 0.1°C.

**TC-08** £ 199

**TC-08** + Calibration Certificate £ 224

complete with PicoLog, software drivers and connecting cable. A range of thermocouple probes is available.



## **SLA-16 & SLA-32 Logic Analysers** **Pocket sized 16/32 channel Logic Analysers**

- Connects to PC serial port.
- Up to 50MHz sampling.
- Internal and external clock modes.
- 8K Trace Buffer.

**SLA-16** £ 219  
**SLA-32** £ 349  
with software, power supply and cables



## **ADC-100 Virtual Instrument** **Dual Channel 12 bit resolution**

- Digital Storage Scope
- Spectrum Analyser
- Frequency Meter
- Chart Recorder
- Data Logger
- Voltmeter

The ADC-100 offers both a high sampling rate (100kHz) and a high resolution. It is ideal as a general purpose test instrument either in the lab or in the field. Flexible input ranges ( $\pm 200\text{mV}$  to  $\pm 20\text{V}$ ) allows the unit to connect directly to a wide variety of signals.

**ADC-100** with PicoScope £199  
with PicoScope & PicoLog £219



## **ADC-10** **1 Channel 8 bit**

- Lowest cost in the Pico range
- Up to 22kHz sampling
- 0 -5V input range



The ADC-10 gives your computer a single channel of analog input. Simply plug into the parallel port.

**ADC-10** with PicoScope £49  
PicoScope & PicoLog £59

Carriage UK free, Overseas £9 Oscilloscope Probes (x1, x10) £10

**PICO TECHNOLOGY**



Pico Technology Ltd. Broadway House, 149-151 St Neots Rd, Hardwick, Cambridge. CB3 7QJ  
Tel: (0)1954 - 211716 Fax: (0)1954 - 211880 E-mail: 100073.2365 @compuserve.com



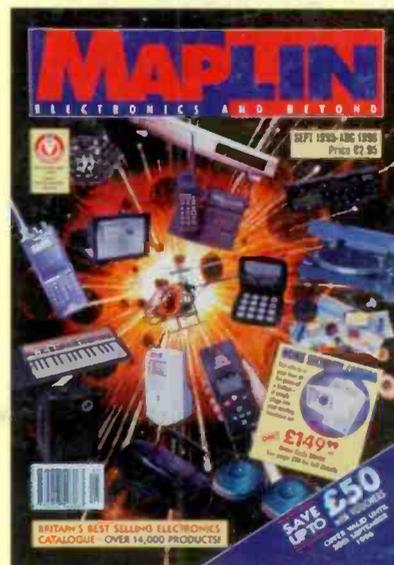
Phone or FAX for sales, ordering information, data sheets, technical support. All prices exclusive of VAT

# With over 14,000 products the new Maplin Catalogue is now bigger than ever



## THE EIFFEL TOWER

Built in 1889 by Alexandre Gustave Eiffel, the Eiffel Tower is 984 feet high and gives an unrivalled view of the whole of Paris.



## THE NEW MAPLIN CATALOGUE

Built for 1996 by Maplin, the new catalogue is almost 1,200 pages long and gives an unrivalled view of the whole world of electronics.

**Now Only £2.95**

**PCB Etching Tray**  
£3.49

**COMPLETE RANGE OF PCB MAKING EQUIPMENT**

**COMPREHENSIVE RANGES OF TEST EQUIPMENT**

**20MHz Oscilloscope with Function Generator** £349.99

**Weller Temperature Controlled Soldering Iron** £44.07

**OVER 60 PAGES OF TOOLS AND SOLDERING ACCESSORIES**

**RANGE OF SATELLITE RECEIVERS AND ACCESSORIES**

**Astra 1D Satellite frequency Extender** £25.99

**JUST LOOK AT THESE SUPERB EXAMPLES!**

**Video Doorphone**  
£199.99

**WIDE RANGE OF SECURITY DEVICES AND ALARMS**

**OVER 300 KITS FOR YOU TO BUILD FROM £5 TO £599**

**Short wave Receiver Kit** £9.99

**50 Watt Mobile 2m Transceiver**  
£389.95

**FULL RANGE OF TRANSCEIVERS, RECEIVERS AND SCANNERS**

**'BIG NAME' HI-FI SEPARATES AND ACCESSORIES**

**Dolby Pro-Logic Surround Sound Processor** £229.99



Get your copy now from WHSMITH, John Menzies and Maplin stores nationwide  
Or order direct NOW on 01702 554161

Catalogue Mail order Price £3.45 (inc p&p). Prices refer to the 1996 Maplin Catalogue and are inclusive of VAT. All items are subject to availability. E&OE. Maplin Electronics, P.O. Box 3, Rayleigh, Essex, England SS6 8LR.